Developing A Comprehensive Performance Measurement Model of Sustainability Particular for Oil Refining Sector

By

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Copyright Statement

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Dedication

This thesis is dedicated to my father whom I deeply miss and wish he could celebrate the end of my PhD journey with me,

to my wonderful mother, may Allah protect her,

to my kind brother,

to my great husband Khaled,

to my beloved three sons Youssef, Seif and Yassin,

for their love and support

Abstract

The oil refining industry has a fundamental role, due to the fact that this industry plays an integral role in international trade, assists in catering the global demand for energy, contributes to energy security and encourages economic development in countries. Despite its integral nature, the threats the oil refining industry is imposing on the environment and the community cannot be overlooked. In order to maintain its position in the market and to be able to meet the competitive needs of the international market, the oil refining industry should work to find balance in its economic, environmental and social responsibilities. It is significant to note that doing this poses a challenge since each dimension requires efficient monitoring and management. This necessitates adopting a performance measurement system that can assist in tracking and evaluating companies' performance from a sustainability perspective. This research has included reviews of past studies and conducted exploratory interviews in order to gain in-depth insight from both academics and industry practitioners with regards to performance measurement models of sustainability adopted for the oil refining sector. This leads to the realisation that there are insufficient existing performance measurement models capable of successfully integrating sustainability alongside the primary properties of the oil refining sector and addressing the global challenges and trends affecting the industry.

As a result, this research aims to address the identified gaps and limitations in the previous studies. This will be achieved through developing a performance measurement model that is comprehensive so as to be capable of integrating the three pillars of sustainability, incorporating the oil refining properties and addressing the current global challenges affecting the industry.

The thesis has incorporated mixed methods in gathering the data and 4 phases were incorporated. The first phase includes conducting a critical review and exploratory interview to identify the research gap from the academic and practitioners' perspectives. The second phase includes an extended literature review to develop a performance measurement theoretical model from a sustainability perspective and developing a theoretical framework which also sets out procedures, barriers, benefits and drawbacks. Next, the third phase includes an empirical study on the Egyptian oil refining sector through a focus group questionnaire which seeks to demonstrate the applicability of the proposed model. Finally, the fourth phase includes a survey, distributed globally, to test the applicability of the developed model and gather opinions on a global scale.

The findings have shown that the existing models lacked the ability to provide a thorough assessment of the performance for oil refining companies. In contrast, the proposed model is expected to have the capability to be able to evaluate the performance of oil refining companies in a comprehensive way. This is achieved by incorporating a broader set of KPIs that align with sustainability goals when compared to existing models, which more typically reflect oil refining characteristics and addresses the current global challenges.

One of the strengths of this study is the identification of limitations in the existing models. Extending from this, this study was able to provide comprehensive measurable indicators that have the ability to meet the sustainability goals and to meet the current global challenges. Furthermore, from a practical perspective, it is also expected to offer guidance to oil refining companies with regard to evaluating their sustainability performance and suggesting a roadmap for implementing the proposed model. Overall, the proposed model has the potential to assist oil refining companies in assessing their sustainability performance and providing recommendations for improvements. This will, in turn, reinforce companies' market presence and enable them to remain competitive within the complex and changing global environment.

Publications Rising from this Work

1. Tamazin, D., Tipi, N., & Validi, S. (2021). The Development of a Comprehensive Sustainable Supply Chain Performance Measurement Theoretical Framework in the Oil Refining Sector. International Scholarly and Scientific Research & Innovation, 15(1).
2. Tamazin, D. E., Tipi, N. S., & Validi, S. (2018, 5-7 Sep. 2018). The Development of a Sustainable Supply Chain Performance Measurement Framework in the Oil Refining Sector. Paper presented at the 23rd Annual Conference of The Chartered Institute of Logistics and Transport, Logistics Research Network (LRN), Plymouth, UK.
3. Tamazin, D., Tipi, N., & Validi, S. (2017). Sustainable Supply Chain Performance Measurement in the Oil Refining Sector: Literature Review.

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List of Abbreviations

AHP	Analytic Hierarchy Process
AMOPC	Alexandria Mineral and Oil Company
ANRPC	Alexandria National Refining and Petrochemical Company
AORC	Assuit Oil Refining Company
APC	Alexandria Petroleum Company
API	American Petroleum Institute
ARPC	Amreyah Petroleum Refining Company
bbl./d	Barrels Per Day
BP	British Petroleum
BSc	Balanced Scorecard
CAQDS	Computer Assisted Qualitative Data Analysis Software tool
CDU	Crude Oil Distillation
CEO	Chief Executive Officer
CORC	Cairo Oil Refining Company
DEA	Data Envelope Analysis
ECHEM	Egyptian Petrochemical Holding Company
EGAS	Egyptian Natural Gas Holding Company
EGPG	Egyptian General Petroleum Corporation
EMRA	Egyptian Mineral Resources Authority
ERC	Egyptian Refining Company
ERP	Enterprise Resources Planning
GANOPEC	Ganob El-Wadi Petroleum Holding Company
HAZOP	Hazard and Operability Study
IBM	International Business Machines Corporation
IEA	International Energy Agency
ILO	International Labour Organisation
IPIECA	International Petroleum Industry Environment Conservation Association
ISO	International Organisations for Standardisation
IT	Information Technology
KPIs	Key Performance Indicators
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MIDOR	Middle East Oil Refining Company
NPC	Nasr Petroleum Company
OFID	Fund International Development
OHS	Occupational Health and Safety
OPEC	Organisation for Petroleum Exporting Countries
PG	Petroleum Gas
ROI	Return on Investment
SC	Supply Chain
SCOR	Supply Chain Operations Reference
SDGs	Sustainable Development Goals
SOPC	Suez Oil processing Company
SPE	Society Petroleum Engineers
SPSS	Statistical Package for Social Science
St. Deviation	Standard Deviation
SWOT	Strength, Weakness, Opportunities and Threats
UN	United Nations

Chapter 1: INTRODUCTION

1.1 Introduction

There has been a noticeable shift in the government's and public's concerns with environmental footprint, cleaner production and proper use of natural resources. Nowadays, the government and public seek to push the concept of sustainability and sustainable practice into all spheres of life. As a result, companies are under pressure to integrate sustainability practice in their strategies and operations. Therefore, increasing awareness of sustainability practice has become a prevailing concern across many industries, including the oil refining industry (Sánchez-Flores, et al. 2020).

On the one hand, the impact of the oil refining industry on the global economy is highly tangible. There are multiple factors that shape the significance of the oil refining sector. Firstly, the fact that the oil refining industry plays a major part in responding to the global demand for energy gives it great importance. Responding to the global demand for energy involves transforming crude oil into refined products that are essential for fulfilling the energy needs of industries, transportation, households and commercial sectors. Secondly, the industry contributes to economic growth through job creation, revenue generation and foreign exchange, particularly with regard to the export of refined petroleum products. Apart from boosting the global economy, the oil refining sector can be regarded as an indispensable link in the petroleum value chain, connecting upstream exploration and production activities with downstream distribution and consumption. Another factor contributing to the importance of the sector is due to its ability to provide energy security to countries. In other words, the oil refining sector can provide a reliable supply of refined products to meet domestic needs. More so, the oil refining industry can also enhance international trade, since petroleum products are categorised as one of the most traded commodities (Al-Thukair, 2009; Sojinu & Ejeromedoghene, 2019).

On the other hand, despite its essential role in economic growth, the oil refining industry is known to have adverse consequences on the environment. Accordingly, it is highly important to be aware of the negative environmental and social effects that are inherent in the operations of the oil refining industry. Greenhouse gas emissions contributing to climate change is one example of the resulting environmental degradation caused by the oil refining industry. Not only can oil refining operations have harming effects on the environment, but also such operations can be threatening to local communities. For example, air pollution can affect the air quality and health of nearby communities. As a result, the industry is attempting to address these environmental and social threats through adopting sustainable practices, which lead to reduced gas emissions. They also look to engage with local communities to ensure their wellbeing (Asmelash & Gorini, 2021). In an attempt to adopt sustainable practices, the industry should pay attention to economic, environmental and social dimensions and seek to achieve a balance amongst them. Balancing economic considerations with environmental sustainability and social wellbeing is essential to ensure efficient performance as well as to meet the increasing expectations of stakeholders and wider society for environmentally friendly economic activity. These considerations are pivotal for the long-term success and sustainability of the oil refining sector and remain a challenge, due to the fact that economic, environmental and social dimensions must be efficiently managed. Additionally, the environment in which the oil refining sector operates is constantly changing, with fluctuating crude oil prices, changing regulatory policies, shifting market demand, geopolitical factors and technological advancement (Ebrahimi et al., 2018).

Therefore, taking steps to address these challenges is of utmost necessity. This is owing to the fact that if no steps are taken, the industry will not be able to mitigate the environmental threats that it causes and will fail to build social acceptance and trust. Moreover, ensuring the industry's long-term viability and competitiveness in a rapidly changing environment will only be achieved through taking serious action; as the adoption of performance measurement systems which makes oil refining companies capable of tracking, evaluating and managing their performance in key areas over time in addition to providing valuable insights into areas for improvement (Taouab & Issor, 2019). In summary, performance measurement systems provide key performance indicators (KPIs) and metrics that are highly beneficial to oil refining companies since these metrics enable companies to monitor their operations, performance and the challenges they encounter. Having comprehensive KPIs is closely associated with the ability to make informed decisions, take initiatives, introduce measures to overcome difficulties and address challenges effectively, which will positively affect the overall performance of the entire sector (Nicolescu & Burta, 2020).

There is a need for the oil refining sector to introduce performance measurements and to find a balance between three dimensions of sustainability (economic, environmental and social) (Sojinu & Ejeromedoghene, 2019). As a result, this study has recognised the importance of each dimension and emphasised the need for integrating the three dimensions and addressing the challenges that faces the oil refining industry. The study drew on previous research on developing performance measurement models from a sustainability perspective in the oil refining sector. This review assisted the researcher to gain a comprehensive understanding of current research and it is evident that previous studies have failed to integrate the three dimensions, despite highlighting the importance and need for this integration in their findings. As part of this research, exploratory interviews with practitioners were carried out. This revealed that oil refining companies have limited awareness of sustainable practices and limited adoption of sustainable practices and focused on traditional performance measurements. This means that the oil refining sector still lacks a comprehensive performance measurement model incorporating the three dimensions of sustainability collectively in order to meet the global challenges and trends of the oil refining sector. Accordingly, this study aimed at bridging this gap by developing a comprehensive model integrating KPIs and metrics. The model was designed to incorporate the three pillars of sustainability, encompass the specific characteristics of the oil refining industry and address the current global challenges. By doing so, it was expected that oil refining companies would increase their operational efficiency through applying this proposed model to address the current global challenges and achieve sustainable growth.

The next section of this study provided a more elaborate discussion to clarify the research aim, objectives and research questions. The reminder of this chapter was organised as follows. Section 1.2 identified the research questions, aims and objectives, including an illustrative map showing the relation between research questions, the research aim, research objective and research methods. Section 1.3 provided a brief insight to the methodological tools employed in this study. Section 1.4 tackled the unique approach of this research including previous research relevant to this study. Section 1.5 highlighted the structure of the thesis and provided a clear outline of the content and objective of each chapter, as well as the expected results.

1.2 Research Questions, Aims and Objective

The subsequent section presented the research questions, as well as the research aims and objectives.

1.2.1 Research Questions

The integral role that the oil refining sector plays in the global economy cannot be overlooked. However, its adverse environmental impact cannot be underestimated. Additionally, maintaining a balance between the three pillars of sustainability is particularly challenging for the oil refining sector due to its volatile nature. Such a dynamic environment adds to the challenges of sustainability. To address these challenges effectively, performance measurement models are required to effectively evaluate and track areas for improvement. However, there was limited adoption of comprehensive models that integrate sustainability dimensions, incorporate industry characteristics and address global challenges. To address this, this research paper planned four research questions as follows:

1. **What are the key challenges facing the oil refining industry?**

This research question aimed at investigating and understanding the main challenges facing the oil refining industry. Starting with the identification and analysis of the challenges facing the oil refining sector is significant since it assisted the researcher in gaining an extensive understanding of the current issues and concerns relevant to the oil refining sector. Gaining a deep understanding of the challenges, the researcher can better develop an effective and a relevant model that is capable of catering for the existing global challenges confronting the oil refining sector.

2. **What are the key indicators that can effectively address the challenges facing the oil refining industry and how can they be integrated into the development of performance measurement model?**

The main aim of this research question was to explore the key indicators that can successfully reflect the oil refining characteristics and address the challenges encountered by the oil refining industry. Exploring key indicators helps in developing a performance measurement model, that can assist oil refining companies to better monitor, evaluate and improve their performance in light of existing challenges and sustainability practices. This will benefit the oil refining industry by enhancing its performance and sustainability practice and increasing its capability of addressing the global challenges.

3. **What are the essential guidelines and considerations that can effectively support oil refining companies in the implementation of the proposed performance measurement model?**

This research question attempted to explore the necessary guidelines and determinants that can guarantee the effective implementation of the proposed performance measurement model. It aimed at identifying the main principles, the best practices in the form of procedures, barriers, benefits and drawbacks that should be considered by the oil refining companies upon adopting the proposed model. These determinants can test how far the proposed model will be applicable in the real context of industry.

4. **How does the developed model compare to existing models in terms of its impact on company's performance from an economic, environmental and social perspective?**

This research question focused on assessing and evaluating the effectiveness and outcomes of the proposed performance measurement model from a global perspective in relation to the other existing models. This will be beneficial in analysing the points of strengths and the areas for improvement of the proposed model. As an extension, this research question sought to understand the relationship between the proposed performance measurement model and the oil refining companies' economic, social and environmental performance.

1.2.2 Research Aim

The aim of this research was to develop a comprehensive performance measurement model from the sustainability lens specific for the oil refining sector. This model sought to integrate the three pillars of sustainability, while also encompassing the specific characteristics of the oil refining industry and addressing the current global challenges facing the oil refining sector. Specifically, this model attempts to assist oil refining companies to track, monitor and measure their performance and enhance their decision-making with regards to sustainability practice.

1.2.3 Research Objectives

This research has four main objectives:

A. **Assessing the ability of existing performance measurement models in relation to sustainability integration and addressing the challenges facing the refining industry.**

This objective sought to evaluate the extent to which current performance measurement models can integrate the three pillars of sustainability and effectively address the challenges that encounter oil refining sector. This evaluation involved analysing the strengths, weaknesses and limitations of the existing models in relation to sustainability integration and the specific challenges facing the industry. Therefore, this analysis highlighted areas where the current models may not be effectively addressed. Based on the findings, the research sought to improve the performance measurement models in order to better integrate sustainability and address the identified challenges of the sector.

This objective aligned with the main aim of the research, that is, developing a performance measurement model that integrates sustainability dimensions, incorporating oil refining sector characteristics and addressing current global challenges. Evaluating the potentials of the existing performance measurement models, in terms of sustainability integration and for catering these challenges effectively, can contribute to the creation of a customised model to meet specific requirements, enhance sustainability efforts and meet the global challenges facing oil refining sector.

B. Developing a theoretical performance measurement framework tailored to the unique needs and challenges of the oil refining sector.

This objective sought to develop a theoretical performance measurement framework specific to the oil refining sector. This required an analysis of key indicators that are beneficial in addressing the current global challenges, reflect the sector's characteristics and integrate the three main pillars of sustainability. A thorough literature review will ensure extensive knowledge is obtained about the key indicators and different approaches that are addressing the current challenges.

This objective was in accordance with the research's primary aim: developing a performance measurement model incorporating sustainability practice and represents the distinctive properties of the sector, along with addressing the current global challenges. Accomplishing this objective could ensure the development of a theoretical performance measurement model that integrates the distinctive characteristics of the oil refining sector with sustainability practices to address the sustainability challenges facing the sector.

C. An empirical study was conducted via focus group on the Egyptian oil refining companies in order to demonstrate the applicability of the developed model.

This objective aimed at demonstrating the applicability of the developed model in the context of the oil refining companies through conducting an empirical study in the form of a focused group discussion on the oil refining sector in Egypt. Egyptian companies were particularly selected as the population of the empirical study since Egyptian companies are witnessing a phase where they are seeking development of the strategies employed by their companies, specifically, integrating the aspect of sustainability which is the core of the study in hand (Hegazy, 2015). Accordingly, this gave the researcher a great opportunity to gather multiple opinions about the guidelines and the developed comprehensive model. Therefore, this objective provided evidence that the model is not only a theoretical concept but can also be put into practice.

This objective supported the research aim, as achieving this objective validates the feasibility of the proposed model in a real-world scenario.

D. A global online survey questionnaire was applied to researchers and managers in the oil refining sector in order to test the applicability of the developed model.

This objective sought testing the applicability of the proposed model on a global scale. The objective was met through an online survey sent to managers and researchers in the oil refining sector.

This objective supported the research aim to develop a thorough performance measurement model that integrates sustainability dimensions and addresses industry challenges. To clarify, this objective was expected to aid understandings about the efficacy of the proposed model from survey respondents. This feedback aided in identifying potential areas for enhancement and further model refinement. Additionally, it provided a thorough understanding of how the proposed model performs in relation to other existing models and how it impacts on company's performance. The online survey tested the applicability of the proposed model on a global scale and this ensures the applicability of the model in international contexts.

Figure 1.1 sets out the relationships between the research objectives, questions and research aims.

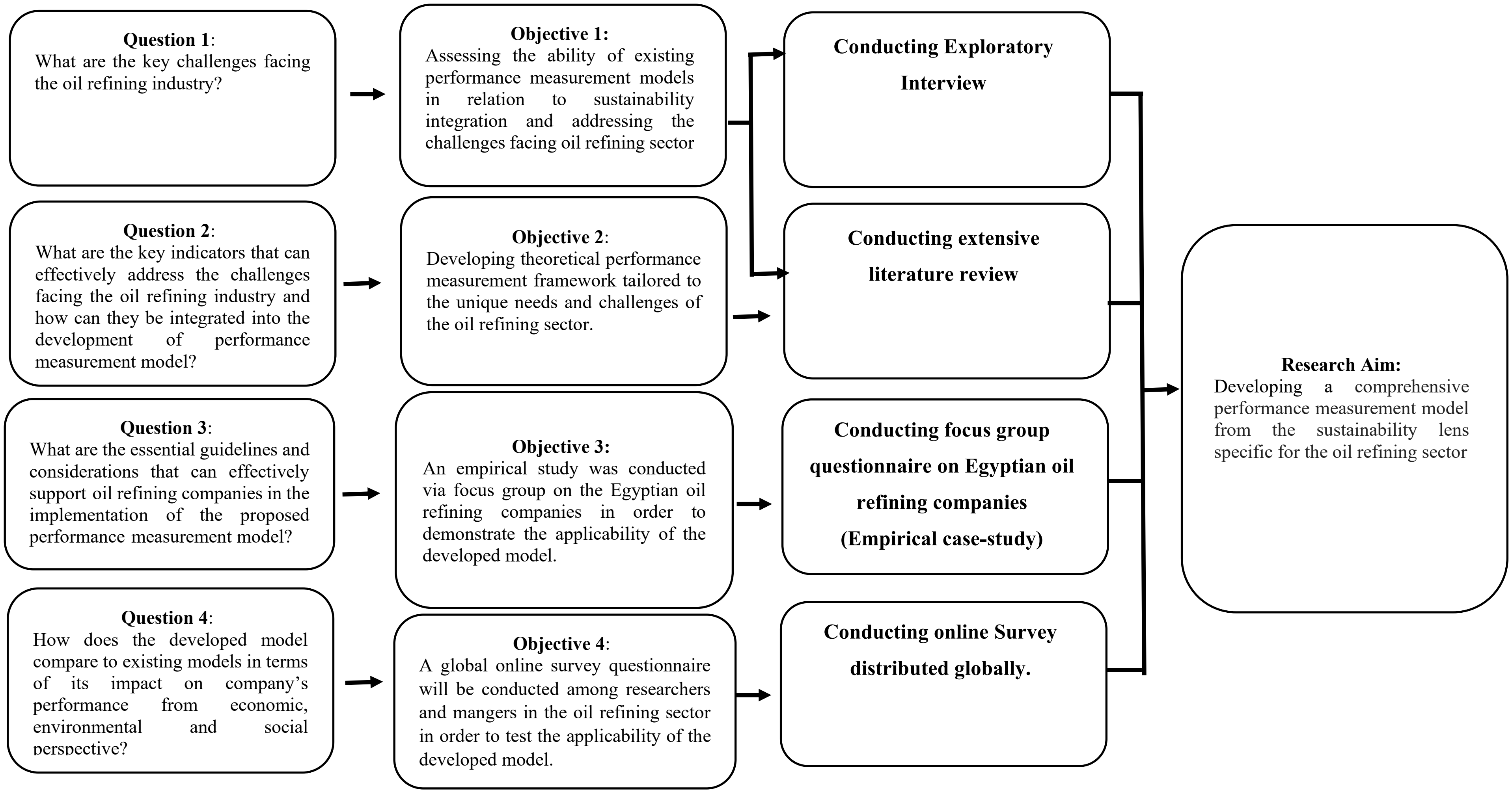

Figure 1.1. The relationship between the research questions, objective, methodology and research aim

1.3 Research Methodology

To fulfil the research questions and objectives and to achieve the research aim, a combination of exploratory interviews, focus group discussions and online survey questionnaires were conducted. The rationale for this mixed method approach is as follows:

1. Carrying out exploratory interviews enables the researcher to understand the current status of the oil refining sector and gain insight into various relevant aspects, such as the level of awareness of sustainability issues among companies in the oil refining sector. Additionally, interviews allow exploration of any existing performance measurement models related to sustainability practice and consideration of the current challenges encountered by oil refining industry. This research phase allowed the researcher to gather information on currently utilised performance measurement models in the oil refining sector and their effectiveness in integrating the three pillars of sustainability.
2. Conducting an empirical study on the oil refining sector in Egypt enables the researcher to demonstrate the applicability of the proposed performance measurement model. This phase of the research took the form of a focus group discussion which sought to identify the directives related to sustainability practices in the form of procedures, barriers, benefits and drawbacks. These directives can act as guidelines that can assist oil refining companies in successfully implementing the proposed performance measurement model. Additionally, the questionnaire allowed the researcher to identify any modifications recommended by managers in the Egyptian oil refining companies. The data collected from the focus groups can then be analysed by applying thematic analysis and content analyses using NVivo software.
3. Undertaking an online survey allowed the researcher to test the applicability of the proposed model. This research phase included an online survey of oil refining companies' managers to gather global perspectives. Understanding global perspectives is essential, especially with regard to the oil refining industry's nature is terms of adherence to the international regulatory environment and its alignment with global trends. This research phase sought to gather a global perspective in order to support the research aims of gathering multiple viewpoints, beliefs and experiences from different cultures. Gathering global perspectives enabled a comparison between the proposed model and existing

models in terms of their impact on company's performance across economic, social and environmental aspects on an international scale. The correlation and regressions tests were applied to analyse the data gathered from the online survey via the adoption of SPSS software.

Combining different research methods for data collection, including the exploratory interview, focus group questionnaire and online survey questionnaire, the researcher attempted to fulfil the research aims and objectives and reinforce the research results through achieving a methodological triangulation.

Throughout all the stages of the research, the researcher adhered to Huddersfield University's code of ethical practices to protect the rights and welfare of all participants.

1.4 Research Originality

The oil refining sector's key role in society stems from its role in transforming crude oil into necessary products that are vital to both everyday life and business. The sector connects upstream exploration with downstream distribution and consumption, acting as a vital link in the petroleum industry supply chain. Additionally, the oil refining sector supports the stability of the global energy supply through assisting in addressing the world's expanding energy needs (Al-Thukair, 2009; Sojinu & Ejeromedoghene, 2019).

Despite the critical role played by the oil refining industry, oil refining has adverse impacts on the environment and society. Accordingly, it is important to effectively examine and assess the performance of oil refineries. A thorough evaluation of a company's performance enables them to track, evaluate and to pinpoint areas that need development. Additionally, this can help to ensure ongoing operation of facilities whereby key energy products are supplied consistently and reliably" (Asmelash & Gorini, 2021). There are some sustainable performance measurment models devloped by previous studies in other industries, but the oil refining process is complex and has its own set of challenges. Therfore, oil refining needs to have a tailored performance measurment model to assit measuring, tracking and evaluating companies performance.

Prior research carried out revealed that oil refining industry currently lacks sustainability performance measurements; and that there are some limitations hindering the generalisation and applicability of the existing measurement models, such as a narrow focus on particular sustainability dimension and a dependence on single case studies. Furthermore, the key performance measurements used in earlier studies were insufficient for addressing the current global challenges facing the sector, particularly the aspects connected to global trends and adherence to international rules. Besides, conducting an exploratory interview with practitioners revealed that oil refining companies maintained a limited awareness and adoption of sustainable practices, with predominance of traditional performance measurement models.

In response to these gaps and limitations, this research intended to provide a thorough performance measurement model integrating the three pillars of sustainability, taking into account the characteristics of the oil refining sector and addressing the current global challenges encountered by the oil refining sector. In order to ensure generalisation and stronger applicability and reliability of the proposed model and to include global perspectives, this research included an empirical study on the oil refining industry in the context of Egypt in the form of focus group questionnaire and online survey questionnaire distributed globally. The empirical study and the online survey assisted the researcher to understand the applicability of the proposed model in the industry context and particularly the online survey helped in understanding the applicability of the proposed model on an international scale. The study also provided recommendations on procedures, barriers, benefits and drawbacks, to help oil refining companies apply the performance measurement model successfully. The significance of this research rests in its contribution to bridging the limitations in existing models and providing a thorough performance measurement model that is in line with sustainability objectives, industry traits and current global challenges encountered by the oil refining industry. The proposed performance measurement model and the suggested guidelines can act as a useful tool for evaluating and enhancing companies' sustainability performance, allowing them to make well-informed decisions to improve their overall sustainability performance. This is crucial for oil refining companies to help them to maintain their competitiveness, satisfy industry standards and support sustainable growth. Consequently, by advocating for sustainable and responsible operations, the research findings have implications not just for the oil refining sector, but also for society as a whole, as they aid in addressing environmental issues, promote economic growth and improve social wellbeing.

1.5 Structure of Thesis

This thesis consisted of eight chapters as follows:

Chapter One: Introduction

This chapter presented a brief overview of the research, presenting an introduction to the research topic and its significance. It set out the research questions, aims and objectives. An overview of the research methodology will be presented along with the techniques used to collect and analyse the data required for addressing the questions, aims and objectives of the research. In addition, the chapter highlighted the research originality, the contribution of the research and significance of the research findings.

Chapter Two: Literature Review

This chapter aimed at providing an overview of the following areas: economic role of the petroleum industry, supply chain concept with more focus on the petroleum supply chain, characteristics and the challenges facing the oil refining sector, sustainability concept and its impact on the oil refining industry and the performance measurement concept and its impact on oil refining industry.

Additionally, this chapter also reviews previous studies that focus on performance measurement from a sustainability lens within the oil refining sector, ending up with identifying the research gap and setting out the research questions and hypotheses.

Chapter Three: Oil refining performance measurement model considering sustainability aspect

This chapter, as an extension to the literature review chapter. The development of the performance measurement framework of sustainability for the oil refining sector is explained in this chapter. This chapter reviews previous studies interested in examining technical issues related to oil refining industry and performance measurement models of sustainability adopted in other industries. A comprehensive performance measurement model from a sustainability perspective, specific for the oil refining sector was illustrated in this chapter, this model is expected to bridge the research gap identified by this study. This chapter also reviewed the previous studies that identify the procedures, barriers, benefits and drawbacks which resulted from the sustainability practice in general and in the petroleum industry to create a theoretical framework.

Chapter Four: Research Methodology

This chapter presents the research design, the philosophical assumptions underpinning this research, as well as the research strategies and approaches. In addition, the chapter presents the research phases, details on data collection methods and sources, the criteria for selecting participants and a description of the data analysis techniques and tools used in each phase.

Chapter Five: Empirical study on the Egyptian oil refining sector: a focus group

This chapter presents the results of the empirical study conducted in the Egyptian oil refining sector. Chapter five begins with the reasons for selecting the Egyptian sector as well as focus group participants and questions, next identifying the methodology adopted for the focus group. Furthermore, the chapter presents the data analysis process.

Chapter Six: Online Survey on performance measurement in the oil refining sector: A global perspective

This chapter presents the outcomes of the online survey, it begins with verifying survey's data, identifying the survey design, discussing the criteria for selecting the survey's participants and the surveys' questions. In addition, chapter six presents descriptive analysis for both; the respondent profile and the research variables through calculating the means and frequencies of the research variables. Furthermore, research hypotheses were tested in this chapter through using correlation and regression analysis.

Chapter Seven: Discussion

This chapter discusses the research findings that will be derived from each research phase. Furthermore, this chapter presents comparative analysis; through linking the theoretical insights with the practical perspectives to identify the similarities and differences between both insights.

Chapter Eight: Conclusion and Recommendations

This chapter outlines the overall research conclusion with a focus on the research objectives and its outcome. This chapter also points out the main academic contribution of the study and how it will be beneficial to the oil refining industry. It also presents the research limitations and set out recommendations for future research.

Chapter 2: Literature Review

2.1 Introduction

The key goal of this thesis is to develop a comprehensive performance measurement model for sustainability in the oil refining sector.

The development of the aforementioned model from sustainability perspective for oil refining industry is the main focus of the thesis, so themes such as supply chain, sustainability, performance measurements along with the integration of these themes in the oil refining industry were explored. This chapter reviews the previous studies that have focused on performance measurement in the context of sustainability within the oil refining industry and an exploratory interview conducted, to identify the research gap from the researchers and mangers perspective. Consequently, the research question and the hypothesis were formulated based on the identified research gap.

The reminder of this chapter was organised as follows. Section 2.2 identified the economic role of the petroleum industry by highlighting the significance and the impact of the petroleum industry within the broader economy. Section 2.3 provided an overview on the supply chain concept with a focus on the petroleum supply chain. Section 2.4 reviewed the specific characteristics and challenges facing the oil refining sector. Section 2.5 examined sustainability and its significance in oil refining industry. Section 2.6 outlined the performance measurement concept, existing models and the impact of the performance measurements on oil refining industry from a sustainability lens. Furthermore, this section focuses on reviewing previous related studies to explore the findings and limitations of these studies. Section 2.7 identified the research gap, including insights from both academics and practitioners. Section 2.7 identified the research hypotheses. Section 2.8 presented an overview of the chapter's objective and concluding the main topics and themes discussed in the chapter.

2.2 The Economic Role of the Petroleum Industry

Petroleum industry is considered to be the lifeblood of industrial nations as oil is deemed to be the most important source of energy to power major industries in the country. The petroleum industry has a positive and significant impact on the economic positions of countries. Many countries rely heavily on revenues from the petroleum sector to finance infrastructure development projects. In this way, the petroleum sector plays a vital role in global economic developments. Additionally, the petroleum industry is vital to the production of many everyday products such as motor vehicles, clothing, accessories, household items, beauty products, medical products, furniture, electronics, toys, agriculture and construction materials, etc. Hence, petroleum products contribute to daily life" (Manzano, 2005). Besides, the industry can support millions of jobs opportunities spanning from oil rigs and refining processes to the global distribution of the final products (Kalinina et al., 2019).

Figure 2.1. illustrates annual petroleum consumption, whereby the rising trend is clear until 2020. To clarify, there is a rise in global demand for petroleum industry. However, in 2020, there was a fall by 4.5% in energy demand due to the corona pandemic. It is important to outline that despite the decline by 4.5%, there still exist total world consumption. This decrease was due to the significant travel restrictions which resulted in less consumption for gasoline, jet fuels and diesel products (US Energy Information Administration, 2022).

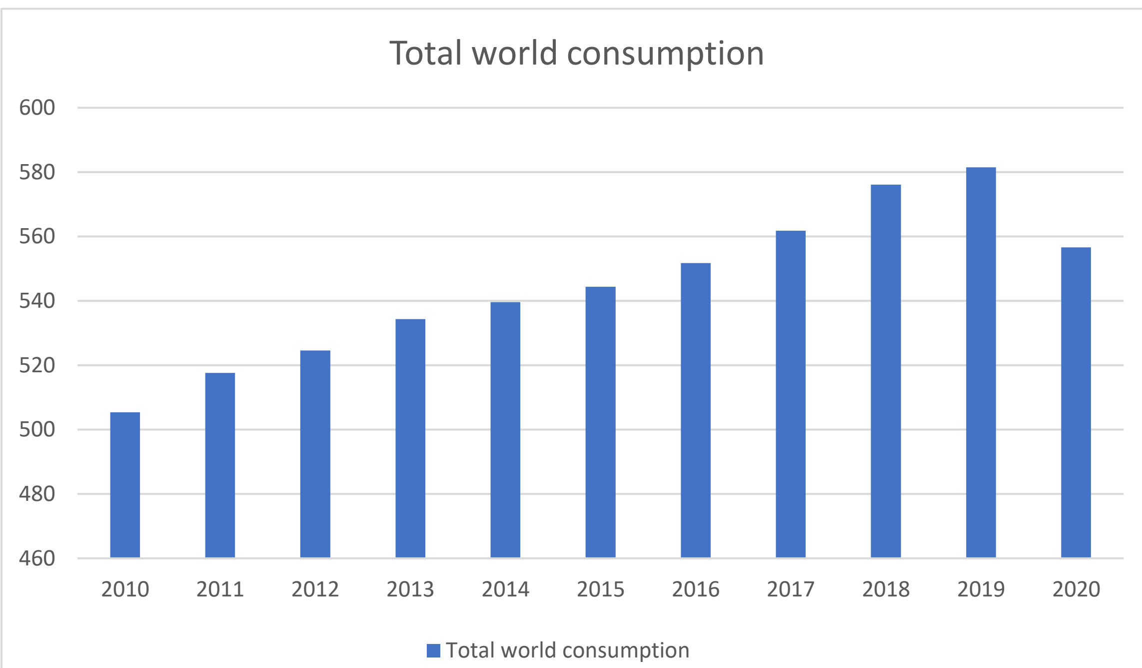

Figure 2.1. Total world consumption (Environmental Impact Assessment, 2022).

In spite of the fundamental role of the petroleum industry, as one of the largest industries in the world with a pivotal part in driving the national economy, it is an industry which contributes the most to the environmental pollution (Ramanathan & Feng, 2009). During the petroleum production processes, some activities such as gas flaring and oil spillage, release toxic organic and inorganic pollutants which can result in acid rain, climate change and the contamination of soil, water and air. These environmental hazards can cause adverse effects directly or indirectly to the ecosystem and social health. Additionally, this environmental pollution affects global warming (Kweku et al., 2018). This has all worked to raise public attention and concerns. In addition to the environmental pollution concerns, the public is paying more attention to future availability of energy sources and renewable resources. There is a need to maintain and preserve energy sources and for less environmental impacts (Prioleau, 2003). Therefore, petroleum companies have to take steps to maintain energy sources, reduce pollution and protect the environment and the public from these toxic pollutants. The present study has identified these steps as the current challenges facing petroleum companies (GLAS, 2017; Mojarad et al., 2018). These challenges have increased in urgency as public awareness of sustainability has increased (Sen et al., 2013; Barforoush et al., 2020). Adopting sustainability practices can help companies to reduce environmental damages, as the main aim of sustainability practice is centred on finding a balance between the three sustainability pillars (environmental, economic and social). These aspects are discussed in the following sections.

2.3 An Overview of Supply Chain Concept and Petroleum Supply Chain

The following section begins with an overview of the Supply Chain (SC) and Supply Chain Management (SCM) perception. Additionally, it outlines the impact of SCM on company's performance. These perceptions provide the research in-hand with solid foundations and basic knowledge about the themes which needed to be well understood as it is related to the research topic. Furthermore, the subsequent section focused on discussing the petroleum SC, segments and the crucial role played by oil refining in the broader context of the petroleum industry drawing on some illustrative examples. This discussion also highlights some necessary background information on the petroleum industry, that serves as the broader context for the oil refining industry.

2.3.1 Understanding Supply Chain, Supply Chain Management and their impact on company's performance

Many previous definitions were given to define the SC concept in previous literature. Prior definitions identify unique characteristics of the SC, broadly describing the network that links the entities, materials, information and activities related to converting raw material to finished products or services, to be delivered to the consumer, with the intent to fulfil their requirements. The process can involve producers, retailer, vendors, warehouses, distribution centres and transportation companies. The activities include procurement, operations, marketing, product development, finance, distribution networks, customer service, legal regulation and similar functions related to moving products in the reverse direction. There are environmental, social and economic aspects related to each process and activity in a supply chain network. The SC concept has been widely recognised as a network that can assist companies in linking all the members and activities which have to be involved in one supply chain together (van der Vaart & van Donk, 2008). Therefore, researchers and practitioners' concerns related to the SC concept have steadily increased over the years (Sukati et al., 2012). The current study has recognised that, over the past years, the supply chain concept is developing in line with changes in the business environment and new trends facing the market. This begins with the emergence of globalisation, which made the global economy more integrated, then followed by the identification of other business trends as the multinational corporations, strategic alliances, joint ventures, just in time, agile/lean manufacturing and the development in technologies. These factors led to changes in supply chain activities and the compatibility of companies, which had shifted from competing wholly through product quality and low-priced products, to competing on their ability to quickly respond to market needs and deliver the right product/service at the right time to the right consumer (Nicolescu & Burta, 2020). These changes involve significant coordination of multiple members in one SC network. Therefore, the SC network has become more complex as it has become the responsibility of all the members in the SC network and not the responsibility of one member or company. A company is no longer viewed as a single entity. Instead, it is viewed as a chain in the SC network. Therefore, market competition between companies will be through their entire supply chains (Mojarad et al., 2018). As the supply chain network is becoming increasingly complex , this leads to the need to effectively manage this complex SC network (Asmelash & Gorini, 2021).

This research attempts to define supply chain management, whereby "Management" means the act of controlling and running the business. This definition is according to the Oxford Dictionary. According to Stock & Boyer (2009) "there are numerous SCM definitions proposed in the literature". "Although there are various definitions, most definitions stem from the definition adopted by the Council of Supply Chain Management Professionals" (Council of Supply Chain Management Professionals, 2022) which identified SCM as the act of planning and controlling all activities related to sourcing, supplies procurement, conversion of raw materials to semi-finished or finished products and logistics management. It was clear from the previous definitions in the literature and the CSCMP definition, that SCM is the art of managing, controlling and coordinating various entities, functions and activities related to the flow of goods or services through links in the SC in order to fulfil consumer requirements for goods or service.

This research also sought to understand the influence of the supply chain management on company's performance. It is well known that managing the SC through SCM system is vital for the success of businesses because, through SCM, managers can oversee and control the supply chain process. Thus, both SC and SCM together from an integral part of all business systems as the process that can manage this wide network. SCM aims at taking every entity, function and activity related to this SC network into account (Lu & Swaminathan, 2015). Furthermore, SCM can help businesses achieve particular goals that can enable improving performance and competitive position. Langlois & Chauvel (2017) stated that SCM can help in building trust, collaboration, communication and effective flow of information in the right timeframe between SC partners. In addition, Karimi & Rafiee (2014) stated that SCM can assist companies to visualise, synchronise and manage activities and functions across the different stages of the SC. Therefore, managing the relationships, functions and activities of all SC parties can lead to improving the quality of the SC process and also work to reduce operating costs, by avoiding shortages, periods of oversupply of inventory and ensure orders are within the optimum delivery cycle time. Efficient management of the SC ensure fulfilment of consumer's expectations by providing the right product (right quality) with the right quantity at the right place and time. Accordingly, companies can have the opportunity to reduce the overall operating costs and improvement in the overall SC performance, so the market can achieve more profit and competitive position. Therefore, SC and SCM should be considered by every organisation due to their vital effect on all parties in the SC (Lu & Swaminathan, 2015).

It was clearly seen that the SC and SCM are important to companies. A point supported by previous research showing that there are some countries and businesses experiencing a positive relationship between applying SCM and performance enhancement (Sabry, 2015; Al-tarawneh & Al-Shourah, 2018)

For companies to be competitive, they should focus on operational excellence which can be achieved by a well-integrated supply chain. SCM is the process by which companies can manage this wide network. Furthermore, for the supply chain to succeed, companies should have a performance measurement system to measure the performance of their SC and identify areas of improvement to increase competitiveness (Langlois & Chauvel, 2017).

In light of the fact that the primary focus of this study is on the oil refining industry, it is crucial to have a comprehensive understanding of the broader context in which the oil refining industry operates.

2.3.2 Petroleum Supply Chain

The petroleum SC has one of the most complex and highly intensive networks. The petroleum SC is comprised of production facilities, from crude oil exploration to refining plants up to final product markets, passing through many logistic activities such as international and domestic warehousing, transportation, docks and markets. While the petroleum SC comprises multiple and interrelated process which are segmented in nature, any failure in any process or activity is critical owing to the fact that it will affect the next stage. Petroleum companies have to understand and visualise the full context of their business environment and all the links between members participating directly or indirectly (suppliers, distributors and retailers) in their SC before planning their activities (Kazemi, 2016; Lima et al., 2016).

The petroleum SC is comprised of three activities: exploration, oil production and oil recovery. These activities drive under one of the three segments: upstream, mid-stream and downstream. The first segment is the upstream which is related to the oil and gas exploration and production of crude oil. The mid-stream is related to the transportation and storage of crude oil. The downstream is related to the refining and marketing of petroleum products (Sabry, 2015; Kazemi, 2016; Lima et al., 2016). The following section defines the three activities in terms of the related segment:

A. Exploration and transportation: these activities are considered related to upstream stages in the petroleum sector. Exploration and transportation are regarded as an integral part of the initial step of exploration. With the use of contemporary oil geologists and satellites, the exploration process determines whether there is hydrocarbon (oil and gas) deposits beneath the surface of the earth. Geological investigation and surveys are carried out in this step and if the outcomes are favorable, the production process is progressed to the following stage.

The extraction of crude oil, whether onshore or offshore, is referred to as the production process.

In the upstream phase, there may be domestic or foreign suppliers throughout the supply phase, or there may be coordination between the two. Crude oil then enters the convenient stage and is prepared for refinement. The crude oil is currently being temporarily stored in tankers. The following step involves moving the crude oil from the supply phase to the company phase; during this phase, each supplier may have a different phase for storing the crude oil before it is transferred to the refinery facilities. At this stage, the crude oil is stored in tankers (as short-term storage). The next stage is the transferring crude oil from the supply phase to the company's phase; in this stage each supplier can have different crude oil storage phase to pass along the refinery plants. In other words, in case of international suppliers, the crude oil will be carried directly to the nearest oil terminal in the nearest port by marine vessel tankers (where there are numbers of terminals capable of receiving vessels from different sources loaded with various capacities and different types of crude oil). Upon arrival at the port of destination, the crude oil can either be delivered straight to the refinery plant (through pipes, tanker trucks, or railroad), or it can first be kept in tankers in the port before being transferred by pipelines, tanker trucks and railroad to the refinery plant. Additionally, the crude oil might be kept in storage tanks after arriving at the port of destination and then transferred directly to the processing facilities. In this instance, the crude oil travels to the refinery facility after two storage phases. If you have local suppliers, you can feed the crude oil straight to the refinery facility (after the de-salting process). If not, businesses will cite the aforementioned case studies. (Worldwide vendors). At that point, the crude oil is transported at the refinery plant that is; the beginning of the company's phase.

B. Refining: this activity is known as the downstream stage in the petroleum industry. It is the most complicated and important link in the petroleum SC because it includes a wide range of processing potentials to turn crude oil into products through simple refining (which involves basic distillation and separation processes) or complex refining (which involves a combination of interrelated processes like thermal, catalytic cracking, cooking and deep conversion of crude oil). LPG, naphtha, gasoline, kerosene, gas oil, fuel oil, lubricating oil, asphalt and petcock are among the goods resulting from such processes. Refinery planning (specific production level for each product and operating conditions), product scheduling and refinery process interconnection also form part of the logistics processes at this point, where there is rang of flexibility to meet the changing market demand. As a result, at this point, the aforementioned goods are prepared for delivery to final consumers or for use as a feedstock in other sectors, such as the petrochemical industry.

In downstream phase, the crude oil can pass along one or several refinery plants (needed to transfer crude oil into refined products). Generally, there are two refining processes these are; simple refining and complex refining processes. The simple refining process is the most common which includes basic distillation or separation, while the complex refining process includes catalytic cracking, hydro processing, reforming, isomerisation and alkylation processes.

C. Distribution: this process is also known as downstream stage. Four primary modes of transportation, including railways, tanker trucks, marine tanker boats and pipelines are used to transfer refined products from production facilities to distribution centres. In these stages, distribution centres are required to serve as a point of storage for finished products prior to the point of sale. The finished products are subsequently sold to wholesalers and retailers both nationally and abroad. At this point, transportation distribution and scheduling decisions are made in terms of logistics.

   Additionally, at the downstream phase, the refined products will be sent to distribution centres (customer phase) for marketing and commercial distribution, according to client requests, via pipelines (primary transportation), marine tanker boats, or railroads. In these stages, distribution centres are required to serve as a point of storage for finished goods prior to the point of sale. Wholesalers and retailers receive the refined items either domestically, globally, or both. The products are used by the wholesalers as raw materials in a variety of processes; their clients include petrochemical firms, power plants and large fuel consumers. Retailers are small-scale energy users that use energy or supply it to end users like petrol stations, supermarkets, factories, hospitals, airports and ports.

The following Figure 2.2 shows the previous scenarios Figure

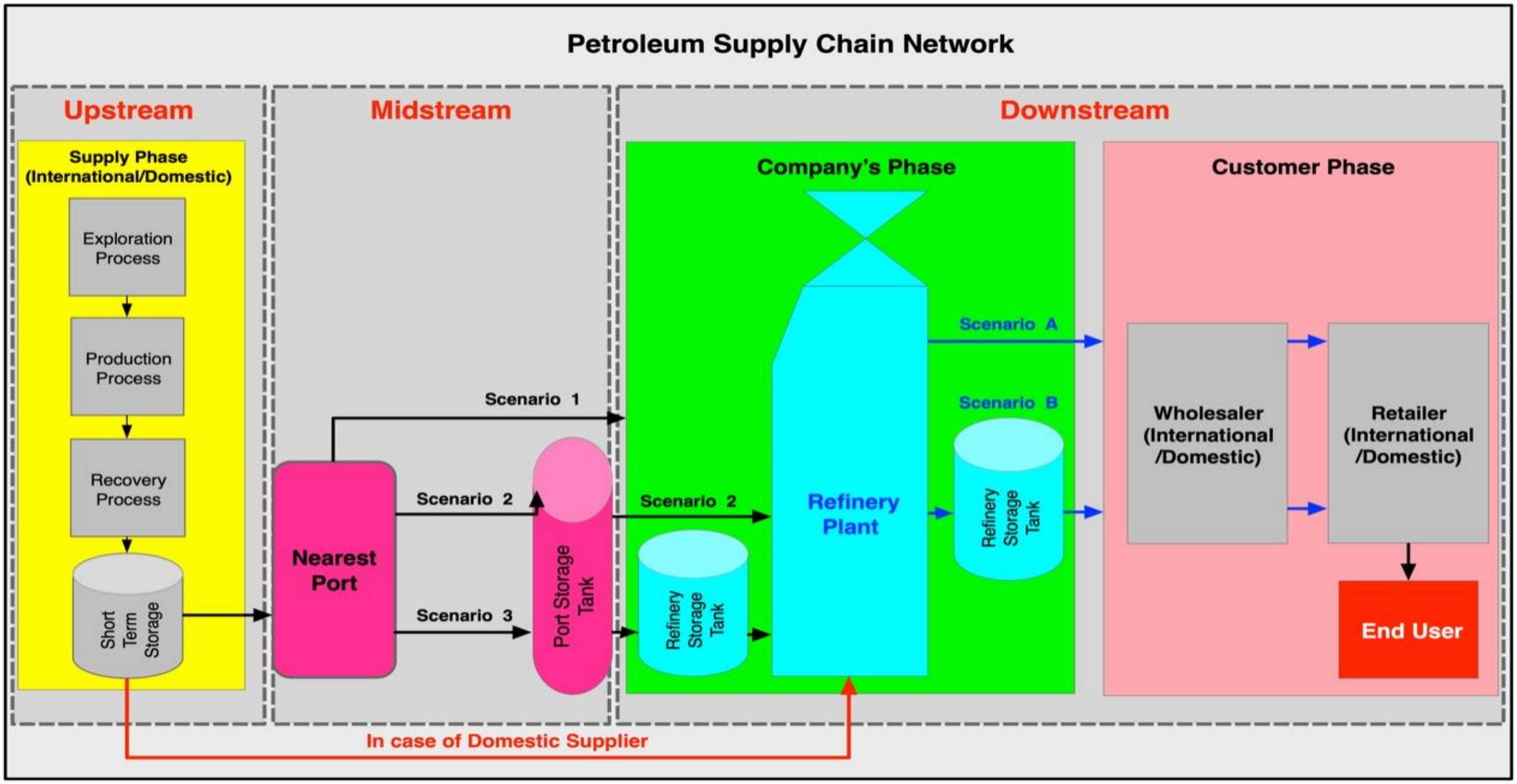

Figure 2.2. Petroleum SC network.

2.3.3 The Importance of the Oil Refining Sector in the Petroleum Industry Supply Chain

The oil refining sector is considered one of the main components of the petroleum industry that handles the processes of converting crude oil into usable products. (Ibeawuchi, 2016). Crude oil is rarely used in its raw form, so it must be processed into useful products or feedstock vital to other industries. Therefore, the petroleum refining industry adds value to the petroleum industry through converting the crude oil into a range of refined products or feedstock that can be used by other industries (Liu et al., 2020). Figure 2.3 illustrates the key phases of the petroleum industry (upstream, midstream and downstream) (Mojarad et al., 2018; Kalinina et al., 2019).

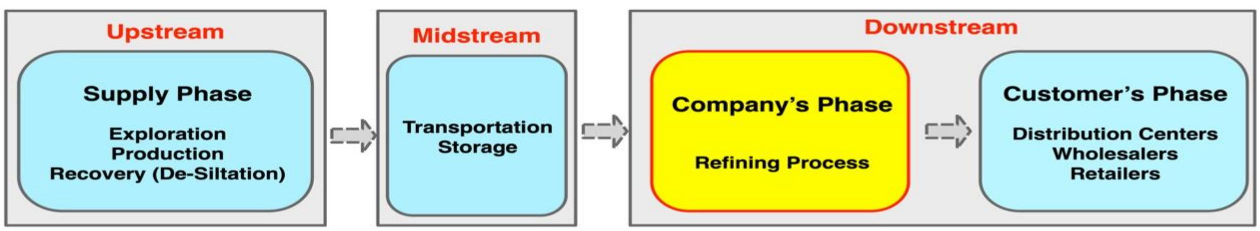

Figure 2.3 Key phases in petroleum industry.

As per Figure 2.3 the oil refining sector is one of the main components of the petroleum SC, particularly in the downstream stage.

Accordingly, Nicolescu & Burta (2020) mentioned some examples in their research, thus demonstrating the importance of the oil refining industry to the petroleum supply chain, as follows:

1. Crude oil refinement: This process is considered the main function of the oil refining industry, which produces refined fuels including petrol, diesel, jet fuel, heating oil and other various petrochemicals from crude oil.
2. Meeting energy demands: The oil refining industry is responsible for producing the energy products and fuels to meet global energy needs.
3. Petrochemical production: Besides producing fuels, the oil refining industry also produces a variety of petrochemicals that are used as feedstock to make plastics, synthetic fibers, medicines, fertilizers and other vital goods for a variety of sectors.
4. Economic impact: The oil refining industry has a positive impact on the economy in terms of creating jobs and promoting economic growth. Oil refineries are significant industrial facilities that support the growth of related sectors including logistics, maintenance

services and engineering companies. The industry also adds to the general economic prosperity of the specific areas where refineries are located.

5. Integrating the petroleum supply chain: The oil refining industry is crucial in linking both upstream exploration and production activities with downstream distribution.
6. Energy Security: The oil refining industry significantly contributes to the country's overall energy security. Countries can increase their energy self-sufficiency and lower their dependency on imported refined products by having a strong local refining capability.

The oil refining industry is of paramount importance to the supply chain for petroleum as it transforms crude oil into refined products. It also meets energy needs and provides petrochemicals. Additionally, it promotes economic growth and integrates with the supply chain and thus aids ensuring energy security. It plays a pivotal role in sustaining numerous economic sectors and providing the world's population, businesses and transportation systems with the energy they require. In the next section a discussion on the characteristics of oil refinery and the challenges facing the oil refining industry was presented.

2.4 A Review of the Oil Refinery Characteristics and Challenges

The upcoming section will address the oil refining characteristics and investigate the challenges facing the oil refining industry.

2.4.1 The Characteristics of the Oil Refinery

Petroleum refining is considered one of the essential processes in the petroleum industry since the petroleum refining sector existed to convert the crude oil to a wide array of useful products (Liu et al., 2020). These petroleum products are the heart of society's everyday life. For instance, petroleum products include transportation fuels, fuel oils for heating and electricity generation, asphalt and road oil and feedstock for making the chemicals, plastics and synthetic materials that society relies on. Therefore, petroleum refining sector is considered one of the critical links in the petroleum industry as it is expected to add value to the petroleum industry by converting crude oil into a range of usable products (Ibeawuchi, 2016). The petrol refining process does not end once the crude oil is discovered and extracted from the well. More phases are needed to transfer the crude oil to the marketplace and to turn it into products that can be easily used by consumers. The process by which crude oil is converted into useful products is called the refining process. This process occurs in petroleum refineries, that can be defined as large, capital intensive facilities, with a continuous manufacturing flow and a network of interconnected buildings and plants where crude oil is pre-treated and divided into different fractions (MathPro, 2011). For more clarifying, the petroleum refining can be considered as one of the most important components of the world economy due to the significant impact it poses on the human life and the development of other industries. Thus, the main products in the petroleum industry are obtained from the activity of a refinery, so most products are used in everyday applications and can be used as feedstock to various industries. The refining process adds value to the petroleum SC, for it acts as the main transformation point for all crude oil into various useful products which are considered critical to the functioning of the economy (Barforoush et al., 2020).

There are more than 660 refineries operating in 116 countries (Veerapandian, 2010; MathPro, 2011). Each refinery has a unique and physical configuration as well as unique operating characteristics and economies. Refinery configuration and performance characteristics are determined based on various factors like availability of funds for capital investment, refinery location, crude oil quality, market specifications and environment regulations. That is why building a typical refinery costs billions of dollars. It also costs millions to operate, since employing hundreds of people and running the process every day of the year is very costly (MathPro, 2011). The refining industry deploys a wide variety of processes.

The petroleum refining industry involves a wide variety of processes, but all refineries have three major types of operations performed to refine the crude oil into finished products or feedstock. These processes are separation, conversion and treating. (Sojinu & Ejeromedoghene, 2019).The three processes are characterised as follow:

A. The separation of crude oil is the initial step in the petroleum refining process. The refinery separation process separates the various types of hydrocarbons mixed in the crude oil through three processes: atmospheric distillation, vacuum distillation and light ends recovery (gas processing). This is because crude oil is made up of a mixture of hydrocarbon compounds, such as paraffinic, naphthenic and aromatic hydrocarbons, as well as small amounts of impurities, such as sulphur, nitrogen, oxygen and metals. Following the separation procedure, liquids and vapours will be released into the distillation units. According to their boiling points, the liquids and vapours inside the distillation units are then divided into fractions, these are; petroleum components. As the initial and most basic step in the refining process, atmospheric pressure distillation of crude oil that is often followed by vacuum distillation. Light fractions are at the top of the distillation tower while heavy fractions are at the bottom. At the top of the distillation tower, when they condense back into liquids, the light fractions, such as petrol and liquefied refinery gases, vaporise and rise. Kerosene and distillates, among other medium weight liquids, remain at the centre of the distillation tower. The bottom of the tower is also where the heavier liquids with the highest boiling points settle.

B. Conversion process: Conversion: This step comes after distillation and enables the processing of heavy, lower-value distillation fractions into lighter, higher-value products like petrol. Fractions from distillation units are converted into streams (intermediate components) in this process, which leads to the creation of final goods. The most common type of dialogue is cracking, which transforms heavy hydrocarbon molecules into lighter ones by using heat, pressure, a catalyst and occasionally hydrogen.

C. The treatment process: This includes the management of raw materials and finished products. Large tanks in a tank farm close to the refinery are used to temporarily store both incoming crude oil and outgoing end products. The unloading, storing, mixing and loading processes make up the refinery's treatment operations. As a result, pipelines, trains and trucks are used to convey either the entering or the departing crude oil.

As long as the petroleum refineries are responsible for the production process of the petroleum industry, it is considered one of the major sources of environmental pollutants (Mojarad et al., 2018). Implementing pollution prevention measurements can yield economic, environmental and social benefits. Currently, the petroleum refining industry is considered one of the highest energy consuming industries compared to other stages or chains in the petroleum industry. In particular, there are concerns about limited ongoing availability of crude oil, which is the main feedstock to petroleum industry. The petroleum refining industry is, therefore tasked with the challenge of using energy in an efficient way and to balance the energy usage and the environmental impacts, which will reflect positively on the economic, social and environmental pillars of sustainability. This is the background for petroleum refining companies to consider sustainability integration in their visions, goals, strategies and activities, since they are increasingly under pressure to reengineer their processes to align with sustainability practices (Raut et al., 2017; Mojarad et al., 2018). Alongside sustainability practices, petroleum companies should have sustainable performance measurement system to measure the performance of sustainability practices. Sustainable performance measurement systems can help petroleum refining companies to track and assess progress related to incorporating sustainability in the goals and strategies set by the company (British Petroleum Company, 2019). Assessing sustainability performance in this way can help managers to understand more about the company's performance regarding sustainability perspective and to influence decision making for effective sustainability practices.

2.4.2 The Challenges Facing the Oil Refinery

There are multiple challenges that the oil refining industry is encountering; such challenges must be taken into account. Understanding and adapting to such current trends will significantly assist the industry in making drastic progress in the environmental performance, efficiency as well as the economic growth, social developments, competition and continuity in the future (Fisher, 2021).

The following section depicts the current trends and challenges met by the oil refining industry, as follows:

1. Air emission reduction

One of the major challenges of the oil refining industry is air emission reduction. Oil refining processes is responsible producing Co2 and No2 particles in addition to volatile organic compounds that affect people's health and the environment negatively (Langlois & Chauvel, 2017).

More attention has been given to this challenge particularly by the development of the COP which stands for Conference of Parties, organised by the United Nations with the aim of bringing countries together every year to discuss the key issues and actions related to climate change. This conference is focused on reducing air emission to decrease its negative impact on the environment. Oil refining processes emit huge amounts of pollutants into the air. Reaching zero emission by 2050 was set as the main target of the COP, encouraging oil refining companies to actively participate in achieving this goal by strictly adhering to the suggested polices and recommendations (Putri et al., 2019).

2. Recycling of wastewater

At the present time, another challenge identified for the oil refining industry is the wastage of fresh water. As highlighted by the Internal Energy Agency, the oil refining sector is regarded as the third largest industry and considerable volumes of freshwater resources are used in the oil refining processes. A huge amount of water is needed in such an intensive process to perform the full range of activities, including cooling, heating and processing. On the other hand, there are huge amount of water discharged resulting from oil refining process. The discharged water, if not properly managed, poses a threat on the environment. The main challenge lies in conserving the use of freshwater resources, so to avoid the global population from facing the risk of water scarcity and to protect the environment from discharging unrecycled water. Recycling is achieved through incorporating advanced treatment technology to remove pollutants and contents and reuse the treated water in the oil refining process. The challenge is to achieve zero liquid discharge. However, implementing this remains a challenge as it requires substantial investment and infrastructure (Sánchez-Flores et al., 2020).

The incorporation of a recycling wastewater strategy in the oil refining industry can result in several benefits including minimising water consumption and discharge, cost saving and improving environmental performance. Additionally, this can help oil refining companies show their commitment towards applying sustainability practices to different aspects in the oil refining process (Sánchez-Flores et al., 2020).

3. Recycling solid wastes

There are calls for the oil refining industry to support the action of reducing solid waste generated during the oil refining process (Raut et al., 2017). During the oil refining process, a huge amount of solid waste is generated in the form of sludge, catalysts and spent oil. These wastes contain valuable resources that can be recovered through recycling. Oil refining companies can use some solid wastes as fuel in their operations, by recycling these solid wastes through using catalysts that can assist in converting solid wastes to energy. This can all lead to reducing waste and utilising resources efficiently. All of these measures will assist oil refining companies to maintain a commitment to incorporating sustainability (Sánchez-Flores et al., 2020).

4. Producing environmentally friendly products

Throughout recent years, the growing attention given to climate change and environmental degradation has resulted in calls for using environmentally friendly products. Many countries, such as the USA, Canada and the European Union are planning to implement clean fuel standards. This means that oil refining companies should ideally produce fuel products with lower levels of sulfur and other pollutants. Examples of products that are considered environmentally friendly include:

ultra-diesel fuel, base oil group II and III and low sulfur fuel oil, along with gasoline blended with bioethanol oil (Rajeev et al., 2017).

The expected outcome from producing environmentally friendly products is assisting oil refining companies to decrease the amount of pollution resulting from the oil refining processes. This, in return, will contribute to protecting the environment from pollution, improving companies' social responsibility, as well as assisting oil refining companies to integrate sustainability (Nosratabadi et al., 2019).

5. Implementing environmental management systems

The primary objective of environmental management systems is to give guidance to companies on how to enhance their environmental performance, prevent pollution and adhere to the environmental regulations. An example of an environmental management system is ISO 14001. By meeting this challenge, oil refining companies will be able to comply with environmental regulations and demonstrate their commitment to sustainability (Rajeev et al., 2017).

6. Preserving energy in all oil refining processes

Implementing energy preservation in oil refining processes is not always feasible due to the complex nature of the oil refining industry, which is considered an energy intensive process, in converting crude oil into finished petroleum products. However, preserving energy in oil refining processes can be a problematic area for companies, as any efforts to reduce energy consumption must not be at the expense of maintaining the effectiveness and reliability of the required operations (Güney, 2019).

In order to face these challenges, multiple energy conservation actions should be undertaken, such as optimising the operation of existing consumption, using more energy equipment, or using renewable energy sources. (Energy, 2020).

7. Protecting the ecosystem

The main challenge of applying protection for the ecosystem in the oil refining industry is to make sure that the multiple processes and activities of the oil refining industry are being performed in a manner that will not lead to hazardous effects on the environment. As a clarification, the oil refining industry generates large amounts of greenhouse gases, toxic substances and waste materials. Such waste products can pose a major threat to the environment if they are treated inefficiently. Reducing air and water pollution, minimising waste discharge and preventing the generation of harmful chemicals into the environment represent the challenges facing the oil refining sector upon incorporating a protective ecosystem in the industry. The fruitful outcomes that are expected from utilising a protective ecosystem in the oil refining industry is expected to enable companies to preserve bio diversity and assist in having a non-polluted air and water. Finally, oil refining companies are expected to focus on adopting more sustainable policies and apply environmentally friendly practices (Mojarad et al., 2018).

8. Implementing new projects concerning environmentally friendly practices

It remains a challenge for the oil refining industry to implement new projects with environmentally friendly practices. However, replacing old practices and policies that have been incorporated for several years with more innovative strategies is not an easily achievable target. This is owing to the fact that fulfilling this goal involves making drastic changes to existing infrastructure, such as installation of new equipment and modifying existing processes. A high level of awareness about the benefit of environmentally friendly practices is essential to avoid barriers such as resistance to change and to ensure appropriate allocation of resources such as time and money will ensure sustainability challenges are overcome (Kalinina et al., 2019).

The role played by the oil refining industry in incorporating new projects that implement environmentally friendly practices should be emphasised. This is pertaining to the fact that adopting these environmentally friendly policies will lessen the negative influence that oil refining industry has on the environment, as well as, to human health. Thus, adopting practices that are characterised by being environmentally friendly should be put into consideration by the oil refining industry. These practices involve reducing emissions, wastes, conserving energy and using renewable energy sources to meet the requirements of the current trends that call for lessening the environmental threats that are caused by the industry. Working on such a challenge will definitely assist oil refining companies to minimise the degree of pollution that they cause to the environment leading to a more sustainable future (Li et al., 2017).

9. Complying with international standards

As revealed by some previous studies, the challenge of meeting the international standards like ISO is significant. It demands adherence to regulations and standards, including those related to safety, environmental protection, close monitoring of product and process quality specifications, testing and maintenance of equipment and process controls. Compliance to the international standards will be beneficial to oil refining companies by eliminating the risk of quality issues and achieving more efficiency (Liu et al., 2020).

It is a demanding challenge since the oil refining process is complex in nature. Meeting strict international standards requires investment in capital, deployment of advanced technology and equipment as well as implementation of quality control measures throughout each phase of the production process. Additional costs are also incurred in terms of investment in research and development, equipment, equipment upgrades and staff training. In terms of the benefits, in adhering to international standards, oil refining companies will be able to enhance product quality, increase safety and offer greater environmental protection which can benefit both the industry and the wider society. This, in return, allows oil refining companies to demonstrate commitment to sustainability (International Petroleum Industry Environmental Conservation, 2017).

10. Staying up to date with the latest developments and innovation

The oil refining industry has experienced drastic development during recent years, including renewable fuel, advanced refining technologies, digitalisation and artificial intelligence, Carbon capture utilisation and storage.

To clarify, the oil refining industry is witnessing a continuous development by way of new ideas, technologies and approaches to problem solving and improvement to process. Hence, oil refining companies are expected to catch up with new, innovative approaches to remain competitive and to be able to adapt to the multiple challenges facing the sector (Li et al., 2017; Barforoush et al., 2020).

New innovations bring new opportunities for industries that, if successfully adopted, will guarantee their sustainability, efficiency and competitiveness. The challenge of adopting new innovative strategies lies in making such innovations capable of contributing to the success of oil refining companies as long as enabling them to catch up with the pace of the rapidly- evolving global economy. This can be achieved by making companies sustainable in the long term (Mojarad et al., 2018).

11. Data integration

Data integration is a challenge for the oil refining industry owing to the huge and complex volume of data generated by the various systems and processes involved throughout the production process. The challenge lies in managing, integrating and securing data effectively. The key to overcoming this challenge is in adopting the latest technologies as well as adopting effective processes and protocols. Additionally, training employees to ensure they are fully oriented with such technologies and policies is also of utmost importance (Schneider et al., 2017).

Some examples of new technologies and approaches that the oil refining industry should invest in include cloud computing, big data analytics and cybersecurity measures. This challenge helps oil refining companies to ensure that data is accurate, consistent and reliable (British Petroleum Company, 2019).

12. Risk management process

Risk management process is identified as another challenge the oil refining industry needs to consider and it includes several actions. Firstly, securing energy is highly vital to the oil refining industry. Energy refers to a country's or a region's ability to have access to sufficient energy supplies at affordable prices. In addition to securing energy, securing resources is also essential. Resources refers to the accessibility and availability of the key raw materials, energy and any other goods or services that are prerequisites for operating the refineries. Similarly, it is important to ensure an ongoing and sufficient amount of feedstock is available, by way of raw materials or food stock needed for producing energy or other products. In addition, managing operational risk is vital and includes human error, equipment failure and natural disasters, along with external threats such as (cyber-attacks, terrorism, etc.) (Raut et al., 2017).

Another type of risk to consider is the environmental risk. Environmental risks are those dangers that can adversely influence the environment. There are several factors that cause environmental risks such as production processes, transportation and the use of petroleum products (Moullin, 2007).

Ensuring that oil refining processes will take place in a safe and reliable manner is closely associated with having an accurate identification, assessment and management of environmental risks. This can help companies to demonstrate commitment to sustainability (Raut et al., 2017).

13. Building relationships with governments

Opening channels with the government to build trust and reinforce the relationships between oil refining companies and the host government is intrinsic to optimum performance in the oil refining sector. However, while the government is primarily concerned with promoting economic development, companies' top priority will be directed at maximising their profit. These conflicting priorities can be ironed out if the government and oil refining companies maintain good relations. In other words, establishing trust and understanding between companies and governments enables the conflicting interests of both parties to reach a compromise. This will result in effective collaboration between the two parties with regard to any key arising issues (Schneider et al., 2017).

14. Investing in operations, processes, facilities equipment and employees

As a result of the urgency of meeting the increasing demand for petroleum products due to the population growth, oil refining companies are expected to invest in their operations, processes, facilities, equipment and employees. Furthermore, the industry needs to adhere to the environmental regulations and lessen the adverse influence that oil refining industry has on the environment. In addition, oil refining sector should take into account investing in research and development that will contribute to coming up with effective solutions for energy consumption, lowering emissions and increasing their efficiency. Another aspect that is worth mentioning is investing in training and developing the skills of the employees that leads to enhancing their level of productivity and competitiveness. Investing in expanding the current market along with opening new ones is also vital since such an action is expected to increase profitability and diversify business portfolios.

The challenge that oil refining industry is that it has to keep up with the new challenges, competition, market demand, environmental regulation, consumer demand, updated technology. Addressing the previously mentioned issues would cost the company a huge amount of money. Facing this challenge is expected to be fruitful to oil refining companies as this will have a long-lasting impact on making oil companies competitive and sustainable (Langlois & Chauvel, 2017).

15. Social responsibility

Social responsibility requires companies to go beyond their immediate interests and consider the broad impact of their actions. This is an overarching aspect of wider business practice and includes consideration of labour practices, human rights, environmental responsibility, product safety, community engagement and similar ethical practices.

- Human Rights: This includes the basic rights and freedom that every human being is entitled to, regardless of their nationality, gender, race, religion or any other status. Human rights also include equality and freedom from any discrimination. It also incorporates safe working conditions and appropriate working hours. Human rights are protected by international laws and conventions.
- Labour Practice: This refers to how workers are treated in the workplace and includes fair wages, motivation, benefits and incentives. Labour practices are usually governed by national laws and regulations as well as international labour standards.
- Environmental responsibility: This refers to the requirement for operational practices to be carried out in an environmentally friendly manner.
- Community engagement: This ensures that companies are building relationship and collaborating with the local community.
- Ethical Practice: This ensures that operations are conducted in an ethical manner.

It is a challenge for companies to balance their business goals with their social responsibilities, which can be costly and time-consuming, however, it is an increasingly important aspect as it promotes ethical behavior and sustainable practices. This challenge helps companies contribute to the wellbeing of their employees, protecting the environment and supporting local communities, which all contribute to doing business in a responsible and sustainable way (Putri et al., 2019).

16. HAZOP analysis

HAZOP stands for hazard and operability study, which is a technique used to identify potential hazards and operational problems in a process plant.

The challenge of HAZOP in the oil refining industry is hinged on its complex nature. In addition to being a complex process, such a process also uses materials that are considered hazardous. This means there is an urgent need for regular monitoring and management in order to prevent or minimise the occurrence of accidents (Taouab & Issor, 2019).

In order to apply HAZOP, the examination of any potential dangers should be carried out by specialists. Specialists are able to not only predict the consequences, but also to come up with the necessary measures that can prevent the occurrence of accidents or injuries. In terms of implementation, this is challenging for the oil refining sector because it is considered to be time consuming as well as resource-intensive process that maximises costs (Nosratabadi et al., 2019).

Carrying out a HAZOP analysis can assist companies to comply with regulatory requirements leading to long-term benefits, particularly for the companies' sustainability outcomes (Nosratabadi et al., 2019).

It was clear that there are many current challenges facing the oil refining industry. Figure 2.4 shows these challenges within the context of the industry as a whole.

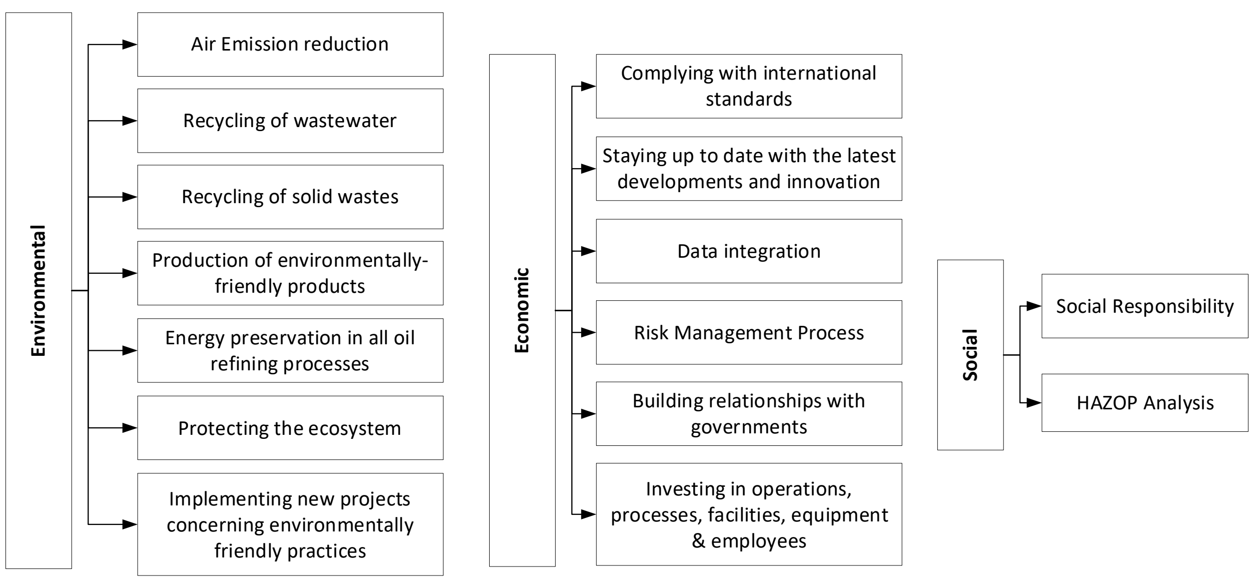

Figure 2.4 Challenges facing the oil refining sector.

Each of these challenges impact the environmental, economic and social dimensions of the oil refining sector. Considering these challenges will help the oil refining companies to navigate through sustainable practices, which is a growing global consideration. This research, therefore sought to understand the different aspects of sustainability practice within the oil refining sector, focusing on the impact on company's performance.

2.5 Examining Sustainability and its Impact on the Oil Refining Industry

The following section discusses the concept of sustainability and the importance of integrating sustainable practices to enhance company's performance. Additionally, this section examines yy the wider effects of implementing sustainable measures within the oil refining sector.

2.5.1 Sustainability Overview

There is an increasing awareness of the need for a low carbon future and concerns about the effects of global warming and resources scarcity contribute to the growing public awareness of sustainability (Ojeda-Benitez & Ramírez-Barreto, 2020). Sustainability development is a reaction to the government's and public's increasing attention to the environmental degradation, climate changes, global warming and resources limits (Sánchez-Flores et al., 2020). There has a been a noticeable shift in the government's and public concerns with environmental footprints, cleaner production and the proper use of natural resources (Ageron et al., 2012). These are considered real challenges and there is an assumption that these challenges can be overcome by sustainability (Gunasekaran & Spalanzani, 2012). In 2015, the United Nations (UN) adopted the 2030 agenda for sustainable development for all countries globally. The agenda includes seventeen sustainable development goals (SDGs) aiming at addressing some of the world's economic, social and environment challenges (United Nations Development Program, 2015).Sustainability practice enhances the balancing of the environmental, the economic and the social aspects, in equal harmony (Ageron et al., 2012; Brockhaus et al., 2016).

The environmental pillar of sustainability refers to the use of renewable natural resources and the use of clean technologies to reduce the negative environmental impacts. The economic aspect is related to utilisation of resources effectively. Finally, the social aspect refers to protection of the people's health from pollution and other harmful activities from business (Seuring et al., 2014).

Nowadays, the governments and the public seek pushing the concept of sustainability and sustainable developments into all spheres of life. As a result, companies seek changing their methodology to incorporate sustainability themes in their traditional SC, SC management and SC performance measurement system. In fact, companies are increasingly under pressure to integrate sustainability developments in their strategies and operations (Sánchez-Flores et al., 2020). As a result, companies are reconsidering and re-engineering their processes and operations to meet sustainable measures and standards. This puts strain on the companies to reshape their traditional supply chain and put into their consideration implementing modern perspectives like sustainability aspect in the company's. These sustainable measurement tools can assist companies to understand how effectively they are achieving key company objectives from a sustainability perspective and this research sought to understand more about the role of sustainability practices on company's performance.

2.5.2 The Impact of Sustainability Practices on Company's performance

Ashby et al. (2012) stated that for companies to become more sustainable, they should begin with an awareness of the impact of sustainability changes on company's performance. Seuring et al. (2014) pointed out that sustainability practice can assist in improving the environmental, economic and social aspects of a company, since the key role of sustainability practice is to bring balance between the three sustainability pillars; environment, economic and social.

Sustainability practice assists companies to use energy more efficiently and this will result in less costs, less wastage and improvement in environmental performance. Sánchez-Flores et al. (2020) highlighted that due to the increase in public awareness for adopting sustainability, customers are likely to buy products from those companies that follow sustainability processes. As a result, sustainability practise is not only improving the environmental and social performance, it can also provide companies with an opportunity to enhance company image and reputation which will attract more customers. In addition, Brockhaus et al. (2016) agreed that companies can minimise cost and increase productivity. By using energy efficiently and improving production processes in line with environmental goals, this will lead to less waste and energy saving so that more money will be saved. Nosratabadi et al. (2019) stated that companies which are concerned with sustainability practice can easily comply with the rules and regulations which are set by governments as legal requirements for any industry. Rajeev et al. (2017) explained that companies which are concerned with sustainability can more easily attract employees, as people prefer to work for companies that care about social wellbeing and the environment. According to the aforementioned discussion which revealed that sustainability practice is vital due to the following reasons it can improve the company's performance, quality of life, save natural resources for the next generations. Thus, sustainability became an important issue in our life. The COVID 19 Pandemic shed light on the importance of sustainability practices. Sánchez-Flores et al. (2020) stated that sustainability practices helped companies to survive. Therefore, integrating sustainability practices with company goals, strategies, SC, SC management and SC performance measurement is increasingly important.

This research aimed at exploring the practical application of sustainability practices in the oil refining sector. This will support companies to engage with stakeholders and consider their ongoing sustainable perspective for maximum advantage.

2.5.3 The Significance of Sustainability Practice in the Oil Refining Sector

Oil refineries can benefit in several ways by incorporating sustainability practices into their daily operations.

1. Environmental compliance: Adopting sustainability practices can assist the oil refining industry to reduce its impact on the environment through complying with environmental rules and regulations. This entails minimising emissions, implementing pollution control measures and reducing waste, as well as applying energy-saving procedures and utilising greener technologies. Oil refineries can help mitigate climate change and protect natural resources through reducing their carbon footprint and compliance with global environmental requirements (Nosratabadi et al., 2019).
2. Stakeholder engagement: Sustainability practices in the oil refining industry encourage oil refining companies to build trust and good relationships with their stakeholders by fostering regular engagement with stakeholders such as local communities, environmental organisations and customers. Hence, stakeholder engagement can enhance a company's image and reputation (Rajeevet al., 2017).
3. Operational and resource efficiency: Implementing sustainability practices can optimise the overall operational efficiency of oil refining companies through conserving energy and water sources, reducing waste, enhancing efficiency in operating and promoting recycling and reuse of materials. Consequently, operational and resource efficiency can enhance profitability and competitiveness in the market (Rajeevet al., 2017).
4. Risk management: Embracing sustainability practices can encourage oil refining companies to identify, evaluate and mitigate various risks associated with the company's operations. This includes health and safety risks, environmental risks, regulatory and compliance risks and financial risks. Risk management is essential for preserving the environment, the safety of employees and ensuring financial stability (Kalinina et al., 2019).

5. Innovation: Sustainability practices encourage oil refining companies to embrace new innovation practices and technologies relevant to the energy sector, such as cleaner technologies, renewable energy integration, digitalisation and data analytics and waste management innovations. Adapting new innovation practices and technology can enhance the oil refining company's sustainability, efficiency and future growth (Mojarad et al., 2018; Kalinina et al., 2019).

Sustainability application has significant impact on the oil refining industry which goes beyond environmental concerns, including both social responsibilities and economic advantages.

2.6 Performance Measurements and its Impact on the Oil Refinery Industry

This section explores the performance measurement and provides key examples of well-known performance measurement models. According to the previous studies, this section also discusses the impact of integrating sustainability practice into performance measurement models within the oil refining sector.

2.6.1 The Importance of Performance Measurement

Performance measurement practice has become an important issue in recent years (Owais & Kiss, 2020). Performance measurement is a tool used to measure and evaluate SC performance. SC performance measurement can be defined as a continuous measurement process that aims at quantifying the efficiency of SC performance through sequential functions, which are collecting, understanding, analysing, reporting, managing and improving data if required (Chan & Qi, 2003; Heini, 2007; Moullin, 2007). SC performance measurement practice should be considered an essential practice due to the fact that it can assist companies to regularly track, monitor, evaluate and compare their current performance with planned goals (Owais & Kiss, 2020). This process can help companies identify their strengths and weaknesses in SC performance as well as areas of improvement (Moullin, 2007). In this way, SC performance measurements practice can be considered as one of the essential aspects in managing a business (Owais & Kiss, 2020).

Taking into account the integral role of performance management, this study aimed at exploring the impact of SC performance measurement practice on company's performance. SC performance measurement is important for several reasons. According to Owais & Kiss (2020), SC performance measurement practice can provide companies with reliable information related to the company's current performance. This increases transparency to the company's practice. Fisher (2021) highlights that SC performance measurement practice can create an opportunity for companies to monitor their current process and take the right decisions, if required. Zunic & Vlasic (2006) mentioned that "performance measurement allows a company to continually check that their progress is being achieved in line with planned goals". This idea was reinforced by Owais & Kiss (2020) who believed that "performance management can ensure that company activities align with set goals". Owais & Kiss (2020) demonstrated that "SC performance measurement practice can help companies to collect, track and asses their progress based on solid data". This helps the company to realise its strengths and weaknesses in terms of company's performance. More so, the company will be capable of recognising new business opportunities. Moullin (2007) emphasised the same idea, stating that "effective performance management can enable a company to evaluate its performance in a meaningful way, based on performance measurement data". Putri et al. (2019) explained that SC performance measurement processes can help to ensure that a company's sub-systems, that include departments, teams and processes, are cooperating to achieve the desired outcomes. de Waal & Kourtit (2013) stated that "SC performance measurement practice helps companies to survive, despite fierce current market competition, through continually monitoring, evaluating and improving supply chain performance". It is clear that SC performance measurement practice is fundamental and plays an integral role in improving the overall performance of companies. This has been reinforced by Taouab & Issor (2019) who outlined the positive effect of SC performance management and the performance of companies.

2.6.2 Key Examples of Well-Known Performance Measurement Models

There are various performance measurement models that have been designed to measure supply chain performance. Some of these models are used in specific sectors, such as SCM/SMS Models which target small and medium companies in fast moving consuming goods, or Global EVALOG, which is used in the automobile industry (Estampe et al., 2013). Other models are purely financial, such as Activity Based Costing (ABC), Strategic Profit Model (SPM) (Balfaqih et al., 2016). Furthermore, there are other SC performance measurement that are well known models and can be used generally and not limited to a certain sector, such as the Balanced Score Card (BSC) and the Supply Chain Operation Reference Model (SCOR) (Estampe et al., 2013). These models are examples of well-known SC performance measurement models used extensively in diverse industries and businesses. Each model integrates particular dimensions. For instance, the BSC focuses on four aspects, which are customers, finance, internal process and innovation and growth, while the SCOR focuses on six criteria, these are; planning, sourcing, making, delivering, returning and enabling.

Most aspects of the SC performance measurement model are traditional as they consider cost, productivity and financial measures. These traditional models are useful, though not sufficient to measure SC performance, particularly with the increasing awareness on sustainability practices which are concerned with integrating the environmental, social and economic aspects (Chan & Qi, 2003). Recently, there is awareness towards a low carbon future and concerns about the effects of global warming and resources scarcity, this drives companies to integrate sustainability in their goals and process. Subsequently, this puts a strain on companies to reshape their conventional supply chain and to implement modern sustainability perspectives in the company's strategy, goals, SC, SC management and SC performance measurement system (Ashby et al., 2012). As a result, companies face a challenge to identify a performance measurement model that is tailored for the industry characteristics and capable of integrating the sustainability practice. Therefore, the research sought to understand more about the sustainability concept and the impact of incorporating sustainability on companies' performance.

As a result of its integral role, this study- in the following section- identifies the significance of performance measurement in the oil refining industry. In addition, identifying the impact of integrating sustainability into performance measurements in the oil refining sector. Furthermore, the research reviewed most of the previous papers that are concerned with performance measures of sustainability adopted for oil refining sector.

2.6.3 The Significance of Performance Measurement for the Oil Refining Industry

Performance measurement can have a big impact on a company's success as it can provide insight to the company's progress. Performance measurement practice is even more crucial for oil refining companies since the oil refining industry is operating in a complex and challenging environment. Performance measurement practice helps oil refining companies to assess their operational efficiency and identify areas for improvement through continuous tracking and monitoring of key performance indicators that are related to each process and activity, which can help shape the right action and effectively address the challenges facing the oil refining industry (Güney, 2019).

The oil refining industry faces various challenges and has a unique nature which distinguishes it from other industries. Oil refining is one industry that is vital to the world's energy security and economic growth. In addition, this industry operates within a vast, complicated and integrated global supply chain with significant safety risks since it handles flammable and hazardous materials and operates in high pressure systems. In order to clarify this, the oil refining sector operates in a highly volatile market affected by geographical dynamics, fluctuations in crude oil prices and changing demands of consumers. The oil refining industry is widely recognised as an industry with a significant environmental footprint, which stems from emissions, resources consumption, waste generation and water and air pollution. Finally, the oil refining industry operates under strict international rules and regulations related to all the factors contributing to the need for unique and tailored assessments compared to other industries, to help oil refining companies handle the complexities, challenges and unique characteristics of this industry and to ensure efficient and secure production processes. In addition to this, performance measurement practice can also assist oil refining companies to enhance their productivity, guarantee quality, promote environmental issues, manage risks, adhere to regulations, make informed decisions and to effectively engage with stakeholders. Recently, the trends in performance measurement system are integrating the sustainability theme. Therefore, the research aimed at understanding more about the impact of incorporating sustainability into performance measurements in the oil refining sector, which will be discussed in the subsequent section (Mojarad et al., 2018; Kalinina et al., 2019; Energy, 2020).

2.6.4 Effect of Integrating Sustainability into Performance Measurements in the Oil Refining Sector

The previous discussion emphasised the significance of the oil refining industry, performance measurement and sustainability. Additionally, the preceding discussion showed the importance of integrating sustainability in performance measurement. For all these reasons, the integration of sustainability into performance measurement is significant in the oil refining industry. To clarify, sustainability practices are important to address the environmental, economic and social challenges that oil refining companies face while the performance measurement provides the tools and framework to track, assess and improve sustainability performance over time. In other words, sustainability practices can help oil refining companies to address each dimension through minimising companies' operations environmental impact, promoting economic value and enhancing the social responsibility. Besides, performance measurement is equally significant as it can assist oil refining companies to monitor, assess and improve company's sustainability performance through developing key performance indicators to track each relevant metric over time. Therefore, the integration of sustainability practice into performance measurement is significant in the oil refining sector to guarantee that sustainability goals are effectively monitored, managed and achieved. As a result, this research sought to gain deeper insight into performance measures of sustainability applied for the oil refining sector, discussed in the consequent section (Güney, 2019).

2.6.5 A Review of Performance Measurement Models adopted in the Oil Refinery Sector from a Sustainability Perspective

This research sought to review the previous papers concerned with performance measures of sustainability specific to the oil refining sector. Previous studies incorporating performance measurement models from a sustainability perspective, within the oil refining sector, was reviewed. Accordingly, the following section discusses the methodology adopted to review previous studies to identify the performance measurements from sustainability perspective adopted for oil refining sector, through identifying the key words and the data base used.

2.6.6 The Methodology Adopted in the Literature Review

Relevant publications were identified through an extensive literature review. The researcher selected several key phrases including, "performance measurements of sustainability", "performance metrics of sustainability", "sustainable performance measuring", "relevant sustainable performance measurement" and "sustainable KPIs for oil refining sector". To ensure the credibility of the papers selected and to ensure a wide range of journals and papers could be drawn from, four online databases were used including Scopus, Science Direct, Emerald and Business Source Complete. Thus, this research considered these data bases because they are widely used platforms that cover wide range of journals and conference papers. The articles were screened based on the relevance to the key phrases. The researcher then sought to understand what these studies have reached so far regarding the performance measurement models of sustainability adopted for the oil refining sector in addition to identifying the KPIs which were developed by these studies to assist companies in evaluating their performance from the sustainability perspective.

2.6.7 Assessing Previous Performance Measurement Models for Sustainability in the Oil Refinery Industry

The study in hand aimed at reviewing most of the previous papers that have tackled performance measures of sustainability adopted for the oil refining sector.

Kazemi (2016) presented a model that enables monitoring and evaluating of the environmental and social aspects of performance within the oil refining industry. Upon applying this model, companies should be able to trace their progress and performance, in addition to, identifying areas for improvements, in the environmental and social areas. Despite the importance of taking into consideration the environmental and social dimensions that are crucial for sustainability assessment, it is equally important to consider the economic aspect. Integrating the three dimensions provides a comprehensive evaluation of sustainability.

Kazemi (2016) outlined the results of an online survey. The participants were managers in Iranian oil refining companies and their perspectives were gathered to assess the environmental and social key performance indicators. As previously mentioned, carrying out a survey on one country alone can be regarded as a research limitation that will hinder the generalisation of the findings and the conclusions drawn from the study. In addition, Kazemi (2016) failed to provide a comparative analysis, thus limiting valuable insights that could be gained from comparing and contrasting practices across different countries or regions.

Besides, the fact that the paper focused on one country suggests that the international perspective had been overlooked. As an illustration, being an international industry that operates with a global framework of rules, regulations and standards stipulates aligning with the international sustainability goals and the industry benchmark. Hence, it is highly vital to consider the international perspective able to achieve the best practices.

What can be concluded is that the study, in order to enhance the findings and applicability thereof, it is vital to incorporate the economic dimension of sustainability along with the social and environmental aspects. Upon applying this, oil refining companies will become capable of achieve a more comprehensive and balanced approach to sustainable development. Another point the previous study should reconsider is; expanding the sample size by including multiple countries and conducting survey in various regions. This will also increase the validity of the findings and in return allow applying and generalising the findings drawn from the study to a wider scale.

Aghelie (2017) presented a performance measurement model specifically designed to assess environmental sustainability in the oil refining sector. This model incorporated a systematic framework with a set of environmental indicators that can function as a valuable tool for refineries. This is owing to the fact that, by incorporating this model, oil refining companies will be able to assess, benchmark and monitor their environmental performance. Utilising such a model will help refineries to effectively measure and track their environmental sustainability performance in key areas such as energy efficiency, greenhouse gas emissions, water management, waste management and air pollution control. In other words, such a model is expected to enable refineries to achieve environmental improvements by identifying the major areas related to the environmental issues. As a result, this model will have a role in enhancing sustainable practices within the oil refining industry and particularly, in promoting the environmental management responsibility within the industry.

It is important to note, however, that Aghelie's (2017) paper has only tackled the environmental aspects of the oil refinery sector, whereas the economic and social dimensions were overlooked and therefore the paper could not offer a complete picture of sustainable oil refining practices as it did not incorporate all three pillars of sustainability.

Moreover, Aghelie (ibid) relied on reviewing multiple studies addressing the same topic, which effectively assisted the researcher to identify the trends, patterns and the common themes in the literature related to the same topic. Nevertheless, relying exclusively on the existing literature, despite its significance, will not yield highly fruitful results as the researcher may not be able to catch up with capturing industry specific contextual factors and evolving trends. In addition, another limitation that can be associated with counting only on the existing literature lies in lack of accessibility to the real world observations and empirical evidence. Such a limitation poses a major threat to the validity and the accuracy of the findings. Instead, such a paper has to consider complementing the literature review with empirical data, case studies and industry specific insights. This integration of data would help in not only validating but also modifying the model based on real world experience. This in return will result in providing more an extensive comprehension of environmental sustainability in the oil refining sector.

The research of Mojarad et al. (2018) aimed primarily at evaluating the environmental sustainability of the oil refining sector. The paper developed a framework that comprises a set of environmental indicators which serve as a framework for evaluating, monitoring and assessing the environmental performance of refineries. However, the scope of investigation relied on in this paper is restricted due to its focus exclusively on the environmental aspect, also disregarding the economic and social dimensions. Incorporating such a restricted focus will only allow a limited understanding of the oil refining company's performance, which will impede any holistic assessment of sustainability within the oil refining sector. Additionally, Mojarad et al.'s (2018) paper relies heavily on a single case study conducted on the Tehran oil refinery. Despite the valuable insights presented by the study, its findings cannot be generalised to a wider range of oil refining companies. It was also limited in its consideration of the practical implications of the research, as it did not compare the proposed model with other existing models. This step is crucial in order to test the applicability of the suggested model across different companies and countries.

Relying on a single case study means that international aspects that have a broader perspective cannot be considered. As a clarification, the oil refining industry is an international industry that operates globally. This characteristic of the industry necessitates the need to strictly adhere to the international rules and regulations. The reliance on one case study will hinder the paper model from addressing the international aspects; hence, it will not be capable of meeting the international standards and aspects. Also, the framework may have a limited relevance to oil refining companies operating in different countries: therefore there will be a difficulty in effectively capturing the sustainability challenges facing the industry on the global scale.

Consequently, it is recommended that the paper should broaden the scope of its analysis by incorporating the economic and social dimensions of sustainability along with the environmental dimension. Another aspect that will facilitate comparative assessments and broaden the applicability of the findings is to refer and take account of multiple case studies from different refineries in addition to considering diverse international contexts.

Kalinina et al. (2019), focused on the use of treated effluent as a sustainable water supply in petroleum refineries, specifically at the Kermanshah oil refinery in Iran. The study evaluates the lifecycle and economic aspects of an integrated treatment system for recycling refinery effluent. The research considers eight environmental indicators. The study also highlights the importance of renewable energy and the role of using environmentally friendly chemicals in enhancing the efficiency and sustainability of the treatment process. Although this provides valuable insight with respect to the integrated treatment system for recycling refinery effluent, there are a few potential areas that were disregarded by this study. This study focused on the lifecycle and economic assessment of the treatment system, with strong emphasis on environmental indicators. This can be viewed as a narrow scope and therefore an incomplete assessment of the social factors used in the evaluation of the treatment system. A narrow scope will limit understanding since the considerations related to stakeholders' engagement, community wellbeing and sustainable development were not addressed. In addition, Kalinina et al. (2019) focused on a specific case at the Kermanshah oil refinery in Iran and as mentioned previously this can restrict the generalisability of the findings to other refineries.

Barforoush et al. (2020) proposed a performance measurement framework for sustainable oil refining. The primary goal of this framework was providing guidance in the decision-making process and enhancing the sustainability practices in the industry. In order to evaluate the sustainable practices carried out as part of the oil refining processes, the study has effectively integrated the economic, environmental and social indicators together. However, the findings of such a study cannot be generalised to all oil refining companies. This is pertained to the fact that this paper, in its methodology, relies on a very limited sample and will likely result in overlooking some of the features of the oil refining industry. Hence, validating the suggested framework on a broader scale and testing its applicability across different companies and contexts is fundamental. Without doing so, it will be challenging to determine the effectiveness and suitability of the framework as applicable to the industry as a whole.

Another shortcoming of the reliance on one study is the lack of a valid comparison between the existing models or frameworks. The paper proposes a novel framework; it is essential to evaluate how close/ distant the study model from the existing performance measurement models in the field. By taking only one single study into account, the comparison between the paper model and the existing ones will be incomprehensive. In other words, relying on one study will not provide an extensive thorough comparison that identifies in detail the contributions that the paper model is going to add to the industry along with the area that need improvements. An in-depth comparison that can give the researcher an opportunity to trace the difference and similarities between the existing models and the paper model can only be achieved by reviewing multiple studies.

Furthermore, the fact that the paper focused only on a case study might limit the international perspective of the research. When developing a performance measurement framework, it is crucial to take the international context into account. The oil refining industry operates globally and companies have to abide by the international rules and regulations. If oil refining companies fail to meet the international standards, this will influence the application of the framework to companies operating in diverse countries that will in return lessen its effectiveness in meeting the global sustainability challenges that the industry is encountering.

Additionally, the key performance indicators (KPIs) outlined in the paper's framework do not adequately address the challenges that have been previously discussed. This point is problematic, for these challenges reflect the global trends and issues facing the oil refining industry. Thus, companies are expected to incorporate these challenges into their vision, strategy and performance measurement systems. By doing so, the process of tracking, monitoring and evaluating companies' performance to ensure its consistency with the company's vision, strategy and the challenges specific to the industry, will be carried out productively and smoothly. This performance measurement practice enables companies to proactively respond to industry trends and effectively manage the associated risks and opportunities. Therefore, the aforementioned paper's framework should have included KPIs that reflect the challenges identified. This will give companies a hand in evaluating their performance with regard to catching up with these global trends. More so, this will also make companies' operations, strategies and performance measurement systems compatible with the evolving needs of the oil refining industry and this will in return ensure their continued success in a dynamic and regulated global environment.

Nicolescu & Burta (2020) conducted an Environmental Assessment Impact (EIA) of oil refineries in Iran with a specific focus on the Tehran oil refinery case-study. The EIA process involves evaluating environmental impact reports, conducting field studies and monitoring environmental conditions. Their study proposed the design and utilisation of software models to assess the environmental impact of oil refineries in Iran. These models are tailored for the specific operational needs of the region. Their paper combines the Analytic Hierarchy Process (AHP) method for decision making and Geographic Information System (GIS) technology for spatial analysis. To clarify, employing AHP assisted in weighing the criteria and sub-criteria, while GIS facilitated the analysis and visualisation of the spatial distribution and relationships of the identified impacts. Therefore, the objective of their study is to provide a systematic and comprehensive approach that can be used in evaluating the environmental impacts of oil refineries in Iran in general is on the Tehran oil refinery in particular. It is clear that Ana-Cristina & Florina-Simona's (2020) study adopts a systematic and comprehensive approach to assess the environmental impacts of oil refineries in Iran. Nevertheless, there are significant shortcomings in terms of its negligence of other important dimensions. While the study primarily paid attention to the environmental aspect, as with most of the previous studies, it disregarded the economic and social dimensions. This narrow focus is likely to result in a superficial understanding of the overall sustainability of the oil refining industry. Furthermore, studying only the specific case of Tehran's oil refinery industry will restrict the generalisation of the findings to other regions and countries. Instead, a more holistic approach that incorporates a broader range of factors and expands the geographical scope would have enabled the researcher to have an in-depth understanding of the sustainability of oil refinery projects.

There is a limited number of papers that consider the performance measurement of sustainability in the oil refining sector. The existing ones, seem to pay close attention to specific aspects of sustainability while overlooking others. This approach impedes extensively evaluating the sustainability practices in this sector. To obtain a deeper understanding, it is essential to combine the three key dimensions of sustainability: environmental, economic and social aspects.

For instance, in the examined studies, Anghelei (2017), Mojarad et al. (2018), Kalinina et al. (2019), and Nicolescu & Burta (2020) focus is on the environmental aspects, while overlooking the economic and social dimensions. Conversely, Kazemi (2016) took account of the environmental and social aspects but failed to address the economic dimension. Incorporating the three dimensions is of utmost importance in order to come up with a comprehensive and balanced approach that will contribute to developing sustainability in the oil refining sector.

Moreover, the aforementioned papers may have limitations such as relying on a single case study and the absence of a comparative analysis that compares the suggested model with the current models. These two shortcomings resulted in restricting the applicability and reliability of the proposed models. To enhance the robustness of sustainability measurement, it is vital to consider multiple case studies, compare findings with existing models and aim at internationalisation, ensuring broader applicability and validation of the proposed sustainability assessment framework.

More so, it can be evidently realised that previous papers' key performance indicators do not effectively address the challenges previously discussed. Addressing and analysing these challenges is crucial since they are relevant to the global trends in the oil refining industry. It is essential to incorporate these challenges into companies' visions, strategies and performance measurement systems to monitor and evaluate performance, ensure compliance with the industry's trends and company objective. Also, addressing these trends assists oil refining companies to increase their competitiveness and adaptability to the evolving trends.

It is clear that there are shortcomings in how sustainability practice is monitored and evaluated within the industry. This can be referred to as the gap in performance measurement from a sustainability perspective in the oil refining sector.

2.7 Research Gap

This study aimed at identifying the research gap between both the academic and practitioners' perspective. The academic perspective focuses on identifying the gaps shown in the literature, while practitioners' perspective aims at identifying gaps in the industry. By covering these two perspectives, the study can have an in-depth understanding of the research gap between both the theoretical and the practical perspective.

Furthermore, within this section, the research questions, formulated based on the identification of the research gap, are outlined.

2.7.1 Identifying the Research Gap from the Academic Perspective

The oil refining industry plays a fundamental role, not only in flourishing the global economy but also in supporting various sectors. Despite its significance, it poses major threats to the environment, economy and society due to the negative impacts oil refining industry has on the environment. To clarify, the oil refining industry has adverse influence on the environment, thus leading to climate change and greenhouse gases. As a result, the urgent need for having sustainable practices is increasing. Moreover, there is a growing global initiative that urges the oil refining industry to make its strategies, visions, goals and performance measurements align with the sustainability practices, global trends and challenges. In this sense, having a performance measurement that can assist companies to evaluate monitor and improve their performance is so vital. Additionally, performance measurement can help managers in gaining insights into the performance of their companies through providing indications of how far their companies are aligned with their goals and strategies. Also, performance measurement can assist managers to identify the areas of weaknesses requiring improvements. Consequently, this research aimed at reviewing previous studies on sustainability performance measurement in the oil refining sector.

It is clear from the literature review that there are very few papers that have explored the performance measurement of sustainability in the oil refining sector. These papers that did explore this also stressed the urgent need for giving more attention to this area. Secondly, some papers focused on only one or two aspects of sustainability, neglecting the other equally important dimensions. There is only one single paper that proposed a performance measurement model for the oil refining sector that integrates the three pillars of sustainability: the economic, the environmental and the social dimensions. However, the findings of this study cannot be applied more widely. This is owing to the fact that this study relied exclusively on a single case study. This limits the applicability of the conclusions drawn from the study to other oil refining companies. In addition, these papers failed to hold a comparison between the previously developed models and the existing models or frameworks and this is a significant limitation. Finally, the reviewed papers failed to consider global trends and challenges that influence the industry. Putting the strategic nature of the oil refining industry into consideration and being aware of the requirements to adhere to international rules and regulations, the oil refining sector is expected to actively catch up with the global trends and to face the challenges as this will boost the level of competiveness and responsiveness to the evolving needs and expectations of the global market.

It is, therefore evident that having a comprehensive performance measurement model which integrates all three dimensions of sustainability, considers the distinctive characteristics of the industry and addresses the challenges that the industry currently encountering will provide a comprehensive evaluation of oil refining companies' performance from the sustainability perspective. This is the identified research gap that will ensure companies can cater for global trends and meet the global challenges facing the industry.

Consequent to conducting a comprehensive literature review in this field, the researcher sought to understand how companies in the oil refining sector are measuring and evaluating their sustainability practices. To put it differently, this research sought to conduct exploratory interviews to identify the currently applied performance measurement models of sustainability in the oil refining sector.

2.7.2 Identifying the Research Gap from the Practitioners Perspective through conducting an Exploratory Interview

Besides reviewing academic studies, the researcher sought to explore the current status of the oil refining sector and the commonly deployed measurement models.

That is, the research in hand conducted exploratory interviews carried out with experts in the oil refining field to collect different experts' and practitioners' perspectives about sustainability practices in the oil refining sector. The interviewees were selected from the experts who attended the international conference titled "Egypt's Petroleum International Conference "(EPIC), that was held in Egypt in 2016 that attracted global delegates. The researcher interviewed 43 experts in the oil refining industry. Interviewees were asked whether oil refining companies adopt KPIs to measure their performance from the sustainability perspective and what models the companies refer to for measuring their performance from the sustainability lens. The interview structure broadly included four questions. Firstly, respondents were asked about sustainability practices within their company. This was followed by asking the respondents whether their company follows a key performance matrix of sustainability to measure the company's performance from the sustainability perspective and if so, the interviewees were asked about the models their company referred to for assessing their performance from the sustainability lens. These interviews helped the researcher to identify performance measurement models for sustainability that are currently used within the sector. Additionally, these interviews helped the researcher to observe if there are similarities between the data compiled from the academic perspective and the data collected from the practitioners.

What has been revealed from the exploratory interviews is that there is a limited awareness and adoption of sustainability practice within the oil refining companies. As far as measuring a company's performance is concerned, it has been found that some companies still rely on the widely used performance measurement models, even though they don't integrate the three sustainability aspects. Despite sustainability practice becoming a current a focal point for oil refining companies to pay attention to, most of the existing models still focus on traditional performance metrics that do not integrate all the sustainability indicators required for a comprehensive assessment of sustainability performance. Whilst there is limited awareness and adoption of sustainability practice within the oil refining companies, this does not apply to all companies, as some companies have developed their own customised models to measure their company's performance.

The interviewees also indicated that sustainability implementation is no longer regarded as optional. Instead, it transitioned to become an essential requirement after the development of the SDGs 2030 by the United Nations, thus raising the awareness of government bodies, companies and the wider public. For that reason, the interviewees clarified that the sustainability adoption rate is expected to increase rapidly in the coming years. In addition, the interviewees highlighted that petroleum refining companies have a responsibility to raise the awareness about the sustainability concept in a way that provides energy efficiency as well as contributing to the economic, social and environmental aspects in a balanced manner.

The results of this interview clarified and reinforced the research gap identified by the literature review. The gap identified in the research is having insufficient performance measurement models that are capable of incorporating the sustainability, alongside the main properties and global challenges of the oil refining sector.

To bridge this research gap, the current research aimed at developing a comprehensive performance measurement model tailored for the oil refining sector. This model would consider the oil refining special characteristics, integrating the sustainability aspects and addressing the challenges and trends facing the oil refining sector globally. The model is also expected to assist oil refining companies in measuring the company's performance. To fulfil the aim of this research, the following research questions have been developed:

Q1. What are the key challenges facing the oil refining industry?

Q2. What are the key indicators that can effectively address the challenges facing the oil refining industry and how can they be integrated into the developed performance measurement model?

Q3. What are the essential guidelines and considerations that can effectively support oil refining companies in the implementation of a performance measurement model?

Q4. How does the developed model compare to existing models in terms of its impact on company's performance from an economic, environmental and social perspective?

By addressing these research questions, this research hopes to add insights into the challenges that the oil refining industry is currently encountering, as well as, the key indicators and to provide valuable guidelines for implementation by oil refining companies to enhance their performance in a sustainable manner. Additionally, the research aimed at comparing the proposed comprehensive performance measurement model of sustainability for the oil refining sector with the existing models and to assess its impact on companies' performance with regard to the economic, environmental and social dimensions. This will help to determine how effective the developed model is in addressing sustainability goals and challenges facing the oil refining industry.

The identified research gap serves as foundation to establish the research aim, which then was translated into broader research objectives. Subsequently, the research aims were transformed into specific research questions which would guide the formulation of the research hypotheses. The upcoming section explains the research hypothesis formulation.

2.8 Hypothesis Formulation

In this section, the researcher sets out the formulation of the research hypotheses. There are two main research hypotheses (H1 and H2) and each of these hypotheses is further divided into three sub-hypotheses. The following section tackles both H1 and H2

This research reviews previous studies that have explored performance measurement for sustainability in the oil refining sector. The majority of the previous studies lack a comprehensive assessment based on integrating the three pillars of sustainability for effectively measuring sustainability practice. In contrast, the models that have been utilised in previous papers focused only on one or two dimensions of sustainability and the other two dimensions despite their equal significance were not explored resulting in an incomplete measurement of performance.

In addition, practitioners in the industry pointed out in the exploratory interviews, that some companies still count on the traditional performance measurement models in the oil refining sector. In doing so, companies overlook the fact that deploying these models will not lead to a comprehensive assessment of the sustainability practices, because they are not integrating all the required dimensions of sustainability by depending on the traditional metrics.

Kliestik & Vidrova (2020) highlighted that there is a direct relationship between key performance indicators and company's performance, whereby if the KPIs are comprehensive, suitable and appropriate to measure what they are intend for, company's performance will be effectively monitored, measured and assessed. In this way, implementing an effective measurement practice can optimise company's performance.

On the contrary, McDougall et al. (2021) pointed out that a lack of key performance indicators has negative consequences, including an absence of a comprehensive assessment, thus leading to ineffective monitoring, evaluation and assessment. This will negatively affect the entire performance of the company. The impact of an incomplete assessment on overall company's performance can vary depending on the extent of what was measured. In other words, the level of coverage and depth in the assessment will play a significant role in determining the intensity of the impact on the company's overall performance with respect to the economic, environment and social aspects.

According to previous discussions, it was found that the majority of the studies lack a comprehensive assessment that can be incorporated to assess companies' performance from the sustainability perspective. That is, most papers encompass a few dimensions of sustainability and neglecting other dimensions of equal significance when considering evaluating the performance of companies from sustainability lens. The perspective of practitioners also indicates that some companies still use models lacking sustainability integration and rely on traditional metrics.

According to, previous studies that explore the integration of sustainability practices into performance measurements in the oil refining sector, the relationship between key performance indicators (KPIs) and company's performance directly influence the degree to which it influences company's performance on the environmental, economic and social levels. Based on these findings realised from the previous studies which consider the effect of integrating sustainability into performance measurements in the oil refining sector and other previous studies considering performance measurement of sustainability in oil refining sector, the researcher expects that the currently used KPIs may have a limited impact on company's performance in these previously mentioned aspects. The scope the existing models cover is limited due to the absence of integrating the three pillars of sustainability. This leads to the formulation of the first research hypothesis (H1), that was subdivided into sub-hypotheses (H1.1, H1.2 and H1.3); and each was tested separately.

H1: The currently used key performance indicators will not yield a noticeable impact on company's performance in terms of the environmental, economic and social aspects.

H1.1: The currently used environmental key performance indicators will not yield a noticeable impact on company's performance in terms of the environmental aspect.

H1.2: The currently used economic key performance indicators will not yield a noticeable impact on company's performance in terms of the economic aspect.

H1.3: The currently used social key performance indicators will not yield a noticeable impact on company's performance in terms of the social aspect.

The research aim is to develop a comprehensive performance measurement model for the oil refining sector. This model was designed to take into account the special characteristics of the oil refining sector, while integrating sustainability aspects and global challenges affecting the industry. In this way, this model was intended to bridge the identified research gap. The second research hypothesis (H2) is formulated based on three factors. Firstly, the proposed model is expected to be more comprehensive than the currently used models. Secondly, the research seeks to test the applicability of the proposed model by examining the relationship between the variables defined in the hypothesis. Thirdly, the research addresses the limitations of the previous studies that were overlooked in the previous studies. In other words, previous studies did not compare their developed models with the currently used models as they relied on only one case study. (H2) is formulated to compare the developed model with the currently used models. By doing so, the research can assess the applicability of the proposed model and address the limitations of previous studies. This is the background for the second research hypothesis (H2). The second research hypothesis is subdivided into sub-hypothesis (H2.1, H2.2 and H2.3); whereby each is tested separately.

H2: There is a significant difference between the developed model and current models in terms of their impact on company's performance in terms of the environmental, economic and social aspects.

H2.1: There is a significant difference between the developed model and current models in terms of their impact on company's performance in terms of the environmental aspects.

H2.2: There is a significant difference between the developed model and current models in terms of their impact on company's performance in terms of the economic aspects.

H2.3: There is a significant difference between the developed model and current models in terms of their impact on company's performance in terms of the social aspects.

2.9 Summary

To conclude, the oil refining industry plays a vital role in catering for the demands of the world's energy. It also provides a vital link within the broader petroleum industry by providing important products that are intrinsic to everyday life and serve as feedstock for a wide range of industries. Despite its highly significant global role, the oil refining industry is increasingly known for its environmental threats and subsequently, these are real challenges for the industry. For the oil refining industry to remain competitive and sustainable in today's dynamic business environment, it is essential for the oil refining industry to consider its impact on the environment. Consequently, there is an urgent need for a performance measurement model that can closely monitor and accurately evaluate company's performance to assist oil refining companies consider their environmental impact. The study in hand reviewed the previous papers that explored performance measurement for sustainability in the oil refining sector. The literature review showed that existing performance measurement models currently utilised in the oil refining sector are not capable of integrating the sustainability dimensions and addressing the global challenges. This could be due to the fact that the performance measurement indicators encompassed in these models are insufficient for integrating the sustainability dimensions and addressing current global challenges facing the oil refining industry. Therefore, the aim of this study is to develop a comprehensive performance measurement model for sustainability designed particularly for the oil refining industry. This model is expected to integrate sustainability dimensions, incorporate the oil refining industry's special characteristics and to address the global challenges and trends that the oil refining sector is currently facing. The next chapter outlines the stages of developing the proposed comprehensive performance measurement model.

Chapter 3: Oil Refining Performance Measurement Model Considering Sustainability Aspect

3.1 Introduction

The previous chapter identified the research gap embedded in "still having insufficient performance measurement models that are capable of incorporating the sustainability theme along with including the main properties of the oil refining sector and addressing the global challenges and trends". This research sought to bridge the identified research gap through developing the performance measurement model from sustainability perspective capable of integrating the three dimensions of sustainability, incorporating the characteristics of the oil refining industry and addressing the current global challenges encountering oil refining sector, in addition to developing a theoretical framework which includes some foundations aspects in the form of procedures, barriers, benefits and drawbacks facing oil refining companies upon implementing the performance measurement theoretical model.

This chapter is considered an extension to the literature review in Chapter 2 as both the aim and tools used in both chapters are different. That is, chapter 2 reviewed previous studies which are concerned with SC, petroleum industry, sustainability and performance measurement in general and other studies concerned with studying these previously mentioned concepts related to the oil refining industry to understand the foundations and surroundings of the research topic. In addition, this research attempted to review previous studies concerned with performance measurement from sustainability lens applied for oil refining sector, to realise the limitations in these studies and identify areas that require further investigation. On the other hand, this chapter reviewed previous papers concerned with technical issues related to oil refining industry to extract some indicators that represent the oil refining characteristics, this review ended up with initial performance measurement model. Additionally, this chapter comprised review of the previous studies concerned with performance measurement of sustainability in other industries to review if any other indicators required to be added to the initial model and this review ends up with 2nd version of the performance measurement model. Furthermore, this chapter reviewed previous papers concerned with sustainability practice in petroleum industry or other industry to come up with some determinants that encounter oil refining companies upon implementing the performance measurement theoretical model.

This chapter highlighted the phases of developing the proposed performance measurement theoretical model of sustainability particular to the oil refining sector. It also discussed the theoretical framework that identifies procedures, barriers, benefits and drawbacks of sustainability practices. This theoretical framework was developed to give an overview of the central themes that can help the companies in implementing the proposed performance measurement model. An overview of the chapter outcomes is provided in Figure 3.1.

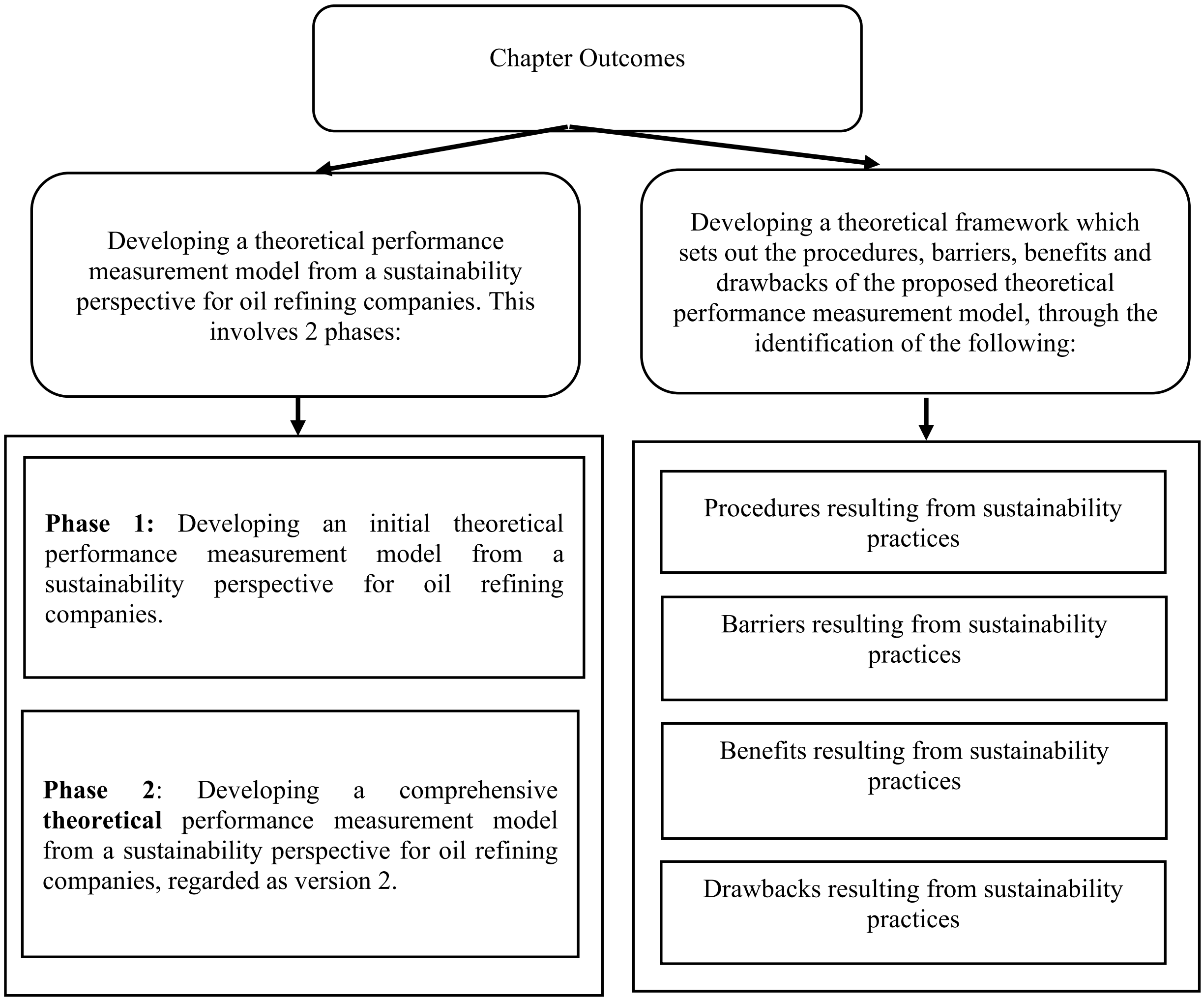

Figure 3.1. Chapter Outcome.

3.2 Developing a Performance Measurement Model of Sustainability Specific to the Oil Refining Sector

This model was developed through two phases. The first phase identified the characteristics of the oil refining sector in order to identify the KPIs specific for the oil refining sector. The end goal of this was to develop an initial theoretical performance measurement model from a sustainability perspective tailored for oil refining companies. The second phase involves the review of prior studies that had tackled the performance measurement models in other industries to extract KPIs defined by these previous studies and to consider if they relevant to be added to the initial model. The end goal of this is to developing a comprehensive theoretical performance measurement model from a sustainability perspective tailored for oil refining companies, which is regarded as the second version of the proposed performance measurement model.

The following section outlined the two phases of development whereby the researcher explained the objective, the steps and the methodology utilised for each phase, all culminating in a proposed version. Additionally, each phase ended up with an analysis of the proposed version. That's to say, the first section states the aim of each phase. Next, the researcher discussed the methodology adopted to review previous studies through identifying the key words and the data base used. Besides, the researcher identified the KPIs extracted from each phase to end up with developing the theoretical framework. Furthermore, each phase is supported with a detailed analysis for each model derived from the respective phase, the analysis points out the key performance indicators the model addresses. Additionally, the analysis assesses how each model effectively tackles the current global challenges encountering the oil refining sector (identified previously in chapter 2).

3.2.1 Phase 1: Developing an Initial Theoretical Performance Measurement Model from a Sustainability Perspective Specific to Oil Refining Companies.

To develop the initial performance measurement theoretical model, the research explored the main aspects of the oil refining industry. These are extracted through the analysis of previous studies exploring the oil refining sector in order to obtain relevant KPIs. KPIs are then allocated to one of the three pillars of sustainability to ensure that the oil refining sector's performance measurement model reflects the sustainability aspects. A measurement was identified for each KPI based on the literature review, that all contribute to the development of an initial theoretical performance measurement model from a sustainability perspective specific to the oil refining sector.

3.2.1.1 The methodology adopted in the development of the initial theoretical performance measurement model

The initial theoretical framework was developed via four stages, namely: summary of sources, synthesis of sources, analysis stage and authorisation text phase. In the first stage, a set of keywords was identified from academic and industrial papers and reports exploring the area of oil refining. To pinpoint the main fields of research in this area, relevant papers published between 2000 and 2022 were reviewed alongside most journals on the area of oil refining. To ensure the credibility of the articles, the review used four online databases (Scopus, Science Direct, Emerald and Business Source Complete). These databases were selected as they are large platforms which cover a wide range of journals and conference papers. The review identified 18 key aspects from the main issues surrounding the oil refining industry. These key aspects were transportation, procurement, technology, risk, forecasting, inventory management, contracting, capacity, green aspects, environmental issues, pricing, health and personal safety, quality, uncertainty, zero discharge, operational excellence, social impacts and logistics activities.

In the second stage, the synthesis source stage was carried out and 12 sectors were excluded due to the limited number of publications examining the characteristics of oil refining. Accordingly, the research considered six aspects to be analysed (i.e., technology, environment, security, transportation, health and personal safety and social). Thirdly, the analysis stage was conducted to critically evaluate the selected papers to help the researcher to identify the KPIs used in previous research papers. Each KPI was then categorised under one of the three pillars of sustainability. Fourthly, the authorisation text phase included identifying the measurements for each KPI. These measurements are included in wide metrics developed for each sustainability pillar (this matrix is attached in the research appendix 4, 5 and 6).

3.2.1.2 Identifying KPIs to develop the initial theoretical performance measurement model

Table 3.1 shows six aspects of the oil refining industry, these are; technology, pricing, environment, security, health and personal security, social impacts and transportation. For each aspect, the researcher presented a definition based on the existing literature in this field. Additionally, the researcher extracted the KPIs and explained the relationship between each indicator and their effects on one of the three pillars (economic, environment and social) of sustainability.

Table 3.1. Identifying KPIs to develop the initial theoretical performance model.

Aspect	Definition	Previous Papers	Aims and Objectives	KPIs and the allocation KPIs among the 3 Pillars of Sustainability
Technology	Technological aspect includes: • Advanced process tools • Software applications • Enterprise Resource planning (ERP) systems • Smarter refinery as modern control systems and wireless technology is applied in oil refineries.	• Borgne & Quintero (2003) • Moro (2003) • Emerson (2010) • ABB (2011)	These studies pointed out some technological solutions, innovations, methods and tools such as process automation, data coordination, data visibility, monitoring control technology, wireless communication solutions and remote operators' technology. These technologies will have a major impact on the way the oil refining companies will operate and lead to oil refining companies becoming smarter. Therefore, technology will improve oil refining companies' overall performance.	Smart refinery (**Economic**)
		• Borgne & Quintero (2003) • Diya'uddeen, Daud & Abdul Azi (2011)	These studies are concerned with green technology (environmental perspective), which is the use of new technologies, skills, methods and processes to conserve the natural environment and crude oil resources. An example of a green technology which these studies are concerned with is the bio-refinery technology, which is a technique used as an alternative for some oil refining processes. The studies highlighted that bio-refinery technology requires less temperature and less energy in comparison with the more common oil refining process as well as being environmentally friendly.	Bio-refinery Technology (**Economic and Environment**)
		• Diya'uddeen et al. (2011)	This study is concerned with green technology. This study discussed some of the means to treat petroleum refinery effluents (wastewater contaminants), which can help oil refining companies to protect the environment.	Refining Effluents (**Environment and Economic**)

Aspect	Definition	Previous Papers	Aims and Objectives	KPIs and the Allocation KPI among the 3 Pillars of Sustainability
Environment	The environmental dimension tackles the potential changes in air, water or soil resulting from the oil refining process.	• Szklo & Schaeffer (2007) • Sánchez et.al (2011)	These studies draw a comparison between producing diesel and gasoline oil (crude oil products) with sulfur content (no treatment in the crude oil feedstock) versus producing diesel and gasoline with low sulfur impurities through the desulphurisation process (crude oil feedstock treatment) which requires more energy and more carbon dioxide emission. These studies adopt different approaches to achieve high quality refined product specifications, improving the crude oil feedstock's quality via several processes, simultaneously with low carbon dioxide, green gases emissions and more energy will be saved.	Crude Oil Feedstock Quality (**Economic and Environment**)
		• Johnson and Coderre (2012) • Rajović, Kiss, Maravić & Bera (2016) • Tahouni, Gholami & Panjeshahi (2016)	These studies are concerned with assessing the gas flaring system in refineries and their relevant environmental impacts. The studies highlight that the gas flaring system maintains safety as it is an alternative to allowing gases to escape. It can, therefore assist in reducing emissions for the process combusts and breaks down the gases compound from the original state to carbon dioxide instead of breaking out to the atmosphere directly.	Flared Gas (**Environment**)
		• Zadakbar et al. (2008) • Duck (2011) • Emam (2015) • Comodi et al. (2016)	These studies discuss some solutions to the non-eco-friendly gas flaring process. The studies review the flare gas recovery solution and its technical application. The studies define the flare gas recovery as the process of recovering waste gases that would typically be flared, so these waste gases can be used as fuel gas somewhere in the refining facility. This will result in less carbon dioxide and greenhouse gas emission. Therefore, flare gas recovery is an attractive method to reduce environmental pollution.	Flared Gas (**Environment**)

Aspect	Definition	Previous Papers	Aims and Objectives	KPIs and the Allocation KPIs among the 3 Pillars of sustainability
Environment (Cont.)		• Bluestein et al. (2010) • Johnson & Coderre (2012)	These studies are concerned with greenhouse gas emission and the global regulations regarding greenhouse gas emission. The studies define greenhouse gas emission as the emission of gases released from the petroleum industry that affect the global warming and contribute to climate changes. In addition, they mention that there is an increase in the demand for energy and the amount of energy the world is consuming. Therefore, the studies point out that the petroleum sector is a significant source of greenhouse gas emission and it is, the petroleum sector's responsibility to mitigate greenhouse gas emissions.	Greenhouse gas emissions **(Environment)**
		• Frynas (2009)	This study is interested in the field of other gas emissions, defining and explaining the origin and levels of other gas emissions. This study describes other gas emissions as those which are similarly produced during oil refining operations, but which do not affect global warming. That is, the oil refining sector has to commit to the global, regional and local rules and regulations to reduce the other gas emissions to be spread in the air which will result in reducing the level of pollution.	Other Gas Emissions (**Environment**)
		• Gossen & Velichkina (2006) • Hu & Zeng (2013) • Yusuf et al. (2013) • Hasani & Nabhani (2016)	These studies highlighted that, aside from air pollution, there is also land and water pollution. The studies explain that land pollution is defined as the pollution which occurs as a result of waste and oil spills generated from different types of oil refining operation. Water pollution arises from oil refining companies' residue discharged in the waterways (seas, rivers, lakes or pounds). Thus, these studies presented that land and water pollution constitute environmental problems, so it is expected to treat companies' residual before discharging in an environmentally friendly manner.	• Discharge to Water (**Environment**) • Waste (**Environment**) • Oil Spills (**Environment**)

Aspect	Definition	Previous Papers	Aims and Objectives	KPIs and Allocation KPI among the 3 Pillars of sustainability
Environment (Cont.)		• International Petroleum Industry Environmental Conservation (2014)	This report is concerned with the steps that are needed from the petroleum sector to conserve energy and to use water wisely as they are precious resources. This report highlights that the most effective way to save energy is energy efficiency and conservation. Energy efficiency is reducing the energy required to provide the same product or service through the introduction of innovative technology. Energy conservation is reducing the use of energy by turning off equipment while using alternative equipment or eliminating unnecessary activities. These steps can make a major contribution to environmental protection and energy security. These reports explain that petroleum production requires a significant amount of fresh water to be used in the process units or in the cooling system. This fresh water can be withdrawn from lakes, rivers and underground water. This water has to be withdrawn in an efficient way to preserve it for consumption.	• Fresh Water (**Environment**) • Fuel (Energy Use) (**Economic and Environment**)
		• Panwar, Kaushik & Kothari (2011) • Hoggett et al. (2014) • Guivarch & Monjon (2017)	These studies reviewed the use of alternative energy sources to reduce environmental pollution. These studies point out that oil refining companies can use renewable technologies and renewable energy sources (solar energy, wind energy, bio-diesel or hydrogen) as fuel, as these are considered clean sources of energy and efficient use of resources. These renewable energy sources are a great opportunity for energy saving, reducing greenhouse gas emissions and pollution. These studies highlight that it is vital for the petroleum sector to switch from crude oil resource to other resources for production of fuel to ensure cleaner oil refining processes and to simultaneously reserve crude oil resources.	• Alternative Energy Sources (Cleaner Oil Refining Processes) (**Environment**)

Aspect	Definition	Previous Papers	Aims and Objectives	KPIs and Allocation KPI among the 3 Pillars of sustainability
Security	The energy security concept is far reaching as it is concerned with risks in economic, environmental, political and technological aspects.	• Winzer (2012) • Martchamadol & Kumar (2012) • Kiriyama & Kajikawa (2014) • Månsson, Johansson& Nilsson (2014) • Foo and Foo (2015) • Azzuni & Breyer (2017)	These studies identified the absence of a clear and comprehensive definition for energy security, so energy security is regarded as an umbrella for many different aspects. There is a common concept behind all energy security definitions observed by this study, which is the ability of an energy system to react properly sudden changes, uncertainty or risks (political, environmental, economic, technological).	Energy Security Against Uncertainty and Risk (**Economic**)
		• Hoggett et al. (2014) • Guivarch & Monjon (2017)	These papers discuss the relationship between low carbon transmission and energy security using renewable energy resources; it is observed that there is a positive relationship between using renewable energy resources and energy security. The relation is in terms of energy saving, greenhouse gas emission reduction and economic benefits.	Renewable Energy Sources (Alternative Energy Sources) (**Environment**)
Transportation	Transportation is the movement of crude oil from the source of supply (like well heads or platforms) to the consumer. The method used to carry out the crude oil or refined products depends on the amount being moved and the place being moved to, which can be via rail, cars, trucks, tanker vessels and through pipelines.	• Hasan, Ghannam and Esmail (2010) • Martínez-Palou et al. (2011) • Santos, Loh, Bannwart & Trevisan (2014)	These studies are interested in the area of quality of crude. They point out that oil quality is currently declining as most oil reserves have higher sulphur and metal contents. Thus, this type of crude oil is defined as heavy crude oil which represents crude oil viscosity. Heavy crude oil is characterised by high viscosity that renders oil flow through pipelines (not pumped easily through pipelines). Subsequently, oil transportation has become a complex and highly technical operation, which requires an efficient means of transferring heavy crude oil from head wells to refineries. These papers attempt to use different methods to reduce the viscosity of heavy crude oils, like blending crude oil with light crude oil. The studies state that this is the most appropriate and favourable method.	Crude oil Feedstock Quality (**Economic and Environment**

Aspect	Definition	Previous Paper	Aims and Objectives	KPIs and Allocation KPI among the 3 Pillars of sustainability
Health and personal safety	Health and personal safety encompasses creating and maintaining safe and healthy working environments.	• Bjerkan (2010) • Grier & Sidnell (2010) • WIPRO (2013) • Eyayo (2014) • International Finance Corporation (IFC) (2016)	These studies are concerned with occupational health and safety risk management. This field can improve physical (workforce's health) and mental (workforce's awareness) progress. The study pointed out that the risk management process is assessed through internal and external audits to assess risk which can impact on the occupational health and safety. Thus, with respect to carrying out an effective risk management process, it is necessary for companies to have a clear understanding of the legal context, concepts, risk analysis, assessment and control processes. In addition, companies have to record occupational injuries and illness risks across the workplace. Having such records will help to form guidelines to make improvements and to prevent or reduce the risks from recurring. Hence, oil refining companies need to regularly identify and assess occupational health and safety risks within the workplace and to ensure that workers are aware of risks.	Occupational Health and Safety (**Social**)
		• American Petroleum Institute (2017) • Kumar, Karthick, Bhuvaneswari & Nandhini (2017)	These papers discussed product stewardship since petroleum products are classified as hazardous. Thus, oil refining companies are accountable to maintain awareness of the hazards associated with the product through providing product stewardship which provides general health, safety and environmental information about the products This means that communication can be established and a safety data sheet can be prepared, which sets out useful information on the hazards associated with specific products and the emergency measures required in case of an accident.	Product Stewardship (**Social**)

Aspect	Definition	Previous Papers	Aims and Objectives	KPIs and Allocation KPI among the 3 Pillars of sustainability
Social	There are many different definitions of social businesses and they can be viewed from several different angles (such as local procurement, local hiring practices, social investment, workforce health and development). These aspects can contribute to social wellbeing.	• International Petroleum Industry Environmental Conservation (2011) • Esteves et al. (2013) • International Petroleum Industry Environmental Conservation (2016) • RTENN (2016) • Olawuyi (2017)	These studies are concerned with defining the concepts of local procurement and local hiring. These studies pointed out that local procurement means the companies procure goods and services from companies residing in the host country. Local hiring means the employment of national workforce. These papers point out that These studies highlighted that local procurement and hiring is indicated through complying with host governments rules and legislation which set the percentage of local procurement and hiring practice. This has led to significant social and economic development for the host countries.	• Local content (**Economic**) Local Procurement (**Social**)
		• Anderson & Bieniaszewska (2005) • IPIECA (2008)	These papers seek to explain social investment activities. These studies point out that companies have the responsibility to implement social and community investment programs in areas where they operate to build a bigger and stronger society. The studies highlight that social activities do not directly affect the company's profit, but these activities can provide social wellbeing.	• Social Investment (**Social**)
		• Asad, El-Emadi, & Marquardt (2007) • Carew, Ogletree, Gonzalez & Bozick (2017)	These studies are based on gaps in performance, basic education, language and practical experience to create the right kind of training. This means there are different needs of training for each type of employee. These papers pointed out that implementing powerful training and development programs will increase workers' skills and productivity as well as employees' loyalty. This will allow companies to accomplish their objectives and goals effectively.	• Workforce Development

Figure 3.2 sets out the initial performance measurement model of sustainability for oil refining industry. The figure represents each KPI allocated under one of the three pillars of sustainability, as well as the measurement for each KPI (these measurements will be identified Appendix 4, 5 and 6).

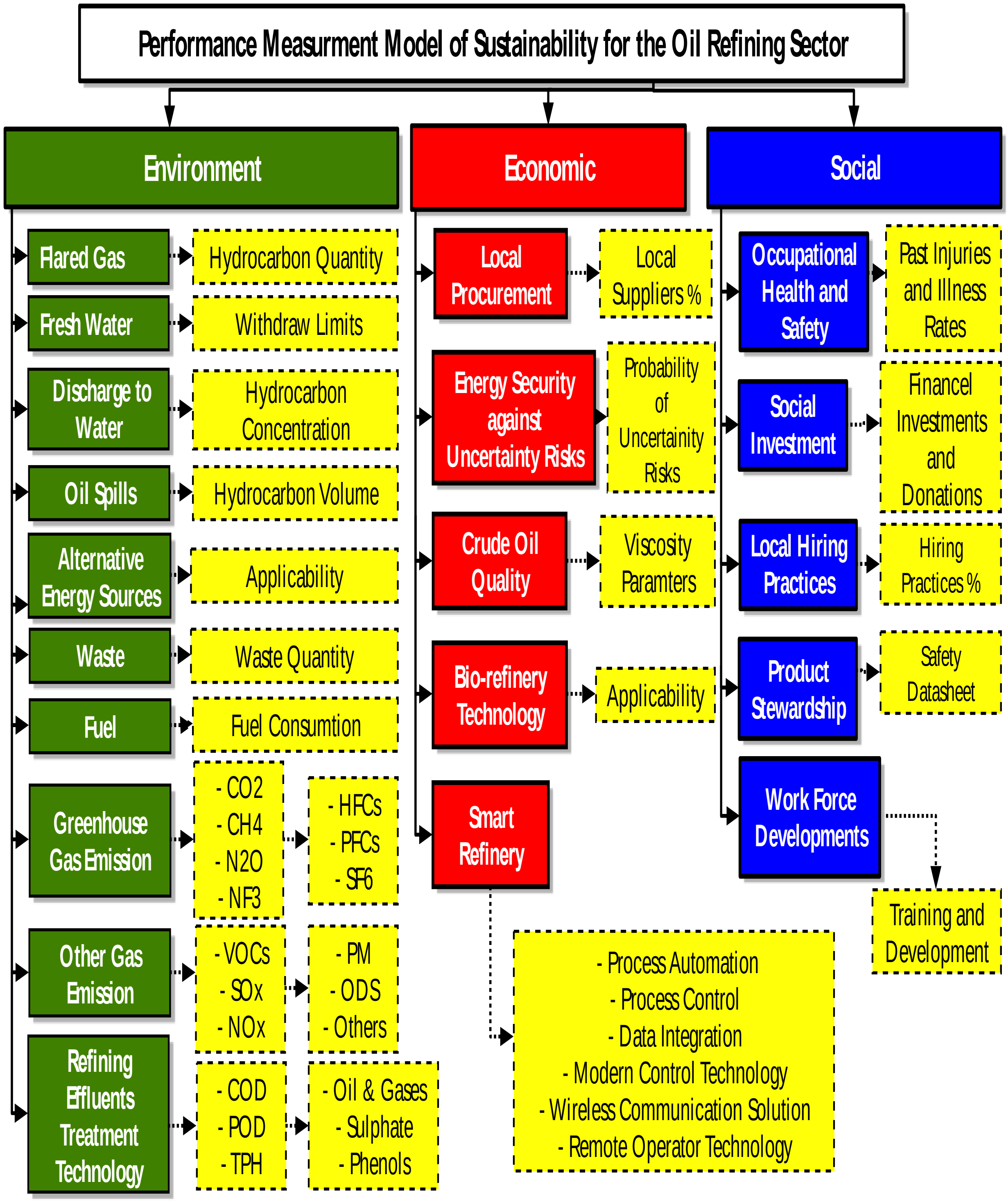

Figure 3.2. The initial performance measurement model of sustainability specific to the oil refining sector.

3.2.1.3 Evaluating the effectiveness of the initial performance measurement model in addressing global challenges

This section will compare the key indicators of the initial model and the identified current global challenges of the oil refining sector to evaluate the effectiveness of the initial performance measurement models, this will be illustrated in the following Table 3.2.

Table 3.2 Evaluating the effectiveness of the initial performance measurement model in addressing global challenges.

No.		Initial Model's KPIs	
		Addressed	Not Addressed
Environmental			
1	Air emission reduction	√	
2	Recycling of wastewater	√	
3	Recycling of solid wastes	√	
4	Production of environmentally friendly products		√
5	Energy preservation in all oil refining processes		√
6	Implementing new projects concerning environmentally friendly practices		√
7	Protecting the ecosystem		√
Economic			
8	Complying with International standards	√	
9	Staying up to date with the latest developments and innovation	√	
10	Data integration		√
11	Risk management processes	√	
12	Building relationships with governments		√
13	Investing in operations, processes, facilities, equipment and employees		√
Social			
14	Social responsibility	Not all social responsibilities are addressed as employee rights, company-community relations, business ethics and employee recognition and others which were listed in the social responsibility definition	
15	HAZOP		√

As shown by the above table, which compares the key indicators of the initial model and the identified current global challenges of the oil refining sector, it is evident that the initial model was not able to address the majority of the identified global challenges. Further development of the initial model was therefore undertaken to ensure most of the challenges were met. To put it simply, it can be realised from the previous table that the initial model's key performance indicators, which are derived from previous studies focusing on technical issues in oil refining, do not have the ability to sufficiently cover all of the challenges encountered by the industry. Such a realisation highlights and reinforces the existing research gap identified in Chapter 2 which embedded in having insufficient performance measurement models that are capable of integrating the sustainability theme, incorporating the distinctive features of the oil refining sector and addressing the current global challenges and trends. Consequently, there is an urgent necessity for developing a comprehensive model that encompasses all the previously mentioned dimensions. In order to do so, the research in hand will review previous studies which tackled performance measurements of sustainability for other industries. This is expected to be fruitful with regard to gaining further insights to extract more KPIs introduced by previous studies.

3.2.2 Phase 2: Developing a Comprehensive Theoretical Performance Measurement Model from the Sustainability Perspective Tailored for Oil Refining Companies

The previous discussion highlighted the limitation of the initial model. This led to Phase 2, whereby previous papers exploring performance measurement models of sustainability in other industries are reviewed. This will enable extraction of relevant KPIs as defined in previous studies. These KPIs can then be added to the initial model to ensure more of the oil refining characteristics and current global challenges of the oil refining industry were addressed. The extracted KPIs are attached to the previous indicators which were set in the initial developed model. This culminated in the development of a comprehensive performance measurement model of sustainability specific to the oil refining industry, which is regarded as version 2.

3.2.2.1 The methodology adopted in the development of the comprehensive theoretical performance measurement model

The comprehensive theoretical model was developed via four stages, namely: summary of sources, synthesis of sources, analysis stage and authorisation phase. Firstly, nine keywords were extracted from previous SC performance measurement models drawn on in the literature review. These keywords are: performance measurement models of sustainability, performance metrics of sustainability, sustainable performance measurement models, sustainable indicators, sustainable performance measurement index, sustainable KPIs. Secondly, literature review also enabled extraction of KPI for each aspect which were then categorised under one of the three pillars of sustainability in order to ensure that the selected KPIs reflect the sustainability perspective.

Fourthly, this research provides a measurement for each KPI. The provided measurements were apportioned based on the literature review and are summarised in wide matrix in Appendix 4, 5 and 6. The following sections outline the methods used in identifying the relevant KPIs for the comprehensive theoretical performance model.

3.2.2.2 Identifying KPIs for the comprehensive performance theoretical model

Table 3.3 shows the previous papers that addressed performance measurement models of sustainability in other industries and the KPIs set in these papers. The table then identified which of the three pillars of sustainability each KPI is categorised under by the researcher (economic, environment and social).

Table 3.3 Identifying KPIs for the comprehensive performance theoretical model.

No.	Research Paper and its Objectives	KPIs and their respective categorisation under the 3 Pillars of Sustainability (Economic, Environment, or Social)
1	Ahi, Jaber & Searcy (2016) examined several KPIs that they identified from previous studies to assess sustainable SC performance. The authors concur that incomprehensive frameworks and models for assessing sustainable SC.	• Energy consumption (**Economic**) • Quantity of solid wastes (**Environment**) • Sustainable return on investment (**Economic**) • Injury and illness incidents records (**Social**) • Company-community relations (**Social**)
2	Boukherroub, Ruiz, Guinet & Fondrevelle (2015) proposed a technique called the weigh goal programming technique. This developed technique can be used to link sustainability performance to SC decisions. From a practical perspective, this approach can be used to facilitate decision making to help companies choose the appropriate SC operation plan to achieve its goals.	• Emission reduction (**Environment**) • Reduction of solid wastes (**Environment**) • Minimum energy consumption (**Environment**) • Environment policy, strategy and targets (**Environment**) • ISO 14001 certification (**Environment**) • Community development (**Social**)
3	Ramezankhani, Torabi & Vahidi (2018) are concerned with the automotive sector and examined several KPIs in this sector, through using a dynamic network data analysis for sustainable SC performance assessment.	• Injury and illness incidents (**Social**) • Appropriate physical working condition (**Social**) • Appropriate working hours (**Social**) • Engineering controls, personnel protective equipment and clothes (**Social**) • Research and development (**Economic**) • Process quality (**Economic**) • Product quality (**Economic**) • Safety inspection Audit (**Social**)
4	Gong, Simpson, Koh & Tan (2018) identified and analysed some sustainable metrics which were set in previous studies. This study highlighted that there are still incomprehensive sustainability performance metrics. In addition, the paper pointed out a gap between the expected sustainability implementation and its implementation in reality.	• Quantity of recycled/ reused/recovered solid wastes (**Economic**) • Environmentally friendly practice (**Environment**) • Safety inspection audit (**Social**) • Emergency plan (**Social**) • Safety orientation and control (**Social**) • Local hiring practice (**Social**)

No.	Research Paper and its Objectives	KPIs and their respective categorisation under the 3 Pillars of Sustainability (Economic, Environment, or Social)
5	Erol, Sencer & Sari (2011) developed a sustainable SC measurement framework to evaluate sustainable SC performance. The framework was based on fuzzy entropy and fuzzy multi-attribute and was tested using data from middle-sised Turkish grocery retailers.	• Fresh water consumption (**Economic**) • Waste minimisation (**Environment**) • Renewable resources (**Environment**) • Energy consumption (**Environment**) • ISO certification (**Environment, Economic and Social**) • Soft skills development and training (**Social**) • Worker motivation and compensation (**Social**) • Annual employee turnover (**Social**) • Diversity and equal opportunity (**Social**) • Annual recorded injuries (**Social**) • Facilities, equipment and maintenance (**Economic**)
6	Ahi & Searcy (2015) conducted a systematic literature review to identify and analyse the metrics addressed in green SC and sustainable SCs. The study highlights that the sustainable SC management area requires new metrics to be developed.	• Greenhouse gas emissions (**Environment**) • Quantity of recycled/reused/recovered water (**Environment**) • Industry's Association member (**Environment**) • Atmospheric acidification (**Environment**) • Quantity of oil spills (**Environment**) • Environment audits and assessment (**Environment**) • Employee environment training and awareness (**Environment**) • Discharge to water (**Environment**) • Reduction of air emission (**Environment**) • Solid wastes (**Environment**) • Quantity of recycled/reused/recovered solid wastes (**Environment**) • Capital employed (**Economic**) • Subsidies (**Economic**) • Fringe benefits (**Social**) • Corruption/bribery policy (**Social)** • Business codes (**Social)** • Employee engagement (**Social**) • Employee representative on corporate board of directors (**Social**)

No.	Research Paper and its Objectives	KPIs and their respective categorisation under the 3 Pillars of Sustainability (Economic, Environment, or Social)
7	Rajeev, Pati, Padhi & Govindan (2017) conducted a comprehensive literature review, between 2000 to 2015, to explore the evolution of sustainable SC measurements and to identify some sustainable performance metrics. They concluded that sustainability issues emerged in line with trends across industries and economies. Such research recommends further sustainable SC measurement-based studies, claiming they are vital in addressing sustainable SC performance measurement for many industries.	• Appropriate physical working condition (**Social**) • Safety inspection **(Social)** • Safety warning signs **(Social)** • Workplace first aids **(Social)** • Community funding support **(Social)** • Capital employed (**Economic**) • Annual employee turnover (**Social**) • Diversity and equal opportunities (**Social**) • Community funding and support (**Social**) • Product stewardship (**Social**) • Corruption/bribery policy (**Social**) • Business codes (**Social**) • Safety inspection audit (**Social**) • Quantity of recycle/reused/recovered solid wastes (**Environment**)
8	Delai & Takahashi (2011) pointed out that the models utilised in the previous papers focused on only one or two dimensions of sustainability, whereas other dimensions with equal significance were overlooked. This paper seeks to gather most of the KPIs from various previous studies which were concerned with different industries and context and to set these KPIs in one study.	• Greenhouse gas emissions (**Environment**) • Fresh water consumption (**Economic**) • Quantity of recycle/reused/recovered solid wastes (**Environment**) • Oil spills removal (**Environment**) • Renewable energy sources (**Environment**) • Environment audits and assessment (**Environment**) • Soft skills development and training (**Social**) • Quantity of oil spills (**Environment**)
9	Andalib & Soltanmohammadi (2019) were interested in reviewing previous studies to investigate the drivers of sustainable SC practice and to identify the sustainble metrics used in previous studies. The study also explores the escalating demand for sustainable SC measurements, citing these as the global industry, the negative effects on society and environmental concerns.	• Employee engagement (**Social**) • Capital employed (**Economic**) • Company- community relations (**Social**) • Renewable energy sources (**Environment**) • Environment audits and assessment (**Environment)** • Business codes of conduct (**Social**)
10	Tajbakhsh & Hassini (2015) analysed previous studies interested in sustainable SC performance measurements to identify some sustainable performance metrics. They also identified some KPIs and pointed out that there are limited studies that address social sustainability measures. The authors also stated there was a lack of studies focusing on the healthcare and pharmaceutical sectors.	• Greenhouse gas emissions (**Environment**) • Energy consumption (**Environment**) • Process quality (**Economic**) • Crude oil emission reduction (**Environment**) • Accessible job opportunities (**Social**) • Product quality (**Economic**)

The framework for the proposed comprehensive performance measurement model of sustainability was divided into three models because it was challenging to address all the indicators in a single model. This was set out in Figure 3.3, whereby the first level represented one of the three dimensions of sustainability (environment, economic and social), the second level represented the themes for each dimension and the third level represented the KPIs for each theme.

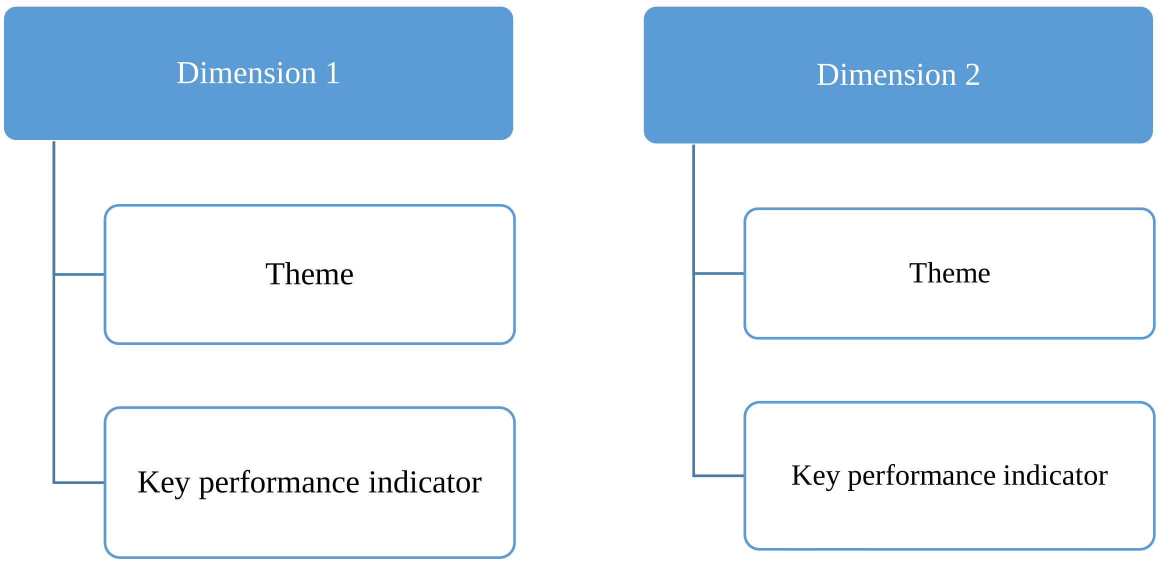

Figure 3.3. Proposed Performance Measurement Model structure.

Figure 3.4 below illustrates a comprehensive performance measurement model of sustainability tailored for the oil refining industry. Figure 3.5 shows an environmentally sustainable model, Figure 3.6 presents a sustainable economic model and finally, Figure 3.7 represents the socially sustainable model.

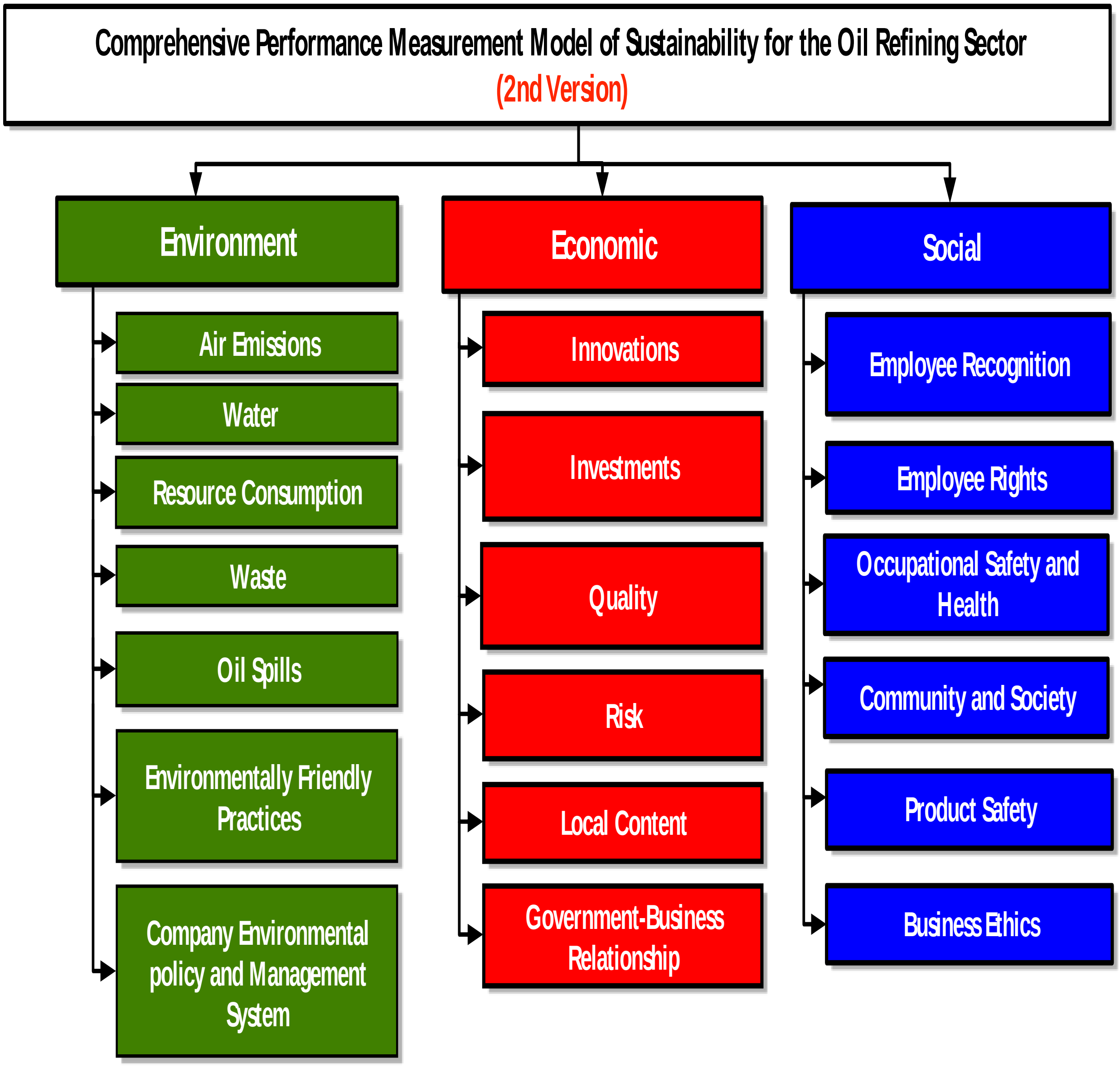

Figure 3.4. Comprehensive performance measurement model of sustainability for the oil refining sector.

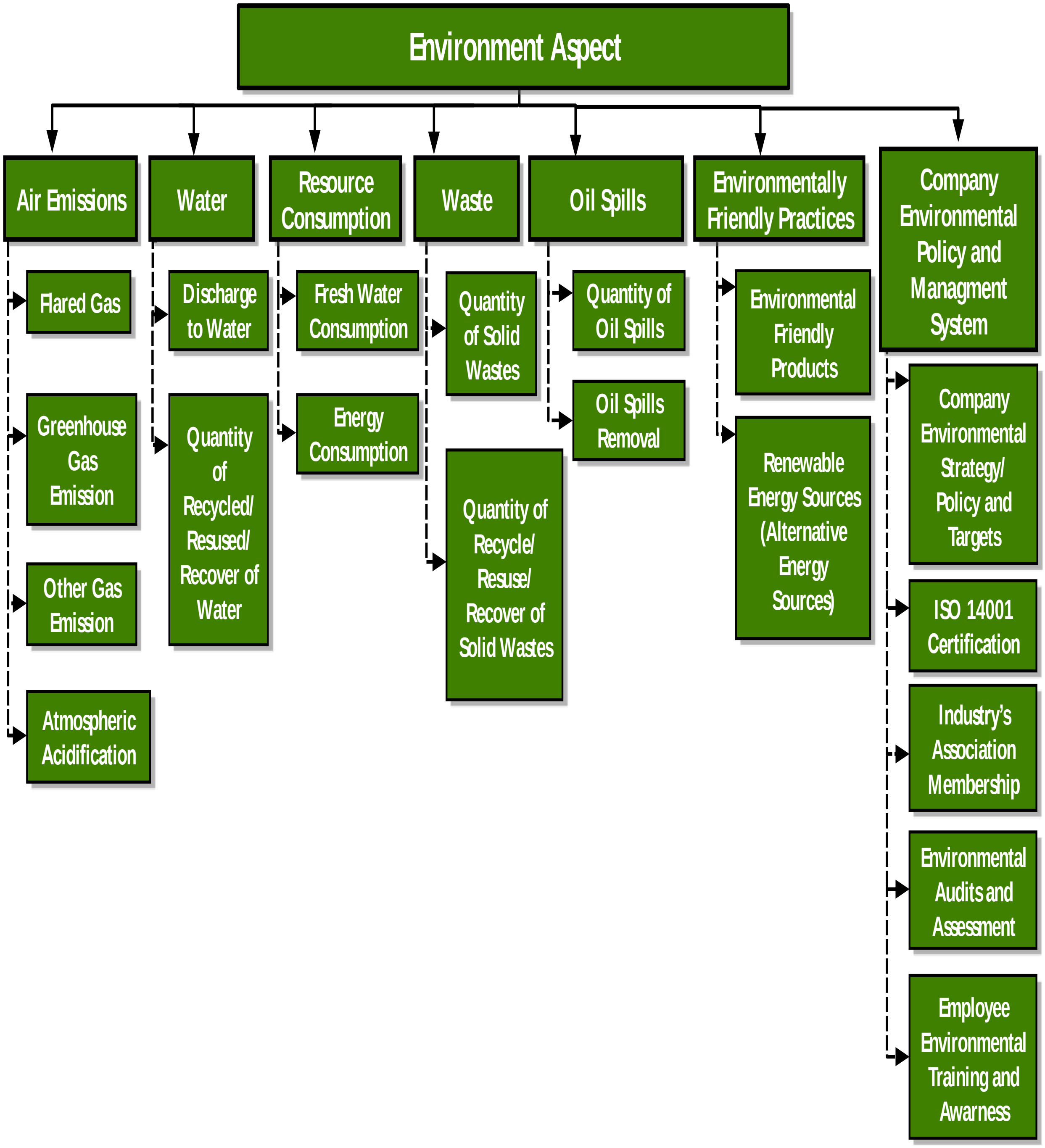

Figure 3.5. Environmental performance measurment model of sustainbility for the oil refining sectoion (2nd version).

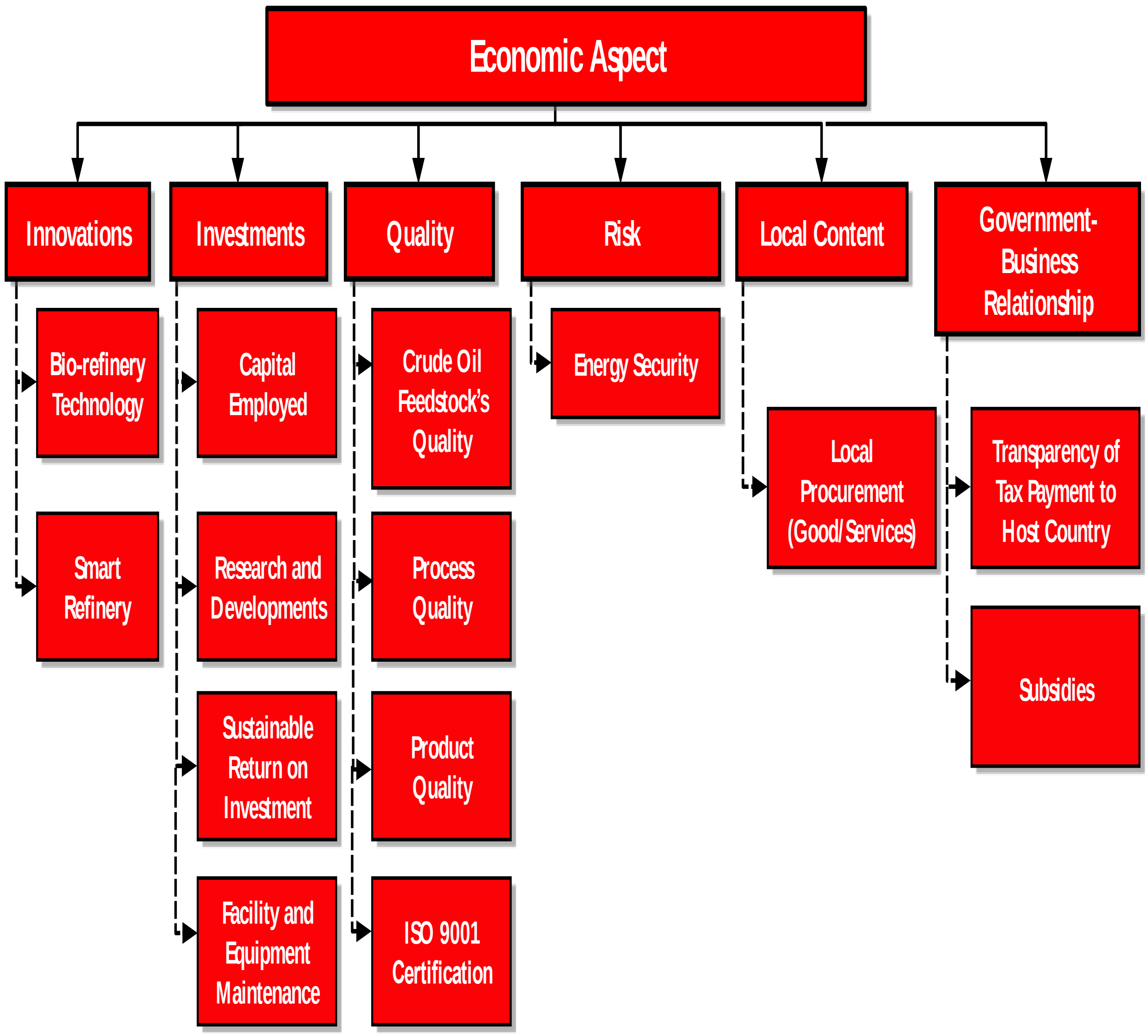

Figure 3.6. Economic performance measurment model of sustainbility for the oil refining sector (2nd version).

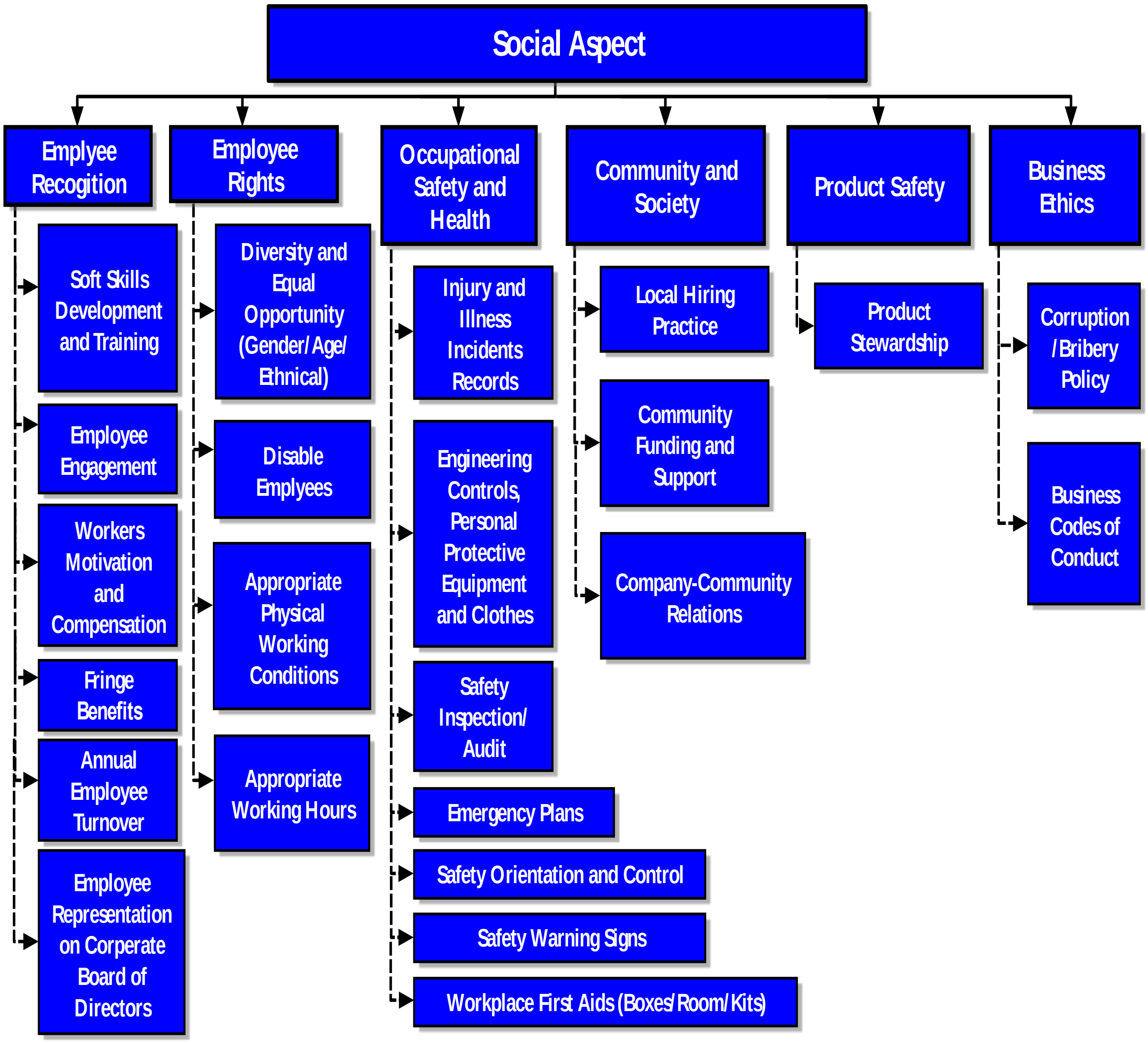

Figure 3.7. Social performance measurment model of sustainbility for the oil refining sector (2nd version).

3.2.2.3 Evaluating the effectiveness of the 2nd version of the proposed model for addressing global challenges

This section compared the key indicators of the second version of the proposed model and the identified current global challenges of the oil refining sector to evaluate the effectiveness of the 2nd version of performance measurement models; this is illustrated in the following Table 3.4.

Table 3.4 Evaluating the effectiveness of the 2nd version of the proposed model for addressing the global challenges.

No.		Initial Model's KPIs	
		Addressed	Not Addressed
Environmental			
1	Air emission reduction	√	
2	Recycling of wastewater	√	
3	Recycling of solid wastes	√	
4	Production of environmentally friendly products	√	
5	Energy preservation in all oil refining processes		√
6	Implementing new projects concerning environmentally friendly practices		√
7	Protecting ecosystem		√
Economic			
8	Complying with International standards	√	
9	Staying up to date with the latest developments and innovation	√	
10	Data integration		√
11	Risk management processes	√	
12	Building relationships with government	√	
13	Investing in operation, process, facilities, equipment and employee	√	
Social			
14	Social responsibility	Not all the social responsibilities are addressed as safety orientation and advanced safety training and Loss time injury frequency rate and others which were listed in the social responsibility definition.	
15	HAZOP		√

As demonstrated in the above table, when comparing the KPIs in the 2nd version of the proposed model with the global challenges facing oil refining industry, it appeared that most challenges have been addressed. However, there are still some challenges, which were not yet dealt with and this accounts for approximately 30 % of the indicators. This means that around 70 % of KPIs were included in the second version of the proposed model.

KPIs which were not capable of addressing were about 52 % of the challenges. Therefore, there is 22 % improvement that is significant. Consequently, the research continued to modify the proposed model to ensure it is able to address more of the challenges facing the oil refinery sector. Further enhancement of the model is achieved through carrying out focus groups and online surveys to gather opinions from the oil refining practitioners. Participants were asked to review the proposed model and they were provided with the opportunity to modify, add, or exclude any of the KPIs. This stage was crucial for validating and extending the proposed model in alignment with the industry and global contexts.

3.3 Developing the Theoretical Framework Representing the Procedures, Barriers, Benefits and Drawbacks of Sustainability Practice

The purpose of this research is to develop a comprehensive performance measurement model of sustainability specific to the oil refining sector. In line with this, the study aimed at providing oil refining companies with guidelines in the form of procedures, benefits, barriers and drawbacks that companies may encounter upon implementing the proposed model. These guidelines were expected to be a foundation for oil refining companies to refer to in consideration of the proposed model. Previous studies that explored the procedures, benefits barriers and drawbacks of sustainability practice in the petroleum industry, or other industries, were drawn upon to create the theoretical framework.

3.3.1 The Methodology Adopted to Develop the Theoretical Framework of Procedures, Barriers, Benefits and Drawbacks Arising from Sustainability Practices

From examination of previous research, a list of keywords were formulated including; procedures (preparedness) required for sustainability practice, procedures (or preparedness) required for sustainability practice in the petroleum industry, barriers arising from sustainability practice, barriers arising from sustainability practice in the petroleum industry, benefits (or advantages) of sustainability practice, benefits (or advantages) of sustainability practice in the petroleum industry, drawbacks (or disadvantages) of sustainability practice and drawbacks (or disadvantages) of sustainability practice in the petroleum industry.

3.3.2 Identifying the Procedures, Barriers, Benefits and Drawbacks Resulted from Sustainability Practice

Table 3.5 outlines the previous studies exploring the procedures, barriers, benefits and drawbacks arising from sustainability practice in general or in the petroleum industry.

Table 3.5 Identifying the procedures, barriers, benefits and drawbacks arising from sustainability practice.

Procedure/Barriers/Benefits/Drawbacks	Research Paper and its Objectives	Themes of Procedure/Barriers/Benefits/Drawbacks
Procedures	Negro & Vargas (2019) identified some measures of preparedness for sustainability practice. These measures are required for companies who are willing to integrate sustainability.	• Creating awareness • Assuring two-way communication between leaders and employees • Encouraging employee autonomy • Ensuring that companies have necessary resources for sustainability practice
Barriers	Mahmood, et al (2019) pointed out that there is insufficient research examining the barriers likely to emerge as a result of sustainability practice. As a result, the study examines the barriers which companies encounter from adopting sustainability practices by conducting semi- structured interviews with company managers located in Pakistan.	• Lack of awareness • Lack of resources • Lack of staff training and skills
	Costache, et al (2021) identified some obstacles which can impede integrating sustainability practice in a company's goals and objectives. The study identified these barriers by reviewing previous studies and conducting semi- structured interviews with company managers in Romania to gather their perception of the barriers which can be facing companies as a result of adopting sustainability practices.	• Limited financial resources • Limited human resources • Too expensive • Employee resistance
	Lehner & Eyssen (2017) highlighted some barriers which of sustainability practice. These were gathered through in-depth interviews with managers, owners and employees at different hierarchical levels within three companies to identify their perceptions of the barriers which can hinder effective implementation of sustainability practices.	• Limited financial resources • Limited human resources • Lack of awareness • Employee resistance • Lack of sustainability knowledge • Lack of time
Barrier (Cont.)	Aghelie (2017) indicated, by reviewing previous research, some of the obstacles which companies can experience in implementing sustainability practices.	• Improper communication to support sustainability practices • Lack of technical expertise to support sustainability practices • Lack of government support and enforcement • High initial cost

Procedure/Barriers/Benefits/Drawbacks	Research Paper and its Objectives	Themes of Procedure/Barriers/Benefits/Drawbacks
Barrier (cont.)		• Difficulty in defining the sustainability performance matrix • Limited available training courses/consultancy provided by government • Lack of awareness
	Nordin et al. (2014) outlined some barriers in reviewing previous literature and surveying company managers in Malaysia to gather their perspectives.	• Lack of awareness • Improper communication to support sustainability practices • Lack of government support and enforcement • High initial cost
	Ageron et al. (2012) collected data via in-depth interviews with different managers from French companies. This research aimed to identify the barriers which hinder French companies from implementing sustainability.	1. Lack of awareness 2. Limited financial resources 3. Too expensive 4. Employee resistance 5. High initial cost • Difficulty in SC configuration
	Stewart et al. (2016) developed metrics of the barriers which impede companies from sustainability implementation. These barriers were gathered from reviewing previous research.	6. Lack of awareness 7. Limited financial resources 8. Lack of technical expertise 9. Lack of strategy 10. Difficulty in defining sustainability performance matrix
	George et al. (2016) identified barriers which can obstruct sustainability integration in performance management systems in oil and gas companies. The study involved semi-structured interviews with managers in four oil and gas companies to investigate the barriers which can hinder oil and gas companies from sustainability practices.	• Lack of staff training and skills • Lack of sustainability knowledge • Improper communication to support sustainability practices. • Lack of a formal structure to adopt sustainability practice. • Difficulty in changing managers' mindsets 11. Difficulty in restructuring company strategies towards sustainability practice

Procedure/Barriers/Benefits/Drawbacks	Research Paper and Paper objective	Themes of Procedure/Barriers/Benefits/Drawbacks
Benefits	Hamzah & Hasim (2019) conducted semi-structured interviews with top-level managers to gather their perspectives on the benefits for companies in integrating sustainability into their vision, goals and strategies.	• Preserving and conserving environment • Increasing companies' competitive advantage • Improving a company's reputation • Reducing operating costs
	Bello (2020) considered the gains which can be achieved by companies in adopting sustainability practices.	• Improving a company's reputation • Reducing operating costs • Improving companies' productivity • Increasing companies' growth and profitability • Environmental incidents •
	Niţă & Ştefea (2014) pointed out advantages to companies in adopting sustainability.	• Improving the company's reputation • Attracting and retaining high quality employees • Reducing environmental incidents • Increasing employee safety • Reducing waste
	Ageron et al. (2012) explored the benefits for companies developing sustainability initiatives. The study collected data through interviews with managers from French companies	• Reducing operating costs • Increasing customer satisfaction • Increasing quality
	Hristov & Chirico (2019) demonstrated how positively sustainability practice can affect a company's performance. The study identified benefits in sustainability adoption.	• Reducing operating costs • Increasing customer satisfaction • Increasing quality • Reducing greenhouse gas emissions
Drawbacks	Stewart et al. (2016), and Wan Ahmad et al. (2016) pointed out that few papers have focused on addressing the drawbacks caused from sustainability practices.	• Companies' commitment

While this table identified the procedures, barriers, benefits and drawbacks of sustainability implementation, it is important to note that there aren't many studies focusing on identifying these aspects, particularly the procedures and drawbacks aspects. There are, however, some studies that identified the barriers obstructing companies from integrating sustainability practice in their vision, goals and strategies. Each study listed above utilised different methodologies in different settings to recognise the barriers that might prevent companies from adopting sustainability. There are some barriers that were more prevalent in the previous papers, namely lack of awareness, limited financial resources, employee resistance, lack of knowledge on sustainability, high initial costs, limited training available and consultancy provided by their respective governments. The benefits frequently cited in the studies are: lower operating costs, improving company reputation, increasing quality, increasing employee safety and preserving and conserving the environment.

3.4 Summary

Chapter 2 identified the research gap, highlighting that there are insufficient performance measurement models capable of incorporating the sustainability theme alongside the main properties of the oil refining sector and addressing global challenges. Following on from this, this research attempts to bridge the research gap by developing a performance measurement model from a sustainability perspective specific to the oil refining sector. This chapter, therefore set out an initial theoretical performance measurement model developed through examining the technical aspects relevant to the oil refining sector as discussed in previous studies. Given the scarcity of relevant research papers and the fact that the initial model did not address most of the current global challenges facing the oil refining sector, the researcher also referred to indicators of sustainability in other industries. This was the background for developing the comprehensive theoretical performance measurement model of sustainability for the oil refining sector. After assessment and refinement of the first model, the second version was developed.

On analysis of the second version, approximately 30% of the challenges facing the oil sector were still not adequately covered in order to address all the current global challenges facing the oil refining sector. The second version, therefore provided an opportunity to enhance its capability and allow it to fully address the current global challenges and to do so more effectively. Equally, this research attempted to provide oil refining companies with some foundations in the form of anticipated procedures, barriers, benefits and drawbacks that oil refining companies can expect upon adopting the developed theoretical performance measurement model, forming the theoretical framework to underpin effective practice of the developed model. This research reviewed the previous papers which explored the procedures, barriers, benefits and drawbacks arising from sustainability practice.

Chapter 4: Research Methodology

4.1 Introduction

This chapter served as a guide to understand the research methodology used in this study by providing a comprehensive overview of the research design, research philosophy, research strategy, research approach and research phases. This included the provision of insights into the methods and techniques used in conducting this research. This chapter began with a description and justification of the research design. Next, the chapter defined the research philosophy, approach and strategy followed with a discussion and explanation of the research phases. Finally, the chapter identified the research ethics adopted in this research.

The continuation of this chapter was organised as follows. The next section outlined the research design. Section 4.3 defined the research paradigms that will identify the research philosophy, strategy and approach to determine the most convenient ones adopted in this study. Section 4.4 presented the research phases, through clarifying the research methods, tools, sampling size and criteria, data collection and analysis applied for each phase of this study. Section 4.5 highlighted the procedures followed to achieve data quality and validity. Section 4.6 pointed out the ethical aspects to be considered in this research. Finally, section 4.7 presented a summary for the whole chapter, followed by interpreting the aims of the next chapter.

4.2 Research Design

The following section presented each research objective, in order to highlight the chosen research methods, as well as any alternative methods considered.

Objective 1: Assessing the ability of existing performance measurement models in relation to sustainability integration and addressing the challenges facing the refining industry.

- Meeting Objective 1 involved a mixed method approach, combining the literature review and exploratory interviews, to identify the main challenges facing the oil refining industry and to evaluate how effectively current performance measurement models address these challenges. The literature review was selected as a research method to provide a foundation based upon existing knowledge. In addition to the literature review, exploratory interviews with oil refining industry practitioners were chosen as a technique to gain the perceptions of people actually using or implementing these models in real-world settings, thus helping the researcher in determining their practical applications, strengths, weaknesses and limitations. In order to achieve better understanding the issues and assessing the efficiency of the current performance measurement models from the perspective of the practitioners, exploratory interviews were conducted.

- In terms of alternative approaches, focusing only on a literature review has benefits as it enables the researcher to have a thorough analysis of the existing knowledge and provides a solid foundation for the research topic. Additionally, compared to conducting interviews or gathering primary data, it can save time and resources. However, the researcher was constrained to the data found in the published literature if they exclusively relied on a literature review. Thus, while a literature review is still valuable to research, exploratory interviews with practitioners can be used to capture the real-world points of view and experiences of those who are directly involved in the oil refining sector and eventually deepening and enriching understanding of the research issue.
- The integration of both literature review and exploratory interviews as research methods can significantly enhance the effectiveness of addressing the study objectives, responding to the research question and eventually fulfilling the research aim.

Objective 2: Developing a theoretical performance measurement framework tailored for the unique needs and challenges of the oil refining sector

- A literature review was selected as the research method to accomplish the second objective and respond to the second research questions. The literature review method was chosen because it can give a thorough grasp of the models and techniques already in use for assessing performance from a sustainability perspective. It enabled the researcher to obtain an in-depth understanding of the elements of earlier models, that can help the researcher choose the elements that work best in the suggested model. As a result, the theoretical model was built on the basis of the literature analysis tailored for the specific characteristics and challenges of the oil refining sector.
- The Delphi method was an alternative research method that was taken into account for addressing the second objective. The Delphi method is a structured communication process that involves gathering expert viewpoints through conducting numerous rounds of

questionnaires. To confirm the reliability and validity of the elements chosen for the proposed model, many rounds must be conducted. The Delphi technique can be useful in verifying the elements chosen for the proposed model, but for a number of reasons, it may not be practical to use in the oil refining context. Firstly, this is due to the sensitive nature of its activities. The oil refining business operates under tight confidentiality and security procedures and therefore sharing and exchanging data through numerous rounds of the Delphi technique may prove challenging in terms of maintaining confidentiality. In addition, because of the complexity of the operations in the oil refining sector, it is challenging to involve industry managers in different rounds of the Delphi process because they are often at maximum workload and have time limitations. Due to such restrictions, choosing the Delphi technique to validate the selected elements chosen for the proposed model is unfeasible.

- Due to the limitations associated with the use of the Delphi method in the oil refining sector, other approaches were adopted to overcome these limitations and successfully achieve the study objectives. The selected approaches attempted to perform the same function as the Delphi technique, namely, to validate the proposed model. To demonstrate the applicability of the proposed model, an empirical study using a focus group questionnaire on the Egyptian oil refining industry was carried out. Additionally, a global online survey was distributed to assess the applicability of the proposed model. These methods allow collecting the insights and opinions from industry practitioners, validating the elements chosen for the proposed model and ensuring the model's applicability in a real-world context.

Objective 3: An empirical study conducted via focus group on the Egyptian oil refining companies in order to demonstrate the applicability the developed model.

- A mixed-methods approach was used to fulfil the third objective and respond to the third research question. This included a literature review and an empirical case study through focus groups to canvas the opinions of managers within Egyptian oil refining companies. The literature review is essential to provide a thorough overview of earlier research on the subject of sustainability practice. It helped the research in identifying some determinants in the form of procedures, barriers, benefits and drawbacks presented in academic works.

Additionally, an empirical study was planned to draw on practical guidelines such as procedures, barriers, benefits and drawbacks that can assist oil refining companies in implementing the proposed model. These guidelines demonstrate how the model may be used in the particular context of the oil refining industry, which is what the third objective aims to attain.

- An alternative research method that was considered for addressing the second objective is one-to-one interviews. Although one-to-one interviews have several advantages in terms of obtaining in-depth and personalised insights from participants, in the context of this research, one-to-one interviews may not be suitable for achieving the desired objectives. One-to-one interviews collect perspectives and experiences solely from individual interviews, limiting the opportunity for the exchange of different experiences that represent each of the three pillars of sustainability. In other words, this alternative approach may result in a narrow viewpoint based only on one respondent's experience.
- One-on-one interviews were an alternative research method that was taken into consideration for addressing the second objective. One-on-one interviews can allow the researcher to fully comprehend the interviewer's perspective and experience. But in the context of this study, one-on-one interviews might not be the best method for accomplishing the required objectives. To be clear, one-to-one interviews restrict interaction and the sharing of many experiences that embody each pillar by gathering viewpoints and experiences only from individual interviews. Correspondingly, to capture a more thorough discussion and gather guidelines covering all three pillars of sustainability, a different method is needed. In other words, a method that encompasses gathering multiple participants' perspective in one session, each with experience in aspects related to the sustainability dimensions, will be more appropriate. Subsequently, these interactions between participants with diverse experiences will contribute to the development of guidelines that can assist oil refining companies in implementing the proposed model.
- Conducting a literature review and a focus group questionnaire are suitable methods to adopt in combination in order to accomplish the third objective. The literature review helps the researcher to pinpoint several aspects that companies may encounter when implementing sustainability practices, such as procedures, barriers, benefits and drawbacks that have been covered in earlier research. However, since this research focuses on the

integration of three pillars of sustainability (the environmental, economic and social aspects), focus groups are preferred over one-on-one interviews, since it is useful to consider the interactions between multiple participants representing each pillar in a single discussion. This interaction is not applicable when choosing a one-on-one interview because that interview is designed to examine the attitudes and responses of only one participant. As a result, the focus group setting may foster conversation and linking multiple ideas, that may not occur in an individual interview. As a result, focus groups are preferred over one-on-one interviews since they allow more participant engagement during the conversation.

Objective 4: A global online survey questionnaire applied among researchers and mangers in the oil refining sector to test the applicability of the developed model.

- The selected research method to address the fourth objective and answer the fourth research question was the online survey questionnaire, that was planned to be distributed globally to researchers and managers in the oil refining sector. The online survey provides an effective and convenient means to collect data, with less time and expense, from a variety of respondents, regardless of their location. In other words, the goal of using this method was to obtain a wider variety of opinions on the proposed model and to evaluate efficacy with less effort and expense in comparison with existing models. Additionally, this method assisted the research in-hand to examine the nature of the oil refining industry, as the industry has to adhere to the international rules and regulations. Since it was crucial to comprehend how the proposed model might be applicable and relevant in various global contexts, the online survey was an ideal method to adopt. Furthermore, the selected approach also addressed the shortcomings of earlier research, which frequently lacked generalisation, internationalisation and comparison with pre-existing models. The scope of many earlier studies was constrained by a reliance primarily on a single case study. Using a global survey, the researcher could collect data on a bigger scale, reaching a wider range of participants, thereby enhancing the scope for generalisability and achieving global viewpoints. In addition, using this method, allowed comparing the effectiveness of the suggested model with the existing ones. Overall, an online survey was an appropriate research method for this objective, enabling the researcher to collect international perspectives, address the shortcomings of prior studies and collect substantial amounts of data more efficiently and whilst minimising cost.

- Structured interviews were an alternative research method that has been taken into account to address the fourth objective. While structured interviews offer a number of benefits, such as the chance for direct communication with interviewees and the chance to collect in-depth responses and insights from them, this method may not be appropriate for this objective, which is to capture a broad range of perspectives from an international context. This objective also included bridging the gap in the prior research which tended to rely on a single case study, limiting internationalisation, generalisation and comparative capability to other models. As a result, conducting structured interviews would be difficult to execute on a wider scale because it entails setting up appointments with busy managers and can be expensive and time consuming.
- Since the structured interview was not ideal for addressing the fourth objective, this highlighted the online survey as a good method to accomplish the study's fourth objective because it enables gathering data from a variety of participants in many locations with less effort and expense.

Taking into account data accessibility, feasibility and the requirement for a thorough understanding of the subject matter, the approaches selected for this research were in line with the scope and requirements of each objective.

4.3 Research Philosophy, Strategy and Approach

Flowers (2009) pointed out that it is important to understand the relationship between the research concepts (philosophy, strategy and approach) and the research plan in order to achieve the research aim and to answer the research questions. The research can be meaningfully interpreted when there is clarity about the decisions made. Accordingly, Saunders et al. (2016) referred to the research "onions" which this research will use to realise the aforementioned theories by figuring out the aspects underlying each concept. At this point, the research will be eligible to determine the overall decisions, including the research's philosophy, strategy and approaches.

According to, Saunders et al. (2016), "research philosophy is considered the initial stage in the research process. Research philosophy is the system of beliefs and assumptions about the development of knowledge which includes two branches: ontology and epistemology". Ontology is concerned with the assumptions about the nature of reality (existence), or in other words, it is associated with knowing the social entities that should be perceived in the research as objective or subjective (Scotland, 2012). Thus, research ontology can be classified as research objective or research subjective. There is a difference between research objective and research subjective. Saunders et al. (2016) highlighted that the research objective can be defined as a philosophical concept that is completely unbiased, owing to the fact that it is based on solid data such as mathematical proofs and facts. In other words, it is not influenced by sources of information developed by society's emotions, opinions, interpretations and ideas. Alternatively, the research subjective perspective is based on the philosophy that reality is constructed with social perspective, opinions, experiences, interpretations and emotions. Respectively, determining the research ontology (subjective or objective) is critically important as it will assist the researcher to identify the other's conception (research approach and strategy) as there is consistency between them.

This research is considered subjective. The research aim is to develop a performance measurement model from the sustainability perspective specific to the oil refining sector. That ontology of research is the foundation of the research process and once it is determined, there will be clarity in defining the other conceptions. Subsequently, the research has the potential to identify the research epistemology, which is considered the second branch of research philosophy. According to, Saunders (2016) research epistemology includes two different philosophies which are positivism and interpretivism. In the following sections, the researcher presented the difference between positivism and interpretivism, as well as the difference between deductive and inductive strategies, ending with a discussion on the difference between qualitative and quantitative approaches, in order to determine the most appropriate conception in the context of the research.

4.3.1 Research Philosophy

According to Flowers (2019) research positivism is the philosophical theory that depends on scientific knowledge (i.e., minimum interaction with the research participants). On the other hand, interpretivism depends on knowledge which is socially constructed and is therefore dependent on an understanding of people's interpretations and opinions based on their experience.

Guthrie (2012) highlighted that research concerned with objective philosophy are supposed to have positivism philosophy, because the nature of both philosophies is based on facts and solid data which are not influenced by social interpretations". Alternatively, research studies that adopt the subjective philosophy are expected to have interpretivism philosophy. This is due to the nature of both philosophies being based upon social perceptions.

This research adopts the interpretivism philosophy, as it is primarily based on gathering people's perspectives.

The next section of the study focused on discussing the differences between the research strategies and the selected strategy for this research will be presented.

4.3.2 Research Strategy

Trochim (2006) pointed out that the inductive approach is a theory building process, that starts with empirical data derived from observations and experiments, seeking to find patterns in the data collected to construct a theory describing the situation. On the contrary, the deductive approach is a theory testing process that starts with developing a theory, then predictions are formulated based on testing the theory applied to specific aspect.

Trochim (2006) additionally stated in the same study that research that adopts positivism philosophy usually carries out the deductive approach, whereas the research that adopts interpretivism philosophy usually carries out inductive approach.

The inductive approach is the ideal approach for this type of study. This study began with identifying the research gap, investigating the research gap and then seeking to bridge the research gap through developing a performance measurement model from a sustainability lens specific to the oil refining sector. An empirical case study also formed a part of the research methodology in order to demonstrate the applicability of the theoretical frameworks in the industry by conducting focus groups. This was followed by an online questionnaire to test the applicability of the proposed model by obtaining the perspectives of oil refining experts to test the relationships between the identified research variables formulated in the research hypotheses.

In the next section, the differences between qualitative and quantitative approaches were discussed to outline the one most appropriate to utilise for the purposes of this research.

4.3.3 Research Approach

The difference between the quantitative and qualitative research approach is in data representation, which can be in the form of numeric or non-numeric data (words). Quantitative research explains phenomena by collecting numerical data that are analysed using mathematically based methods

(Payne and Payne, 2011). On the other hand, qualitative research collects information about human behaviour, opinions and social contexts of particular populations in the form of words or texts obtained from audio tapes or video tapes (Roller & Lavrakas, 2015). Incorporating both a quantitative and qualitative research approach is identified as a mixed research method. The mixed research approach integrates collecting and analysing both quantitative and qualitative data within the same study.

In following the mixed research approach, it is essential to understand the mixed methods design. Cresswell (2003) listed the primary types of mixed methods as sequential, concurrent and embedded mixed methods. Hesse-Biber (2010) defined sequential mixed method as expanding the results of one method with another method. Thus, the sequential mixed method can be explanatory sequential, that includes collecting and analysing quantitative data then gathering and analysing qualitative data to explain more or to validate the outcomes of analysed quantitative data. Alternatively, exploratory sequential includes collecting and analysing qualitative data and then gathering quantitative data to explain more or to validate the outcomes of analysed qualitative data. The concurrent mixed method is defined as gathering quantitative data and qualitative data concurrently, analysing each data separately and comparing the results of each analysis to draw an overall conclusion. Cresswell (2003) also identified the embedded approach, using one type of data more comprehensively than other types of data in the research design.

This research methodology followed the sequential mixed research approach, whereby the researcher collected and analysed both quantitative and qualitative data. This included an empirical case study by way of focus group sessions to demonstrate the applicability of the proposed research models within the context of the oil refining industry. This means that the data collected via the focus group discussion was derived from the opinions of the participants of the focus group sessions, expressed and converted into the form of themes to validate the applicability of the proposed models. Next, to test the applicability of the proposed models on a wider scale, an online survey to collect the perspectives of relevant experts (including academic and practitioners) was applied. The composition of both perspectives, therefore works to bridge the gap between practice and academic which can improve the usefulness and quality of the outcomes. The data collected from this phase was analysed and converted into numerical data to test the relationships between the identified research variables formulated in the research hypotheses.

According to, the aforementioned discussion which illustrated that this research combines qualitative and quantitative approach through conducting focus group discussion (qualitative data collected) followed by conducting online survey (as qualitative data were collected and analysed quantitatively) to test the applicability of the conceptual model derived from literature and the empirical study, this clarified the reasons why this research followed exploratory sequential mixed approach.

Therefore, the research in hand followed mix research approach, to enable the researcher to acquire the strengths of both methods together and avoids the weakness of depending solely on one method. Consequently, this should enhance the accuracy of the results obtained through such investigations. In addition, mixed research approach allows researchers to explore diverse perspectives and phenomena from different viewpoints (Hesse-Biber, 2010). Also, adopting sequential mixed research method should increase the reliability and validity of the results (Cresswell, 2003).

Accordingly, at the preceding section the researcher identified the philosophy, strategy and approach conceptions and illustrated the reasons for selecting the appropriate conceptions convenient with the research design that was developed to fulfil the research aim. That is, the researcher sought to illustrate the previous discussion in the following Table 4.1 showing an overview of the research philosophy, strategy and approach adopted of this research.

Table 4.1. Research philosophy, strategy and approach.

Philosophy/ approach/strategy	Selected Philosophy/ approach/strategy	Rationale for adoption
Positivism vs Interpretivism	Interpretivism	• Interpretivism is the philosophy which depends on understanding people's interpretations and opinions based on their experience (Flowers; 2019). • All the research phases are identified according to interpretation, as follows:- o Developing the research gap is based on previous literature and the opinions of experts in oil refining (Exploratory interviews). o Validating the proposed model is based on the perspectives of Egyptian managers in oil refining companies and gathered through focus group sessions. o Testing the applicability of the proposed model is based on the opinions of oil refining experts gathered through an online survey.
Deductive vs Inductive	Inductive	• The inductive approach is defined as a theory building process that starts with observation, gap identification, gap investigation and bridging the research gap; (Trochim, 2006) o This study starts with observing the oil refining sector's current performance measurement models to identify the research gap through reviewing previous studies and conducting exploratory interviews. The research gap was identified whereby the oil industry has insufficient performance measurement models capable of incorporating the sustainability theme alongside addressing the main properties of the oil refining sector and its global challenges. This research sought to bridge the identified research gap through developing the performance measurement model a sustainability perspective to assist oil refining companies in measuring the company's performance. Finally, the research sought to demonstrate the applicability of the model in the industry by conducting focus groups in Egyptian oil refining companies, testing its applicability via an online global survey.
Qualitative vs Quantitative	Exploratory sequential mixed method (integration between qualitative and quantitative data)	• The exploratory sequential mixed method approach includes collecting and analysing qualitative data followed by collecting quantitative data to explain or validate the outcomes of the analysed qualitative data (Cresswell, 2003) • This study collected qualitative data and quantitative data by conducting a focus group (qualitative data) an online survey (quantitative data)

4.4 Research Phases

This section presented the four research phases, including the research methods, tools, sampling size and criteria, data collection and analysis adopted in order to reach a clear conclusion for each of the research questions and address the research objectives.

4.4.1 The first Research Phase: Identifying the Research Gap Through Critical Review and Exploratory Interview

The primary goal of the first research phase was to present a thorough outline of the primary concepts, such as supply chain; sustainability and performance measurements, which underpin the thesis; and their relationship to the oil refining industry. This phase started by outlining the petroleum industry's economic contribution, the petroleum industry characteristics and SC. To be clear, it was essential to comprehend the significance and characteristics of the petroleum sector because doing so aids in understanding the bigger picture of how the oil refining industry operates. This phase also emphasised the importance of the oil refining sector within the petroleum supply chain. This means that it is crucial to fully comprehend the importance of the oil refining industry in the energy system and in economic development, which highlights the significance of the research topic. Moreover, the first research phase discussed the industry's characteristics and the current global challenges encountering the oil refining sector. As a result, it was crucial to understand the characteristics of the oil refining industry and global issues because doing so provides insights into the sector's special features, methods of operation and challenges. Additionally, this research phase pointed out the importance of implementing a tailored performance measuring model, given the special traits and challenges that encounter the oil refining sector. This performance measurement model is essential to assist companies to effectively monitor, track and measure their performance in terms of their sustainability practices and addressing current global challenges. Accordingly, this phase also considered reviewing previous studies on performance measurement in the oil refining industry, aiming at identifying existing models and key performance indicators. So, this review helped this study to identify the research gap and limitations in the existing models.

Additionally, exploratory interviews with practitioners were conducted to gain insights from their perspective about the sustainability practice in the sector and existing models. To clarify, the researcher conducted an exploratory interview with the experts in the oil refining sector. The interviewees were selected from the experts who attended the international conference held in Egypt in 2016: Egypt’s Petroleum International Conference (EPIC). This conference included experts from different countries all over the globe. The researcher selected the interviewee randomly. The research interviewed 43 experts specialised in oil refining industry and they were asked whether oil refining companies adopt KPIs to measure their performance from the sustainability perspective and what models the companies refer to for measuring their performance from the sustainability lens. The interview consisted of four questions. Firstly, respondents were asked about their knowledge about sustainability practice. This was followed by asking the respondents whether their companies follow a key performance matrix of sustainability to measure the companies' performance from the sustainability perspective. Finally, the interviewees were asked about the models their companies refer upon assessing their companies' performance from the sustainability lens. These interviews helped the researcher to understand more the research problem and identify performance measurement models for sustainability currently used in the sector. These interviews also helped the researcher to observe whether there are similarities between the data compiled from the academic perspective and the data collected from the exploratory interviews. The results, of this interview clarified and reinforced the research gap which had been identified by the literature review.

Therefore, the findings from both the exploratory review and the interviews aligned in identifying the research gap, which embedded in the lack of sufficient performance measurement models that integrate sustainability, encompass the unique properties of the oil refining sector and address global challenges and trends. Based on these findings, the first phase ended by formulating research questions and hypotheses. These elements served as a guide and foundation for the entire research study and provided a clear direction and roadmap for the research process.

As a result; the first research phase attempted to identify the research gap, research questions and hypotheses and clearly provide answers for the first research question, additionally to fulfil the first research objectives through identifying the challenges encountering oil refining sector. Consequently, the research gap was bridged through the following research phases.

4.4.2 The Second Research Phase: Extended Literature Review to Develop Oil Refining Performance Measurement Theoretical Model from the Sustainability Perspective

This research phase focused on developing a performance measurement theoretical model of sustainability particular to the oil refining sector. The theoretical model was developed through two phases. During the first phase the research in hand reviewed previous studies considering some technical issues related to the oil refining sector, to identify and extract the KPIs specific for the oil refining sector and to end up with developing an initial performance measurement theoretical model from sustainability lens particular for oil refining companies. Due to the limited number of previous studies that considered performance measurement models of sustainability in oil refining sector, as well as, the fact that the identified key performance indicators that were determined based on the previous studies concerned with technical aspects related to oil refining industry do not sufficiently address the current global challenges, it became apparent that the initial version still lacks the integration of sustainability and encompassing the unique properties of the oil refining sector and addressing global challenges and trends. As a result, the second phase reviewed previous studies that tackle the performance measurement models in other industries to extract KPIs that are defined by previous studies and check whether they should be added to the initial model and to end up with developing a comprehensive performance measurement theoretical model from sustainability lens particular for oil refining companies that addresses most of the challenges facing oil refining industry, which is regarded as a second version of the proposed model.

The two proposed theoretical models were developed separately in different phases, but via applying the same four stages, namely: summary of sources, synthesis of sources, analysis stage and authorisation text phase. Firstly, the study in hand identified keywords, some keywords were selected for the first phase as (transportation, procurement, technology, risk, forecasting, inventory management, contracting, capacity, green aspects, environmental issues, pricing, health and personal safety, quality, uncertainty, zero discharge, operational excellence, social impacts and logistics activities) and other keywords as (performance measurement models of sustainability, performance metrics of sustainability, sustainable performance measurement model, sustainable indicators, sustainable performance measurement index, sustainable KPIs) were selected for the second phase. Secondly, the extensive literature analysis was carried out to obtain KPI for each aspect. Thirdly, the paper in hand attempted to allocate each KPI under one of the three pillars of sustainability to assure that the selected KPI reflects the sustainability insight. Fourthly, it provided a measurement for each KPI (these measurements were identified in a wide matrix attached to appendices 4, 5 and 6 according to the previous literature review discussions.

In addition, this research phase was concerned with identifying some guidelines in the form of the procedures, benefits, barriers and drawbacks that companies may encounter upon referring to the proposed model. These guidelines were expected to be a foundation to oil refining companies in case these companies are encouraged to refer to the proposed model. Therefore, the researcher reviewed the previous studies that have tackled the procedures, benefits barriers and drawbacks emerging from the sustainability practice in the petroleum industry or other industries to come up with theoretical framework representing these aspects. Accordingly, the researcher searched for previous studies considering the procedures, barriers, benefits and drawbacks by setting some keywords. These keywords were procedures (or preparedness) required for sustainability practice, procedures (or preparedness) required for sustainability practice in the petroleum industry, barriers resulting from sustainability practice, barriers resulting from sustainability practice in petroleum industry, benefits (or advantages) of sustainability practice, benefits (or advantages) for sustainability practice in petroleum industry, drawbacks (or disadvantages) of sustainability practice and drawbacks (or disadvantages) of sustainability practice.

To conclude, the second research phase ended with developing a comprehensive performance measurement theoretical model of sustainability particular to the oil refining sector and a theoretical framework representing the procedures, benefits, barriers and drawbacks, these are considered as guidelines that companies may encounter upon referring to the proposed model. That is, the second research phase fulfilled the second and part of the third research objective. In the next research phase attempted to demonstrate the applicability of the developed model in the context of oil refining industry.

4.4.3 The Third Research Phase: Validating the Theoretical Model Empirically Through Conducting a Focus group on Egyptian Oil Refining Sector

This research phase was conducted to demonstrate the applicability of the comprehensive performance measurement theoretical model of sustainability through conducting an empirical study in Egypt on Egyptian oil refining companies. The empirical study was executed through focus group questionnaire for the Egyptian managers of oil refining companies to collect their opinions regarding the procedures, benefits, barriers and drawbacks that companies are expected to face upon adopting the proposed performance measurement model. The identified procedures, barriers, benefits and drawbacks can act as both guidelines and an expected preparation, if the oil refining companies are encouraged to refer to the proposed model. The researcher sought to provide oil refining companies with these guidelines that should assist oil refining companies upon referring to the model.

Egyptian companies have been particularly selected as the population of the empirical study since Egyptian companies are witnessing a phase where they are seeking development of the strategies employed by their companies, specifically, integrating the aspect of sustainability which is the core of the study in hand (Hegazy, 2015). Accordingly, this gave the researcher a great opportunity to gather multiple opinions about the guidelines and the developed comprehensive model.

As for conducting the focus group discussion, this study aimed at conducting focus group sessions through questionnaire on multiple Egyptian oil refining companies to answer the third research question. This is done to find out the views of the main experts in the Egyptian oil refining sector to identify the procedures, barriers, benefits and drawbacks which the oil refining companies may recognise when encouraged to adopt the proposed model as a reference to help them monitor and measure their performance from the sustainability perspective, additionally on the proposed performance measurement model. In this research, conducting a focus group questionnaire was an appropriate method because this research is concerned with the three pillars of sustainability (which is the integration between the environment, economic and social aspects), so it was useful to consider the interaction among the participants representing each pillar in one discussion. This interaction is not applicable when selecting one to one interview as the interview consisted of exploring the attitudes and responses of one participant in one interview. Thus, the focus group interaction may encourage participants to discuss and interrelate various concepts throughout discussion, which may not occur during an individual interview. Ergo, the focus group is preferred over one to one interview because focus group sessions open more room for participants' interaction during the discussion. Hence, the focus group was carried out on various Egyptian oil refining companies aiming at coming up with practical guidance expecting to assist the oil refining companies when encouraged to refer to the proposed model. Additionally, conducting the focus group enabled the researcher to receive some recommendations concerning the proposed model.

In the following sections, the research pinpointed some major aspects related to the focus group questionnaire conducted in this research. These aspects included the focus group's questions, participants, sampling process and analysis.

4.4.3.1 Focus group questions

The questions included in the focus group were five open-ended questions that primarily focused on the participants' opinions. Only five questions were included in the questionnaire to avoid overwhelming the participants. Additionally, in order to avoid confusion on the participants' part, wording of the questions was kept simple, short and clear. Open-ended questions were composed, rather than closed questions, since open-ended questions facilitate a more detailed response.

The rationale for the five questions is as follows:

> Question 1 - The first question aimed at exploring participant's perspectives in relation to the procedures (steps and process) recommended when oil refining companies are encouraged to consider application of the developed model.

> Questioner 2 - The second questions aimed at identifying barriers that may obstruct oil refining companies when considering application of the developed performance measurement model. Such barriers can take the form of rules, culture, law, structure, employee culture, company policy, or anything that makes it difficult to consider realisation of the developed model.

> Question 3 - The third question sought to represent the advantages and positive effects for oil refining companies upon applying the proposed model.

> Question 4 - The purpose of the fourth question was to highlight the drawbacks or the unfavourable factors, that can arise when considering the developed model.

> Question 5 - The fifth question collected participants' suggestions and attitudes related to the developed model. This was an opportunity for participants to talk more generally to advise the researcher to add, exclude or modify any aspects related to the developed model. The focus group questions were intended to be tested through a pilot study carried out on a small scale, comprised of only 10 managers. This pilot study assesses the required timeframe, accurate wording of questions, question sequence and relevance. This stage provides the opportunity for modification of the survey questions and sections based on the participants' comments and to ensure the ultimate feasibility of the questionnaire. Based on this pilot study, the questions underwent some modifications that were put into consideration resulting in a modified version of the questionnaire. The final focus group questionnaire is shown in Appendix 7.

4.4.3.2 Focus group participants

The target respondents in each focus group were preselected from managers from different departments of the same company. The different departments included environmental, financial, human resources, health and safety, SC, quality assurance and sustainability and this constitutes one focus group team. Managers were chosen since they typically have the widest knowledge and experience about company operations, system and strategies. Moreover, sustainability implementation is considered a managerial responsibility requiring submission of management reports to chief executives and management boards.

The rationale for participant selection was also based on the three pillars of sustainability (environment, economic and social). That is, participants preselected from the environmental department were appointed in the focus group team as their perspectives represented the environmental aspect. Participants selected from the financial department would have views corresponding to the economic aspect. Furthermore, participants preselected from human resources and health and safety departments would have decisions related to the social aspect. In addition, participants preselected from the SC department to take part in the focus group team. These participants' primary responsibility is in managing the processes that transform raw material into final product. In other words, this department is connected to all other major departments in the company. The preselected participants from the SC department would likely have extensive knowledge that contributes to identifying the procedures, barriers, benefits and drawbacks highlighted by oil refining companies upon adopting the developed model. Added to this, there were participants chosen from the quality assurance department. Those participants have considerable experience and knowledge in identifying the developed model's KPIs that affect the company's SC performance in terms of quality, reliability and durability. Finally, there were participants from the sustainability department, who are usually responsible for developing and executing sustainable strategies and their KPIs.

Therefore, the participants in the focus group consisted of 7 managers, chosen from 7 departments: environmental, financial, human resources, health and safety, SC, quality assurance and sustainability, constituting one focus group team from the same Egyptian oil refining company. As a result of the diversity of the participants' experiences and backgrounds, the researcher gained a broad range of views and perspectives to identify the procedures, barriers, benefits and drawbacks to be taken into account by oil refining companies when referring to the proposed model.

4.4.3.3 Focus group's sampling process

The focus groups were intended to follow the stages of the sampling process adopted by Roller & Lavrakas (2015) who stated that the researcher initially has to define the target population, select the sampling frame, choose sampling techniques, define the sample size, collect data and finally analysing the data.

Target population

In terms of defining the target population, the researcher selected the Egyptian oil refining companies, due to previously mentioned reasons.

This sample frame was selected according to the lists presented in the websites and reports of (Veerapandian, 2010; Egypt Oil & Gas, 2017; US Energy Information Administration, 2018). Therefore, this research considered these lists that included the Egyptian oil refining companies as guidance in this research. (The Egyptian oil refining companies selected are attached at Appendix 2).

Sampling technique

For sampling techniques, based on the previous sampling process framework, this research found the cluster sampling the most ideal technique, whereby the researcher divides the population into smaller groups to conduct the focus group. To clarify, the cluster technique has been chosen in particular due to a variety of reasons. Firstly, the research's target population is the Egyptian oil refining companies. Besides, the researcher targeted the managerial level from different Egyptian oil refining companies. In addition, these managers were selected from different departments which are environmental, financial, human resources, health and safety, SC, quality assurance and sustainability departments. This constituted one focus group team belonging to the same Egyptian oil refining company.

Sample size

Saunders et al. (2016) showed that when the target population is less than 50, the researcher should interview all the population. Appendix 2 shows the sample list of Egyptian oil refining companies, whereby there are 10 oil refining companies across Egypt relevant for inclusion. It is important to note that while there are10 Egyptian oil refining companies included in the research, some are excluded for practical reasons. For instance, one refinery, located in upper Egypt, which is difficult for the researcher to visit tinorder to conduct the focus group questionnaire in this company. In addition, the Nasr Petroleum Company and Suez Oil are shut down during the time of data collection due to renovations. Therefore, this left seven Egyptian oil refining companies accessible for the purposes of conducting focus groups, each with different ownership and years of operation. This helped to reflect the different experiences and background knowledge about the oil refining sector from diverse mindsets.

4.4.3.4 Focus group data collection

The following process outlines how the data for the focus group were obtained:-

- The researcher made contact with the seven Egyptian oil refinery companies via email to invite them to participate in the research. The email included a brief introduction of the research, an information sheet and consent form. Should the company accept to participate, it is required to sign the organisation consent form and send it back by an email. The consent form comprises an important part of the process in ensuring the research complies with relevant ethical codes in data collection. In addition, the company is required to select internal participants whose experience is relevant to the environmental, financial, quality assurance, human resource, health and safety, SC and sustainability departments to participate in the same focus group session. In the time of the discussion, the researcher asked each participant to sign a consent form to guarantee their approval of conducting the focus group session. As well as, the researcher asked for participants'permission to audio record the focus group session. The recordings were transcribed without disclosing the identity of the Egyption oil refining company or the participants.

4.4.3.5 Focus group analysis

The data collected were transcribed and analysed through the content and thematic analysis method. Content analysis is a technique that interprets data in quantitative counts of codes, with a focus on counting the words of the text data. The thematic analysis helped the researcher in finding out the focus group respondents' perspectives about the gathered data (Alyavin et al., 2019). This all worked to identify patterns of meaning within the data through interpreting that data in the form of codes, categories and themes. These themes reflected the focus groups' perspectives about the guidelines including the procedures, barriers, benefits and drawbacks which the oil refining companies have to recognise when motivated to refer to the developed model as to help the company to measure their performance from the sustainability aspect. In addition, the themes reflected participants' opinions about the proposed performance measurement model. The analysis was accomplished through the assistance of Nvivo-12, a qualitative analysis software developed and managed by QSR international. Maheret et al. (2018) stated that "the advantages of qualitative data analysis software like NVivo primarily lies in replacing the manual and clerical tasks with large dataset, in addition to, improving the reliability and validity of the dataset. The NVivo software is typically used for the analysis of unstructured data, including text, audio and image data, as well as data related to interviews, focus groups, surveys and articles".

This research phase ultimately culminated in a validated comprehensive performance measurement conceptual framework of sustainability for the oil refining sector with a theoretical framework which represents the procedures, benefits, barriers and drawbacks. This research phase fulfilled the 3rd objective, since the other part of the 3rd objective had been fulfilled by the second research phase through identifying the procedures, barriers, benefits and drawbacks based on the literature review perception. This research phase has fulfilled the objective of the research according to the practitioner's perspectives. That to say, in the next research phase, the study in hand sought to test the applicability of the comprehensive performance measurement conceptual framework of sustainability particular to the oil refining sector through conducting online survey questionnaire distributed globally. That is, the study in hand attempted to collect global perspective to support the focus group outcomes through gathering multiple viewpoints, beliefs and experience from different cutlers. Flowers (2019) stated that "gathering multiple perspectives can give the researcher the opportunity to have better understanding, judgement and reduces conflicts and the bias". In addition, the proposed model had to be tested globally in the oil refining industry because the oil refining industry adhere to the international rules and regulations. Therefore, it is important to ensure that the proposed model can be applicable on the international scale.

4.4.4 The Fourth Research Phase: An Online Survey

This phase focused on testing the applicability of the comprehensive performance measurement model through conducting a global online survey. The aim was to include the international context since the oil refining industry has to adhere to international rules and regulations. This purpose of the online global survey is to test the applicability of the proposed models on a wider scale, through gathering the perspective of international experts (including academic and practitioners) in the oil refining sector. The composition of both perspectives can assist in improving the usefulness and quality of the outcomes. Accordingly, the data gathered from the online survey were analysed and converted into numerical data to test the relationships between the identified research variables formulated in the research hypotheses.

The survey enabled the researcher to collect data from pre-defined groups of respondents, thus allowing the researcher to be exposed to different perspectives and insights. Furthermore, the online survey questionnaire research method was considered the easiest and the least expensive method for gathering data as it enables communication with a wide number of people, even if dispersed over a wide geographical area (Groves et al. 2013). Therefore, the survey is a convenient research approach to be adopted in this study to answer the fourth research question which aimed at gathering global perspectives from company managers from different oil refining companies in various countries globally. In the following sections, the research discussed the survey's platform, questions, participants and the sampling process.

4.4.4.1 Survey platform

Saunders et al. (2016) highlighted that "it is critical to choose the right academic research platform that best suits the research". This research conducted an online survey using the Qualtrics platform, a web-based survey software tool made available for student use by Huddersfield University. The Qualtrics platform is user-friendly because it is flexible, secure and an easy-to-use survey tool with advanced functions and statistical analysis. Its multi-language capability enabled the researcher to target a greater number of respondents. Specific to this research, having English and Arabic versions of the sample available is a great advantage since the researcher can target as many respondents as possible without being impeded by the language barrier. Apart from being user-friendly, confidentiality is a further advantage. This is due to the fact that the researcher will not receive respondents' emails or names when they submit the survey, but rather, the IP address of their devices. This will guarantee the privacy of respondents' personal data along with ensuring the validity of the results. The privacy guarantee will encourage more respondents to participate in responding to the survey. Overall, the researcher found Qualtrics the most convenient platform.

4.4.4.2 Survey questions

A variety of questions were used in the survey to help the researcher in obtaining different perspectives from the participants with regard to the oil refining sector, specifically the KPIs used in the sector and their viewpoints about the proposed model.

The survey consisted of multiple-choice questions, as this type of questions is considered easy for participants to understand and to answer. In addition, the survey includes a matrix in which the participants have to show their degree of agreement or disagreement regarding the proposed model. In addition, short open-ended questions were included. This can be beneficial in collecting participants' opinions and attitudes in a more detailed way. Overall, questions included were characterised by clarity and simplicity to limit participant confusion while answering the questions.

A pilot study was conducted to make sure that participants were able to answer the survey questions smoothly. The pilot study included 15 participants who were asked to give their feedback about the manageability of the survey. As a further clarification, the questions were be pre-tested and the results of the pre-test were used to review the questionnaire. The pretesting is used to assess the needed time as well as the wording, clarity, sequences and appropriateness of the questions. Therefore, pretesting gave the researcher the opportunity to modify the survey questions and sections based on the pretesting participant's comments (The final survey questions are shown in Appendix 10).

4.4.4.3 Survey participants

The target respondents of this research were company managers and researchers in the oil refining sector. Company managers were preselected from 7 departments: environmental, financial, human resources, health and safety, SC, quality assurance and sustainability. Managers were targeted since they have the widest knowledge and experience about the company operations, systems and strategies. Another reason for selecting managers is the fact that sustainability implementation is typically considered a managerial responsibility, whereby managers are expected to compile sustainability reports to the chief executive officer or management board.

Additionally, selection is based on the three pillars of sustainability (environment, economic and social). Hence, the participants were preselected from these specific departments due to certain reasons that were highlighted previously in the focus group section.

In addition to company managers, academic researchers were included in the preselection for the survey since their expertise is relevant to the scope of this study and their in-depth knowledge represents a great asset to the research. Professional managers were also included. Together, these respondents represent a diversity of experience in the oil refining sector and this enabled the researcher to gain a broad range of views and perspectives.

4.4.4.4 Survey sampling process

This research sought to gather a global perspective by conducting an online survey questionnaire and realising the perspectives and views of the main experts in the oil refining sector (academic researchers and oil refining company managers) globally. The researcher sought to gather the perspective of these experts in the oil refining sector, whereby the composition of both perspectives can assist in bridging the gap between practical experience and theoretical investigation, that can improve the depth and quality of the outcome. The study also attempted to gather a global perspective to support the focus group outcomes through the collection of multiple viewpoints, beliefs and experiences from different cultures. Flowers (2019) stated that "gathering multiple perspectives can give the researcher the opportunity to have better understanding, judgement and reduces conflicts and bias". Since it is impossible to collect data for the whole population, which is large and geographically dispersed, the research focused on a sub-group of this population and this formed the research sample to which the online survey questionnaire was sent.

This research followed the stages of the sampling process adopted by Roller and Lavrakas (2015), as previously mentioned in the previous research phase section of this paper.

Selecting the sample size for oil refining company managers

The sample frame was selected based upon the report of Star Advisors (2018), which ranks the oil refinery industry globally by region. Star Advisors is a global consultancy that encompasses a wide range of energy expertise and provides regular reports analysing the energy sector (upstream, midstream and downstream). The report ranks the top 14 oil refining companies globally. Also, the report divides the world into 6 regions (Africa, Asia, Europe, Latin America, Middle East and North-America) and in each region, the report ranks the top 14th oil refining companies. The report allocates the ranking based on processing capacity, complexity and profit, to rank the oil refining companies globally and by region. The capacity refers to the barrels per day or per year and this can be further categorised into high, medium or low capacity. Complexity can be defined as the process nature, which is based on the conversation unit or the configuration of the distillation unit set in the oil refining company. The complexity can be categorised into complex processes or simple processes. Profit gives information about the company's performance. Together, the three indications selected by the report (process capacity, complexity and profit) are essential aspects that can represent the operation comparability of companies. Therefore, these reports were selected as guidance in conducting the online survey questionnaire, as it could be relied upon to formulate the sample of the oil refining companies globally. In addition, the report ranks the oil refining companies globally by region and this gave the researcher the opportunity to include different oil refining companies from different parts of the world with different rankings. For example, the oil refining company which is ranked the first in its region can be ranked differently globally (The rank of the oil refinery companies globally and by region is set out in Appendix 3).

The sampling techniques determine the sample size of oil refining company managers and this research selected a multistage sampling technique, which often used to gather data from large and geographically dispersed groups of people. According to, Saunders et al. (2016) the multistage sampling technique is a type of technique that divides the population in clusters and in each consequent stage the researcher can further divide up the selected clusters into smaller clusters until reaching the final stage. Selecting the multistage sampling process for this research was due to the target sample coming from a large population which is spread over a wide geographical area. For this research, the population was divided into multiple clusters and then these clusters were further divided and grouped into various sub-group. Specifically, the world was divided into 6 regions (Africa, Asia, Europe, Latin America, Middle East and North America) and then the researcher selected the top oil refining companies in each region. Furthermore, the researcher randomly selected company managers from every top oil refining company, as preselected from the seven previously specified departments.

The final sample size was 243 surveys distributed to oil refining companies' managers. This number was determined based on the total number of oil refining companies across the world (660 oil refining companies globally) and Saunders's chart, that shows the sample size for different sizes of target population. This research calculated the sample size at a 95% confidence level and a 5% confidence interval (these two percentages are commonly used by researchers). The sampling size is illustrated in following Table 4.2.

Table 4.2 Sample size

Population	Confidence level	Confidence interval	Sample size needed
660	95%	5%	243

Selecting the sample size for researchers

Researchers from previous studies who explored certain fields, such as petroleum, oil refining and sustainability fields, were selected according to a simple random sampling technique. Scotland, (2012) explained that this technique considers a random portion of participants from the entire population. As stated in Saunders et al. (2016) the simple random sampling technique can be chosen when there is a large population and there is equal chance that any of the participants in the entire population will be chosen.

Due to the fact that there are countless numbers of researchers in the previously mentioned fields, their number was considered infinite. According to Saunders, if the population exceeds 1,000,000, it can be regarded as an ideal sample size.. That is to say, there will be no need to go beyond 100,000; instead, this number will represent the infinity. Accordingly, the sampling size of 1,000,000 will be 383. Based on this argument, the researcher sought to target 383 academic researchers.

Therefore, the final total sample size of the online survey is 626 respondents (243 managers and 383 researchers) and the researcher was expected to gather 626 responses from conducting the online survey.

In terms of contacting the managers of oil refining companies, the researcher will utilise three contact methods. Firstly, the researcher will try to utilise LinkedIn to send private messages to managers in the respective departments relevant to the study. These messages include a brief overview of the study and the survey link (through the Qualtrics platform). In an attempt to target as many participants as possible, the LinkedIn's Premium service was purchased in order to extend the contact network. Secondly, to identify relevant contacts, the Oil Field Directory was utilised, which includes contact information for middle east, gulf and international oil refining companies including each company representative's direct email address. These email addresses were used to send emails to the companies to invite them to take part in the online survey. Additionally, they are asked to recommend further managers from relevant departments to take part in the survey. Thirdly, the researcher directly contacted relevant company managers who were selected to participate in the focus group sessions. Finally, an email was sent to those researchers interested in the same field to invite them to complete the online survey. This email included prerequisite information about the purpose of this research and a link to the online survey questionnaire (through Qualtrics platform).

Importantly, the first section of the online survey dealt with consent requirements for participants in answering the online survey.

4.4.4.5 Survey analysis

The survey questionnaire was conducted using SPSS 24 (Statistical Package for Social Science). This package was used for analysing the data collected through the research survey. As the first step, the researcher tested the reliability of data. Descriptive statistics, obtained by calculating the mean and standard deviation, were used for capturing the general features of the research variables. In addition, correlation and regression analyses were selected for measuring the relationships between the research variables formulated in the research hypothesis (see Chapter 6).

This research phase culminated in the identification of the relationships between the variables, as well as the degree of correlation and dependency between these variables. In doing so, this research phase outlined a developed comprehensive performance measurement applied model to assist oil refining companies to measure their performance from a sustainability lens.

Validated principles in the form of procedures, barriers, benefits and drawbacks were also identified, thus providing a roadmap for the oil refining companies in measuring their sustainability performance.

The following section illustrates the research phases. Table 4.3 specifically presents the research phases and how each research phase fulfilled the research objectives, including an outline of the tools used and the expected outcome from each phase.

Table 4.3 The research phases, objectives, tools utilised and their expected outcomes.

Research Phase	Objective	Tools	Outcome
Phase one: Identifying the research gap through critical literature review and exploratory interview	Objective 1: Assessing the ability of existing performance measurement models in relation to sustainability integration and addressing the challenges facing oil refining sector.	• Reviewing relevant previous including the petroleum industry, the oil refining industry, sustainability, performance measurements and the integration of sustainability practices and performance measurement in oil refining industry. • Conducting exploratory interviews	• Identifying the research gap • Formulating research questions and the hypotheses.
Phase two: Extended literature review to develop oil refining performance measurement theoretical model from a sustainability perspective	• Objective 2: Developing a theoretical performance measurement framework tailored for the unique needs and challenges of the oil refining sector. • Part of objective 3 will be fulfilled in phase 2 which is identifying the key theoretical guidelines through reviewing previous studies that discuss the procedures, benefits, barriers and drawbacks encountered in the application of sustainability practices in the petroleum industry, or other relevant industries, to come up with a theoretical framework representing these aspects.	• Reviewing previous studies related to the oil refining sector to identify the key performance indicators which are specific for oil refining sector. • Reviewing previous studies concerned with sustainability practice to identify guidelines in the form of procedures, barriers, benefits and drawbacks.	• Developing a comprehensive performance measurement model from the sustainability perspective for the oil refining sector. • Developing a theoretical framework to represent procedures, barriers benefits and drawbacks.
Phase three: Validating the theoretical model empirically through conducting a focus group on Egyptian oil refining sector	Objective 3: An empirical study will be conducted via focus group on the Egyptian oil refining companies in order to demonstrate the applicability of the developed model.	Conducting a focus group with relevant managers in Egyptian oil refining companies.	Demonstrating the applicability of the proposed model by ensuring it is not only theoretical but can be applied into practice.
Phase four: An online survey	Objective 4: A global online survey questionnaire will be conducted among researchers and mangers in the oil refining sector in order to test the applicability of the developed model.	Conducting an online survey, which will be distributed globally.	Testing the applicability of the proposed model through assessing and evaluating the effectiveness of the developed model in comparison to other existing models.

As demonstrated in the table 4.3, this study benefited from the application of multiple research approaches. In this way, the research achieved data triangulation. Guthrie, G. (2012), and Heale & Forbes (2013) pointed out that data triangulation is the use of multiple independent methods of obtaining data in single investigation in order to reduce researcher bias and enhance the credibility, validity and reliability of the interpretations and conclusions. Data triangulation is one of the most important and powerful research techniques, strengthening results by as it improves and facilitates the validation of data using evidence from different types of data source. The consequent section extended this topic, presenting the methods adopted in this research to achieve research quality and validity.

4.5 Research Quality and Validity

This research achieved reliability and validity through conducting pilot studies, that helped the researcher achieve reliability assessment through indicating the consistency of the focus group and survey's questionnaire (instrument). Also, validating that the focus group and survey tools are the appropriate ones capable of gathering what it is planned to measure. Flowers (2019) stated that "a reliable instrument and tool can lead to strong results". Additionally, as established previously, this study combines different research approaches. This triangulation works to ensure research quality and validity. Triangulation helps in eliminating researcher bias through the use of many independent techniques of data collection in a single project (Cresswell, 2003). Accordingly, the data triangulation method is one of the most effective methods to strengthen research since it validates data by applying evidence from many types of data sources (Guthrie, G. 2012; Heale & Forbes, 2013). For this study, methodological triangulation was achieved by gathering data from several sources of secondary data acquired through literature reviews. Additionally, initial exploratory interviews, focus groups and an online survey were used to compile primary data. Since this research was successful in using the triangulation technique, this maintained the quality of the research (Creswell, 2013). Treharne & Riggs (2015) asserted that "using the triangulation technique can uphold the standard of the research and increase the reliability of the data and conclusions".

4.6 Research Ethics

Research ethics were recognised as one of the most important aspects of this research. This study adopted two research methods to collect the data; a focus group and online survey questionnaire. As a clarification, this research conducted focus group sessions in various Egyptian oil refining companies. Particularly, an email was sent to the Egyptian oil refinery company; this email included a brief introduction of the research, an information sheet and an organisation consent form. Should the Egyptian oil refining company accepts to participate, it was required to sign the organisation consent form and send them back via email. In addition, the company was required to select internal participants whose experiences are relevant to the following sectors: environmental, financial, quality assurance, human resource, health and safety, supply chain and sustainability. These participants took part in the focus group session. Prior to conducting the focus group session, the participants were asked to sign their consent form. The consent form outlined that participation in the focus group session is voluntary and the researcher understands that every participant has the right to withdraw from the study at any stage if he/she wishes to do so. It also outlined the timing and format of the group. At the start of the focus group discussion, the researcher provided an introduction asking for participant permission to audio record the focus group sesion in order to accurattely capture what is said in the session. Whilst the recordings were transcribed, anonymity would be guaranteed for participants since there was no identitification of the Egyption oil refining company and the individual participants. This research fully respected confidentiality and the anonymity of respondents.

Also, the data were collected from the main experts in the oil refining sector via conducting an online survey questionnaire. Firstly, an email was sent to the identified mangers and researchers to invite them to participate in the online survey questionnaire (through Qualtrics platform). This email contained perquisite information about the purpose of this research and a link to the online survey questionnaire (Qualtrics platform). In case, the respondent has the consent to engage in the online survey questionnaire, the first section of the online survey requested respondents' personal consent to participate in the online survey. Additionally, it was made clear that participation in the online survey questionnaire is voluntary and that every participant has the right to withdraw from the survey whenever she/he wants. This research, therefore respects the confidentiality and anonymity of respondents, protecting respondent's privacy by not revealing their identities (names and emails). The research also used a secured platform to build the research survey. Huddersfield University supports researchers by providing free access to the Qualtrics survey tool. This maintains the security of data since the researcher did not receive the respondents' emails or names when they submit the survey, but rather the IP address of their devices and the collected data is saved under a password-protected area of the software on the researcher's personal computer. This also guarantees the privacy of respondents' personal data along with assuring the validity of the results.

This research, therefore adheres to Huddersfield University code of ethical practices in every aspect of the research to protect the rights and welfare of all participants. (The ethics acceptance email is shown in Appendix 11).

4.7 Summary

This chapter showed the methodological approaches for this research. The chapter begins by identifying the research design that included the methods that used to gather and analyse the data required. Additionally, this chapter defined the research paradigms through identifying the conceptions of research philosophy, strategy and approaches adopted.

This chapter also presented the four research phases. The first research phase included a review of the literature to identify the research gap. In the second research phase, the researcher developed a theoretical performance measurement model from a sustainability perspective specific for oil refining companies. In addition, the second research phase identified some guidelines in the form of procedures, barriers, benefits and drawbacks, to be used as a roadmap to assist oil refining companies in the practical implementation of the proposed model. The third research phase aimed at demonstrating the applicability of the proposed theoretical performance measurement model through an empirical study on the Egyptian oil refining companies by way of a focus group discussion. The fourth research phase attempted to test the applicability of the proposed performance measurement model through an online survey distributed globally, the data from which was converted to numerical values to test the relationships between the variable formulated in the form of research hypothesis. Each research phase involved clarification of some aspects such as research phase aim, data collection methods and tools used, sampling technique and criteria utilised and the analysis methods and tools. At the end of each phase the researcher highlighted their outcomes and how this outcome leads into the next phase. Finally, there was a discussion on the means adopted by this research to achieve research validity and quality as well as presenting the ethics considerations involved in this research.

Chapter 5: Empirical Study on Egyptian Oil Refining Sector: A Focus Group

5.1 Introduction

This chapter outlined the implementation of the third research phase, as identified in Chapter 4 and addresses the third research objectives and question (see chapter 1). The main focus of this chapter was to present the results of the empirical study on the Egyptian oil refining companies which was obtained via a focus group discussion with managers in the Egyptian oil refining companies.

This focus group aimed at gathering the perspectives of managers in the Egyptian oil refining companies to demonstrate the applicability of the model within the context of the oil refining industry. This research sought to ensure that the proposed model is not only a theoretical concept but can be put into practice and can be implemented within the context of the oil refining industry by identifying the procedures, barriers, benefits and drawbacks which may be encountered in implementing the proposed model. The focus group was conducted to gather the opinions of the managers in the Egyptian oil refining companies with regards to the proposed model.

The data gathered from this phase may culminate in a modified proposed model, which will be referred to as the third version.

The chapter was set out in order to first define the methodology adopted for the focus group sessions, including the reasons for selecting the Egyptian sector as well as focus group participants and questions. Section 5.3 presented the data analysis processes, analysing the interviewees' responses and using a thematic analysis to present and create codes and nodes grouped into different themes using the NVivo software. The process also determines the presence of patterns in certain words used by interviewees through content analysis. Section 5.5 presented a summary of the results of the analysis.

5.2 The Methodology Adopted in the Focus Group Questionnaire

The following section clarified the reasons for selecting the Egyptian sector as the sample for this research for the purposes of the empirical study. It also highlighted the reasons for selecting the focus group method over other methods, the participants selected to participate in the focus group questionnaire and the focus group's questions and the desired outcome from each question.

5.2.1 The Selection of the Egyptian Market

In this research, the Egyptian market was selected as the population for conducting the empirical study as the Egyptian oil refining market is considered one of the largest non-OPEC oil producers and with the largest capacity in Africa (Thompson, 2021; US Energy Information Administration, 2022). Egyptian companies are currently witnessing a phase during which they seek the development of the strategies employed by their companies, specifically, integrating the aspect of sustainability which is the core of the study in hand (Hegazy, 2015; Resources, 2015). This provides the researcher a great opportunity to gather multiple opinions from the Egyptian managers in oil refining companies about the proposed performance measurement model, as well as the proposed guidelines, specifically at this time where it is a point of focus for the government and the Egyptian oil refining companies. This section examined the Egyptian oil refining sector, presenting a brief historical overview on the Egyptian oil refining sector and identifying its current status and significance.

In the late 19th century, oil was discovered in Egypt, making the country the first oil country in the Middle East and North African region. As early as the 1860s, the government began drilling for oil. The first field was discovered in 1869, was named Gemsa Field at the Gulf of Suez and started yielding oil in 1910. At that time, the British Petroleum company (BP) and the Royal Dutch Shell established a joint venture company called The Anglo Egyptian oil field company to develop the field. Later, several other fields were discovered (Wescott et al., 2016).

In 1962, the Egyptian government established the first national oil company, which is the Egyptian General Petroleum Corporation (EGPC) in Egypt. EGPC was in charge of managing the upstream and downstream activities in the oil sector as well as the exploration and production operations of more than ninety affiliated joint venture companies. It holds several exploration licences in the Western Desert, Sinai and the Gulf of Suez. It also owns and operates much of the country's refining industries (Labib & Hun, 2010).Accordingly, EGPC has full responsibility for all sectors of the Egyptian petroleum industry and holds the sole rights to import and export crude oil and other petroleum products. As a controller of the industry, any foreign investments in Egypt are maintained through a joint venture with the EGPC and are supervised by the government.

The petroleum sector's structure consisted of five major state entities: The Egyptian General Petroleum Corporation (EGPC), the Egyptian National Gas Holding Company (EGAS), the Egyptian Petrochemicals Holding Company (ECHEM), Ganoub EL-Wadi Holding Company (GANOP) and the Egyptian Mineral Resource Authority (EMRA). Figure 5.1 illustrates the Egyptian oil and gas sector organisations.

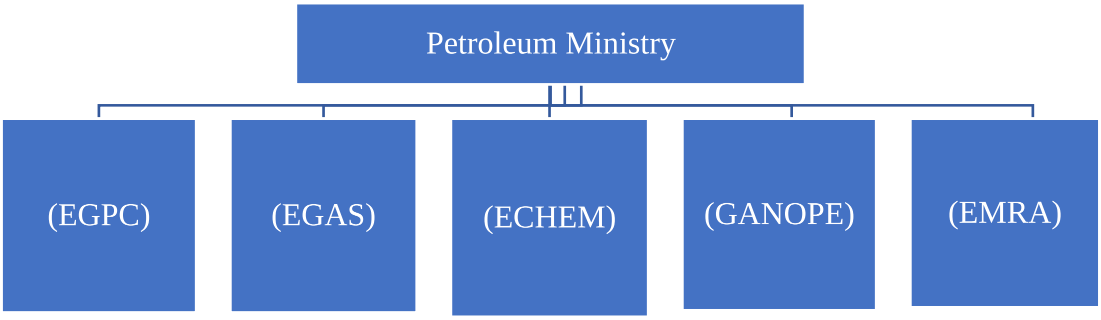

Figure 5.1. Key Organisations in the Egyptian oil and gas sector.

5.2.1.1 The current status and significance of the petroleum sector in Egypt

Egyptian oil is derived primarily from the Western Desert region, that represents the largest part of the crude oil production in Egypt, contributing with 51%, followed by the Gulf of Suez with 20%, the Eastern Dessert with 12%, the Sinai Peninsula with 10%, the Mediterranean Sea with 5%, the Nile Data with 1% and Upper Egypt with less than 1% (US Energy Information Administration, 2013).

Accordingly, Egypt is considered one of the largest non-OPEC oil producers in Africa as well as owning the largest oil refinery capacity in Africa, although most of the refineries are operating at lower levels than their designed capacity. In addition, the country plays a major and strategic role in the regional energy transit. The country combines three structures, the Suez Canal, the SUMED oil pipeline and the Arab Gas Pipeline, which are important transit routes for oil and liquefied natural gas (LNG).

Despite the fact that Egypt has the largest oil refinery capacity in Africa, the Egyptian oil sector has been collapsing since the beginning of 2000s. The country drifted away from being an oil exporter to oil importer. This was due to different factors including a lack of giant oil fields (most of the country's production comes from relatively small fields), the significant rise in the population and the fact that most of the Egyptian refineries are operating well under the designed capacity, the latter being likely due to the age of refineries and lack of modern technologies. This has led to an increase in oil demand with stagnation in production. That is, the domestic supply has fallen short of demand. Therefore, the gap between the production and consumption is growing rapidly (Organization of Arab Petroleum Exporting Countries, 2020).

Subsequently, the Egyptian Ministry of Petroleum is working hard to bridge the gap between the domestic demand and the supply, which represents a major challenge. US Energy Information Administration (2022) pointed out that the Egyptian Ministry of Petroleum has taken active approaches such as:

- Incentivising foreign investments through encouraging foreign partners to continue investing in exploration and development activities.
- Signing new agreements with international exploration and production companies
- Investing in and upgrading the domestic refinery through improving their safety system and raising their capacity. For example, the Middle East Oil Refinery Company (MIDOR) is expanding to increase its capacity by 60% with investment at approximately $1.3 Billion.
- Expanding the country's refining capacity through building more refineries in partnership with foreign companies.
- Planning for sustainable development by adjusting existing economic models in order to maintain balance between economic growth and social needs. This includes protecting ecologies growth and reducing negative impacts of growth on the global environment.
- Discovering new oil to boost Egypt's reserves.
- Developing the infrastructure to promote investment in the country.

The Egyptian Petroleum Ministry set plans to get the petroleum industry back on the path to growth. According to US Energy Information Administration (2022) the Egyptian petroleum sector will witness major transformation which will lead to economic growth in 2020. The Petroleum industry is one of the fundamental pillars of the economy and a significant source of Egypt's national income. Thus, the rise and the decline of oil exports have direct impacts on the country's overall economic development. Therefore, it is in the government's interests to enhance the Egyptian petroleum industry and particularly the oil refining sector, as it is considered one of the key chains in the petroleum industry responsible for production activities.

5.2.1.2 The current status and the significance of the oil refining sector in Egypt

The first refinery was the Suez refinery. It was set up in 1913 by the Anglo Egyptian Oilfields company (US Energy Information Administration, 2022). Egypt has nine refineries with a total capacity of 721,500 bbl/d (Veerapandian.K, 2010; MathPro, 2011). The government is currently undertaking expansion projects in the Egyptian petroleum refining sector and expecting the capacity to increase from 721,500 to 878,200 barrels per day (bbl/d). One of the most significant projects of 2020 was the inauguration of the Mostorod Petrochemical Refinery at the Egyptian Refinery Company. This project is considered one of the most important projects for Egypt and Africa, facilitating the capacity of 4.7 mmt of petroleum products annually. This project is acknowledged as a stepping stone towards exporting petroleum products. It is also considered one of the biggest refining projects in Egypt. Along with the new hydrocracking project for the Assiut refinery, this project will contribute towards Egypt's self-sufficiency plan for petroleum production. Furthermore, the ministry indicates that they are planning several additional refining projects, which are expected to be completed in the coming years. All of this works to enhance the Egyptian refining sector and its wider economy, playing a vital role in securing the country's requirements for petroleum products, achieving high economic return on refineries' production capacities ultimately increasing the value added to the petroleum crudes in Egypt (US Energy Information Administration, 2022).

The strength, weaknesses, opportunities and threats (SWOT analysis) of the current position of the petroleum sector in Egypt is presented in Table 5.1.

Table 5.1. SWOT analysis for the Egyptian petroleum sector.

Strengths	Weaknesses
• Egypt is the largest non-OPEC oil producer and has the largest oil refining capacity in Africa. • Egypt plays a vital role in the international energy markets through its operation of the Suez cannel and Suez Mediterranean (Summed) pipelines. • Egypt has a pipelines transportation network which is around 5,700km to transport crude oil from ports and production fields to refineries. The pipelines also transport petroleum products from refineries and ports to the consuming areas.	• Most Egyptian refineries are operating well under the designed capacity. This could be due to the age of refineries and the lack of modern technologies. There is a need for some of the Egyptian refineries to be upgraded. • Energy subsidies contribute to the rapid growth of oil consumption.
Opportunities	**Threats**
• The petroleum authority needs to upgrade and increase refining capacities to satisfy the growing local demand. • The petroleum authority should encourage private sector participation in exploration and production activities. • The petroleum authority should search for new oil discoveries to boost Egypt's reserves. • The petroleum authority ought to improve and modernise oil and gas sector. • The Egyptian ministry of petroleum should be encouraged to develop and enhance the Egyptian petroleum sector. • The Egyptian ministry of petroleum has to develop a sustainable strategy for the Egyptian petroleum industry during the petroleum industry's transformation.	• There is a lack of giant oil fields, so the country's production depends on small fields. • There is a continuous decrease in oil production whereas there is an increase in population. • The electricity sector still depends mainly on oil and gas fuel for generating electricity.

5.2.2 Participant Selection

As mentioned before, the focus group questionnaire was selected in order to gather participants' views to identify the procedures, barriers, benefits and drawbacks which may be encountered while referring to the proposed model and additionally, gathering the opinions of the managers in the Egyptian oil refining companies with regards to the proposed performance measurement model.

The focus group questionnaire method was selected over other methods to gather in-depth data from the interaction of participants in one discussion, in which each participant's opinion represents one of the pillars of sustainability (environment, economic and social) respective to their field experience. This interaction is not possible with one-to-one interviews, as the interview consisted of exploring the attitudes and responses of a sole participant. This research sought to gain a broad range of views and perspectives based on the diversity of experience and different backgrounds from different departments, to identify the procedures, barriers, benefits and drawbacks perceived in implementation of the proposed measurement model.

The focus group questionnaire was conducted with the managers in Egyptian oil refining companies. Managers are the individuals who have the widest knowledge and experience of company operations, systems and strategies. Sustainability implementation is considered a managerial role with responsibility for reporting to management boards and Chief Executive Officers (CEO). Participants in the focus group session consisted of 7 Managers, pre-selected from 7 departments, these are: environmental, financial, human resources, health and safety, SC, quality assurance and sustainability, to constitute one focus group team representing one of the seven individual Egyptian oil refining companies. The selection of departments was based on the 3 pillars of sustainability (environmental, economic and social). For instance, the participants who are pre-selected from the environmental department were appointed in the focus group team to gather their perspective from the environmental aspect. Participants pre-selected from the financial department reflect the economic aspect and this same concept is applied across all the pre-selected departments.

The study comprises forty-nine voluntary participants (7 managers from 7 different countries). For each participant, five open-ended questions were required to be answered. This amounts to two hundred and forty-five responses gathered from the focus group sessions. In fact, there were two hundred and fifteen responses gathered from forty-three participants that participated in the focus group discussion. This difference was due to the fact that six of the oil refining companies did not assign participants representing the company's sustainability department as these companies do not have a sustainability department or a person responsible for sustainability practices.

The next section presents the questions to be asked in the focus group sessions and the desired outcomes from each question.

5.2.3 Questions and the Desired Outcome

The focus groups were structured to include five open-ended opinion questions. These questions are shown in Appendix 7. The outcomes of these questions are expected to fulfil the research objectives (as stated in Chapter 1). Table 5.2 below provides an overview of the focus group questions and the desired outcome from each question.

Table 5.2. Focus group questions and the desired outcome.

Research Questions	Desired outcome
Q1. What are the procedures required from oil refining companies when referring to the proposed measurement model as reference to help the company to measure its performance from a sustainability perspective?	The main aim of this question is to understand perspectives, opinions and assumptions in relation to the procedures, steps and processes recommended when oil refining companies are considering the proposed performance measurement model. These procedures can be followed to assist the company in measuring their performance from a sustainability perspective. .
Q2. Are there any barriers facing oil refining companies when referring to the proposed performance measurement model as a reference to assist them in measuring their performance from a sustainability perspective? If so, what are they?	The purpose of this question is to identify the barriers which can obstruct oil refining companies when taking into consideration the proposed performance measurement model, to assist them to measure their performance from a sustainability perspective. The question is designed to focus on the obstacles which make it difficult to adopt the proposed model.
Q3. What are the benefits the oil refining companies can expect to achieve when referring to the proposed performance measurement model as reference to help them in measuring their performance from a sustainability perspective?	This question focuses on the advantages, helpful results and positive effects on the oil refining company when considering the proposed model to assist the company in measuring its performance from a sustainability perspective.
Q4. What are the drawbacks the oil refining companies have to consider when referring to the developed model as a reference to help them in measuring their performance from the sustainability perspective?	This question is designed to extract participant views and opinions of the unfavourable factors which can arise when implanting the proposed performance measurement model from a sustainability perspective. This question focuses on recognising the drawbacks.
Q5. Are there any recommendations or suggestions you wish to add?	This is an open question to allow participants to add any important points that might affect the research topic or the proposed model. The focus group participant can advise the researcher to add, exclude or modify any aspects related to the research topic or the developed model.

These questions were initially tested through a pilot study with 10 managers. This pre-test was undertaken to ensure the feasibility of the questionnaire. Based on the pilot study, these questions underwent some modifications and a new version of the questionnaire was utilised in the focus group sessions with the Egyptian oil refining companies.

Based on the preceding questions, this researcher contacts seven Egyptian oil refinery companies by email to invite them to participate in the study. Correspondingly, an email was sent to each Egyptian oil refinery company. This email included a brief introduction of the research, an information sheet and an organisation consent form. In case the Egyptian oil refining company accepts to participate, a signed organisation consent form is required and sent back by email. In addition, the company is required to select internal participants whose experience is in environmental, financial, quality assurance, human resources, health and safety, SC and sustainability sectors to participate in the focus group session.

Based on participant responses, the researcher could obtain views of the main experts in Egyptian oil refining companies regarding the guidelines, which are in the form of the procedures, barriers, benefits and drawbacks, that can be considered as the roadmap that oil refining companies can refer to when adopting the proposed performance measurement model. Also, the guidelines the research can come out with some modification of the proposed performance measurement model that ends up with modified proposed model, which is regarded as the third version.

This section discussed the reasons for selecting the Egyptian market as a population for conducting an empirical study. In addition, the main aims of the focus group and an outline of the participants participating were provided, alongside an overview of the research questionnaire design and the desired output of each question. The next section presented the data analysis process and the results of the analysis of the data collected from the focus group sessions conducted for the current study, which will be analysed through the means of the thematic and content analysis. According to Stock & Boyer (2009), Maher et al. (2018) and Alyavina et al. (2020) who defined the thematic analysis as a method for finding, arranging and offering insight into the patterns across the gathered qualitative data within the thorough interpreting of that data in the form of codes, categories and themes. On the other hand, the previous study defines the content analysis as an analysis technique that interrupts the data in quantitative counts of codes. In other words, a content analysis focuses on the words content in order to determine the presence of patterns in certain words given in qualitative data. According to, Braun & Clarke, (2006) "these means of analysis can helps the researcher to go through the transcript data repeatedly with the intention of finding patterns of meaning to be interpreted into codes, categories, sub-themes and major themes". Also, supports the researcher in approaching large data sets more easily by sorting them into broad themes. That is, these means of analysis are adopted in this research in order to identify themes, codes and the pool of words that frequently used which related to the guidelines in the form of procedures, barriers, benefits and drawback as well as some modification on the proposed performance measurement model.

5.3 Thematic Analysis

In this section, thematic analysis data are presented. Thematic analysis was adopted in this research in order to identify themes and codes related to the guidelines (procedures, barriers, benefits and drawbacks) as well as modifications to the proposed performance measurement model. Thematic analysis is widely accepted in research relevant to the petroleum sector as it provides researchers with valuable outcomes since data is analysed in a systematic and logical manner to increase data validity and reliability (Irhoma, 2017).

This research followed six processes, as presented by (Braun & Clarke, 2006). The six processes provided the researcher with the opportunity to minimise the errors and misimpression of data analysis. The six processes are as follows:-

1. Being Familiar with the Data Collected

After collecting data from the focus group interview in the form of audio files, the researcher manually transcribed these and preserved them as MS Word files. These transcribed files were later imported into NVIVO-12 version software to be analysed (see appendix 8). According to Maher et al. (2018) "NVivo is the most widely used software tool to assist in organising, analysing and visualising qualitative data".

2. Generating initial code

After importing the data of the focus group questionnaires into NVivo software, all the responses are compiled together. This automatically extracted the most frequently appearing words in the focus group transcripts, such as measure, sustainability, strategy, KPIs, awareness, barriers, economic, drawbacks, practicing, social, environmental, etc. (see appendix 8). These extracted words are considered as nodes. The researcher then sought to group patterns observed in the data into codes, ensuring similar codes are kept under one sub-theme.

3. Searching for themes

After compiling these responses, the researcher then manually reviewed the data to find the themes aligning with the research objectives and questions. The same results were achieved through analysing the data within the NVivo software, using word cloud and tree mapping functions (see appendix 8). The most commonly used words were found to measure, sustainability, strategy, KPIs, awareness, barriers, economic, drawbacks, practicing, social, environmental.

4. Reviewing the themes

The frequently used words were illustrated in the following Table 5.3.

Table 5.3. Word frequency table.

Word	Length	Count	Weighted Percentage (%)
Key	3	61	0.06
Performance	11	72	0.07
Indicators	10	46	0.04
Company	7	87	0.08
Measure	7	23	0.02
Model	5	5	0.005
KPIs	3	14	0.01
Identify	8	7	0.01
Developed	9	5	0.005
Strategy	8	61	0.05
Still	5	3	0.003
Department	10	13	0.01
Sustainability	14	158	0.15
Simulation	10	3	0.003
Start	5	2	0.002
Goals	5	20	0.02
Pillars	7	2	0.002
Vision	6	9	0.01
Aligned	7	3	0.003
Implementing	12	4	0.004
Modifying	9	2	0.002
Step	4	16	0.01

Financial	9	12	0.01
Calculate	9	2	0.002
Cost	4	14	0.01
Team	4	12	0.01
Activities	10	2	0.002
Communicate	11	2	0.002
Employees	9	26	0.02
Understand	10	3	0.003
CEO	3	12	0.01
Investment	10	2	0.002
Top	3	8	0.01
Manager	6	9	0.01
Important	9	2	0.002
Support	7	6	0.01
Awareness	9	10	0.01
Convince	8	3	0.003
Trade-off	8	4	0.004
Resources	9	10	0.01
Time	4	4	0.004
Considerable	12	2	0.002
Barriers	8	13	0.01
Efforts	7	2	0.002
Obstacles	9	3	0.003
Practicing	10	7	0.01
Prevent	7	3	0.003
Beneficial	10	3	0.003
Unaware	7	3	0.003
Lack	4	6	0.01
Hamper	6	2	0.002
Sessions	8	2	0.002
Emissions	9	2	0.002
Data	4	6	0.01
Collected	9	3	0.003
Defining	8	2	0.002
Appropriate	11	2	0.002

Right	5	8	0.01
Wastes	6	5	0.005
Reuse	5	3	0.003
Recycling	7	2	0.002
Less	4	3	0.003
Carbon	6	2	0.002
Foot	4	3	0.003
Prints	6	3	0.003
Environment	11	4	0.004
Reduce	6	4	0.004
Industry	8	2	0.002
Community	9	3	0.003

The data collected from the focus were arranged and transcribed for each company (see appendix 8). The researcher used content and thematic analyses which sought to extract the patterns gathered in the qualitative data and set them into categories that are then translated into codes. Each code was supported by similar nodes. In the same way, sub-themes were determined by checking similar codes and gathering them under one main theme. For this process to take place, the researcher followed some procedures. The first step was to carefully read the transcripts written for the number of focus groups at hand, which is an important process in extracting emerging codes out of the text in the transcripts. Then, the researcher gathered similar codes together and different ones are kept separate from each other. This step was useful in interpreting codes and relating them to each other under one sub-theme if they were similar and putting them under separate sub-theme if they are different from each other.

Next, the researcher counted the codes frequencies to sum them up for sub-themes extraction, which was useful in identifying the relative importance of each emerging sub-theme of the study. In this case, if a code was mentioned by the respondent several times, it is counted by the number of being mentioned and not the number of focus groups that mention a certain code. At this step, the researcher was able to identify the emerging sub-themes and their relative weight with respect to other sub-themes. This helped the researcher to move to the thematic analysis and identify relevant quotes by relating quotes of evidence to each sub-theme extracted in the study.

5. Defining the themes

The role of the researcher was to identify various nodes, codes, sub-themes and themes through the analysis processes, conducted via NVivo software (this process was clarified later in this chapter). Five major themes were categorised under different sub-themes to understand the answer of each of the research questions. Each sub-theme is coded and referenced according to how many times it was repeated in the focus group transcripts and this was marked as a reference in the consequent table. Table 5.4 presents the themes, sub-themes and number of references to each made by respondents.

Table 5.4. Summary table of main themes.

Themes	Sub-themes	Reference	Total
Steps and process	Select the appropriate KPIs	9	44
	Carry out simulation phases	6	
	Set sustainable strategy	13	
	Consider the company's resources	5	
	Communicate with employees	5	
	Convince top managers of sustainable vision	6	
Barriers	Lack of financial resources and efforts	8	41
	Lack of management support	9	
	Limited awareness of the sustainability theme	9	
	Internal communication deficiency	8	
	Difficulty in identification of the appropriate KPIs	5	
	Lack of transparency	2	
Benefits	Support the company to be green	9	52
	Enhance the company's profitability	6	
	Extend the company's social awareness	4	
	Promote the company's performance	13	
	Improve the company's reputation	6	
	Draw the attention of employees and investors	3	
	Increase employee safety	2	
	Increase trust and transparency	3	
	Monitor sustainability progress	6	
Drawbacks	Company commitment	2	4
	Cost	2	
Model Modification	Economic aspect	2	6
	Social aspect	2	
	Environmental aspect	2	

The most significant procedures required from oil refining companies when referring to the proposed measurement model as reference is to **set a sustainable strategy** and this is the most significant sub-theme of them all. The sub-themes **limited awareness of sustainability** and **management support of oil refining** were the most frequent barriers for oil refining companies when referring to the proposed performance measurement model. The most important benefit oil refining companies can achieve when referring to the proposed performance measurement model is to **promote a company's performance**. Finally, the most important drawback for oil refining companies when referring to the proposed performance measurement model is **cost**.

6. Reporting the results

A mind map representing a summary of all points arising from the focus groups is illustrated in Figure 5.2

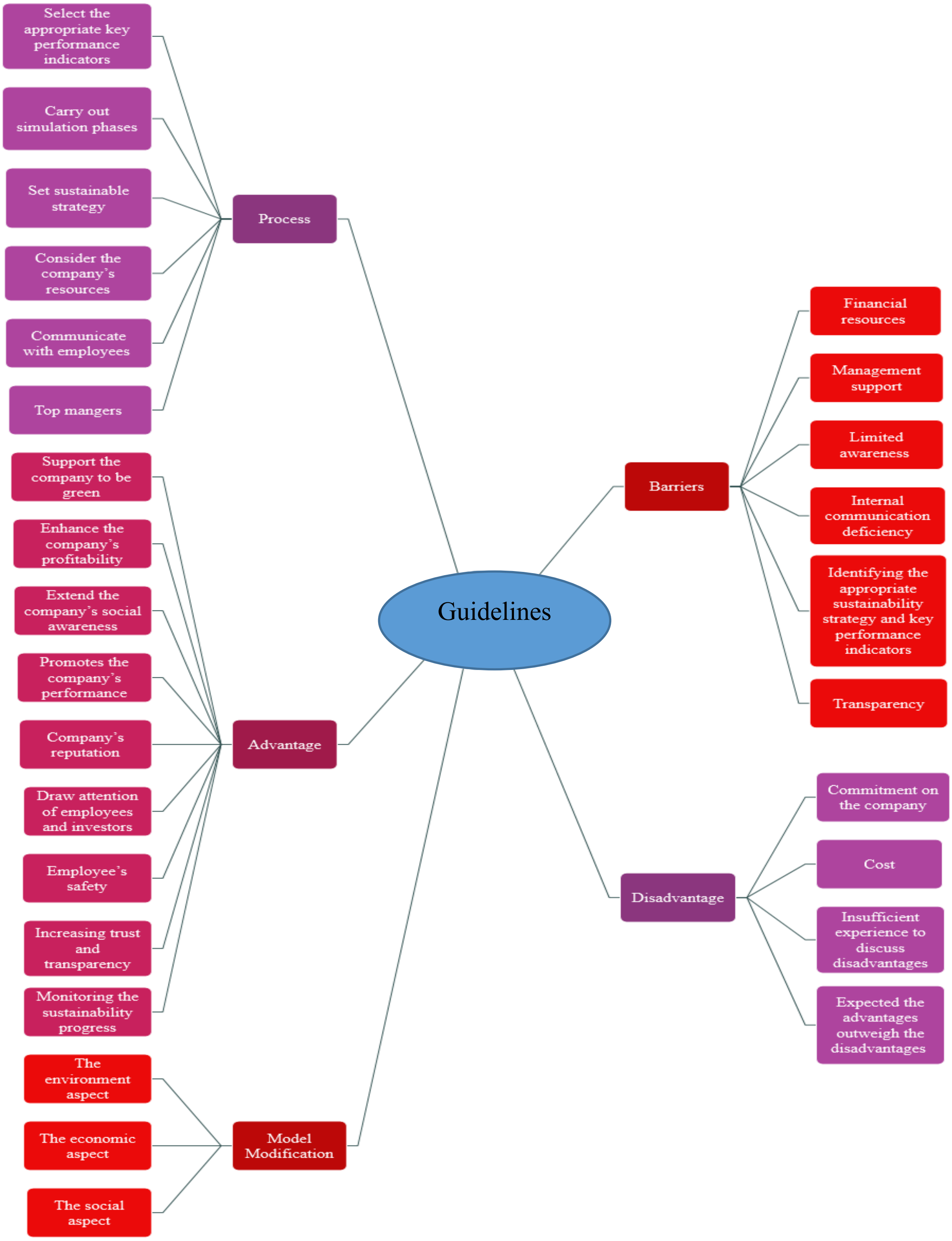

Figure 5.2. Mind mapping of the developed model.

In the next section, the researcher clarified the processes for identifying each sub-theme through extracting the nodes and the codes which support each sub-theme. That is, the researcher extracted 5 themes which are the procedures, barriers, benefits, drawbacks and model modification, based on the research questions stated in the focus group questionnaire. Next, the researcher reviewed and explained data to identify the initial codes. That is, the researcher sought to group patterns observed in the data into codes. The researcher collected similar codes to be kept under one sub-theme. Accordingly, the codes were supported by nodes which represent the reference of participant's quotations (see appendix 8). This means that, under each aspect, there were sub-sections. These sub-sections identified sub-themes placed under each theme. Also, each code related to this sub-theme was defined separately. Then, each code was supported by participant's conversation as well as theses sections ended with a brief discussion and illustration presenting the sub-themes related to each theme. Since the researcher collected 215 responses from the focus group participants, it was a challenge to present all the participants' quotations that were used to support each code and to define the sub-theme (see appendix 9 that presents all the evidential quotes which support each code). Therefore, in the following section, the researcher identified the main themes, sub-themes and codes that supported the sub-theme, in addition to providing an example of the node (the participant's quotation which was used to support the identified codes) for all the sub-themes.

5.3.1 Procedures

As extracted from the focus group respondents the procedures required from oil refining companies when referring to the proposed performance measurement model are selecting the appropriate KPIs, carrying out simulation phases, setting sustainable strategy, considering the company's resources, communicating with employees and convincing top managers of the sustainable vision. These sub-themes, as well as the codes supporting these sub-themes, are presented in the following section separately under the related sub-theme. Additionally, one example of the nodes supporting each code are presented.

A. Select the Appropriate KPIs (KPIs)

The first code extracted to support this sub-theme, was **select the appropriate KPIs.** An evidential quote made by the first focus group was: "*I think the company has to understand first which KPIs are set by the Petroleum Authority, as they are obligatory to implement, which KPIs the company actually uses to measure their performance and which KPIs are still unidentified by the company but are set in the developed model".*

Moreover, the company should **categorise the KPIs**. This was observed by a participant in the first focus group who expressed, *"I think that the company has to categorise the KPIs, so that it gives priority to the KPIs set by the Petroleum Authority. Secondly, it should identify the KPIs matching the company's vision, objectives and strategy"*.

Also, **the company has to pinpoint which developed KPIs suit the project design and equipment.** This was made clear by a respondent in the first focus group who stated that: "*I also want to add that I think that the company also has to identify which KPIs suit the project design and equipment"*.

In addition, **the company should define and understand the developed KPIs.** An evidential quote for this is found in the fourth focus group respondent statement: "*I think the companies have to start with knowing what they need to measure by identifying potential problems and how the current KPIs are used in each department to solve and measure these potential problems. This step will make the company determine the missing KPIs the departments need to measure their progress. Then, the companies, along with the department, should work to find the right measurement by studying the developed model to decide the most appropriate key performance measurement which matches the company's goal and strategy to be used in measuring a department's progress and solving any potential problems"*.

The company *should* **assess the advantages and drawbacks of the developed KPIs before implementing them.** This is observed in the first focus group, with a participant claiming that: *"I think understanding and assessing the measurements, benefits and drawbacks for each KPI is the first stage"*.

The company has to regularly manage and track the current KPIs. This was stated by a participant of the second focus group who said: "*Evaluating a company's KPIs is an important step and managers need to constantly review the company's KPIs at all levels to make sure these indicators are useful to measure and to indicate the required data needed by the company to make better business decisions at the right time"*.

The company has to **refer to successful stories or models that can assist the company in measuring its performance from the sustainability aspect, but choose the KPIs that will help it to meet its sustainability strategy and goals.** This was reflected in the sixth focus group by a participant who stated: "*I want to add that observing a success story of developing sustainability and KPIs is a good example to comply with as it can give a company good insight and some guidelines that it can benefit from"*.

B. Carry Out Simulation Phases

The first code that was extracted to support this sub-theme, is to **carry out simulation** phases. For example, as pointed out by a respondent in the first focus group: "*I think the company should begin by understanding the developed KPIs well, then start to make a simulation for each KPI to assess and define how each KPI can be implemented in the company".*

C. Set Sustainable Strategy

The first code extracted to support this sub-theme is to **set the sustainable strategy.** A participant in the third focus group stated that: *"I expect that the first stage in implementing the model is starting with the company's strategy. I mean, before implementing or modifying any KPI, the department or the company, at all levels, has to realise first what its business is seeking to achieve so that a strategy will be the starting point for modifying or designing the appropriate KPIs".*

The company has to choose the appropriate KPI from the developed model that will align with the company's sustainable strategy. An evidential quote stated by a respondent in the second focus group was: *"Therefore, the assigned team can identify the right KPIs which can help the company's managers to evaluate their progress and performance over time and track whether each department is hitting the company's objectives. In case of non-compliance, the team can guide the department to take the appropriate steps to get there".*

Moreover, **the company should ensure that the company's sustainable strategy covers the three pillars of sustainability.** An evidential quote indicated by a respondent in the fifth focus group was: "*I mean, as we realise from the developed model that sustainability is the integration between three pillars, which are environmental, social and economic, I can observe that some companies' strategy is to focus on the environmental aspect. I can give an example concerning the fact that some companies in the oil refining sector report their greenhouse or carbon dioxide gases. By taking this step, they think that they have a company's sustainable strategy".*

Additionally, it was observed that **there is no single path to develop and implement a sustainability strategy,** which was declared by a participant in the sixth focus group**:** "*I think that there are no ideal steps or a starting point for the development of sustainable KPIs"* and "*I agree that there is no single path used to adopt sustainability and KPIs. I agree that each company represents a unique case and requires a comprehensive review of its own strategy and goals*

D. Consider the Company’s Resources

The first code extracted to support this sub-theme was that a **company has to calculate the cost of the activities carried out to implement the developed KPIs, which match with the company’s sustainable strategy.** An evidential quote revealed was by a respondent in the third focus group who stated: “*I think the important step is to calculate the cost of these activities to develop a KPI”* and “*I think, yes, it is important to identify the right KPI to evaluate and monitor the current performance at all levels, but it is an important step to calculate the cost of the activities carried out to develop such KPI”*.

A company has to be in charge of the sustainability team who will be defining, monitoring, evaluating and implementing the appropriate KPI which will correspond to the company’s sustainable strategy. This is observed by a respondent of the second focus group, who stated that: *“The company should form a team to be in charge of looking at the company’s KPIs. That is, each department will assign one key person to represent the department. Therefore, each key person in the team will be responsible for defining, monitoring, evaluating, implementing and interpreting the KPIs particular for this department”*.

E. Communication with Employees

The first code extracted to support this sub-theme is to **Communicate with Employees. It is observed that the company has to communicate its own sustainable vision, strategy and plan efficiently to its employees to understand the reason and the benefits from implementing the developed KPIs.** An evidential quote stated by a respondent of the second focus group was: “*I believe that KPIs are considered part of the decision-making process for every employee in the company. That is, every employee should understand what metrics the department and company need to gather and how these measurements are linked to the company’s strategy, so every employee can work towards them and provide feedback as necessary”*.

In order to implement the developed model, **continuous modification and evaluation of key performance should be done by a company through increasing employers' and employees’ communication**. This is made clear in the third focus group by a participant who revealed: “*I can also add that each department has to communicate with employees during the modifying or developing phase of the KPI, as to how frequently the department will measure each KPI to monitor the KPI’s status to make sure the developed KPI is still useful and track the information the department intends it to measure”*.

F. Convince Top Managers of Sustainable Vision

An initial code extracted to support this sub-theme was that the **top managers themselves are convinced of a sustainable vision** is proposed so that all the implementation phases are run smoother and easier**.** An evidential quote mentioned by a respondent in the first focus group was: "*I can add that management support is very important, since if the top managers have sustainability awareness and understand the benefits of each KPI, they will give all the needed support by providing awareness, trainings and allocating money to the departments and employees to implement these KPIs".*

5.3.2 Barriers

The barriers which emerged from the data could be expressed into several sub-themes, which are: lack of financial resources and effort, lack of management support, limited awareness of the sustainability theme, internal communication deficiency, difficulty in identifying the appropriate KPIs and lack of transparency. These sub-themes will be illustrated in the following section under the main theme of barriers. Sub-themes are illustrated and under each sub-theme, the codes are identified and presented. Additionally, this research presents one example of the nodes which support each code.

A. Lack of Financial Resources and Efforts

Regarding the first code extracted to support this sub-theme, it was observed that an **oil refining company has a complex design and process, so to insert new KPIs in this complex process requires financial resources and time**. An evidential quote made by a respondent in the first focus group was: "*I think the main barrier is the costs and time required to implement the KPIs. Oil refining companies have a complex design and process, so to introduce new measurements in this complex design, the company is required to spare time, cost and efforts, at all scales, to re-engineer its processes and design to adopt these new KPIs".*

It could also be noted that there is a **lack of financial resources and that resources are considered as essential when a company aims to implement the developed model**. This is made clear by a respondent in the second focus group who stated that: "*I think some companies lack the financial resources to develop the sustainability concept. That is to say, sustainability development requires changes in the company structure, strategies and goals, so a company will bear high costs that demand considerable financial resources".*

A company can **face a trade-off between implementing the developed model and the company's financial resources.** An evidential quote maintained by a participant of the fourth focus group was: "*From my point of view, sustainability development makes the company face a trade-off when dealing with the transition to sustainable practices. In other words, the company will be facing a trade-off in the best course of actions it should take in terms of the company's financial resources, social wellbeing and environmental practices. I think a trade-off is one of the barriers that the company can experience when developing a sustainable concept*".

B. Lack of Management Support

It was observed that **top managers are not aware of the benefits of implementing the developed model, so there will be no support given to implement the developed model.** An evidential quote made by a respondent of the first focus group was: "*I can add that management support is very important. That is, if top managers have sustainability awareness and understand the benefits of each KPI, they will give support by raising awareness, providing training and allocating money to the departments and employees to implement these KPIs*" and "*I think that the barriers which will face a company to implement the KPIs are limited understanding and awareness of the sustainability concept and of the benefits of each KPI*".

It could also be observed that **top managers do have the vision to implement the developed model, but do not have enough experience to implement it**. An evidential quote made by a participant of the first focus group was: "*Regarding the top manager's perspectives and vision, for example, a company can have a certain strategy and all his employees can be adopting this strategy, then the next manager comes in and he/she either supports the same strategy or changes it altogether*".

C. Limited Awareness of the Sustainability Theme

In support of this sub-theme, it was recognised that **employees lack the awareness to understand the benefits of implementing key performance measurement and they can resist or ignore carrying out the developed model.** An evidential quote made by a participant of the first focus group was: "*I think that the attitude and behavior of people towards understanding the concept of sustainability and the benefits of implementing these KPIs will be a barrier. Therefore, I think that raising awareness, having like simulations sessions to visualise the benefits of implementing these KPIs and comparing the performance and the results before implementing these KPIs will make employees fully aware and convinced of implementing these KPIs, even if it will take time and effort*".

It is also observed that there is a **lack of sustainability experts, skills and knowledge**. An evidential quote declared by a participant of the sixth focus group was: "*I think one of the obstacles that can hamper a company for implementing the developed model is the lack of the sustainability skills and knowledge which are required by employees at all levels. That is, effective sustainability performance requires employees with a range of sustainability skills and knowledge to ensure the effective delivery of the company's sustainability policies and objectives*".

The focus group revealed the fact that there is **confusion and conflicts regarding understanding and identifying the appropriate KPIs matching the company's sustainable strategy.** An evidential quote indicated by a participant of the fifth focus group was: "*In my opinion, one of the barriers which can face a company when developing the sustainability theme is defining the sustainability company's measurable goals clearly and determining departments and individuals' responsibilities. That is, if the goals and the tasks are not identified clearly, employees will be unclear regarding the sustainability company's goals and cannot work effectively towards achieving them*".

The Petroleum Authority's level of awareness towards the sustainability theme should be revisited, so the Petroleum Authority can act as a support or barrier to encourage/discourage oil refining companies to implement the developed model. An evidential quote made by a participant of the first focus group was: "*I like to add that the Petroleum Authority can be a barrier or a supporter*".

D. Internal Communication Deficiency

Regarding the first code to support this sub-theme, it is realised that **there is a lack of communication between a company's decision-makers and the employees responsible for measuring, tracking, analysing and eventually submitting a report to the company's decision-makers.** An evidential quote stated by a participant of the second focus group was: "*I think one of the obstacles that can face a company is the disconnect between the decision-makers and those who are measuring, tracking and analysing the data collected to submit their report back to the decision-makers to take the appropriate decisions. The person who is responsible for measuring and analysing the data can have a lack of awareness about the sustainability concept or the company's sustainability goals. In addition, the person reporting and analysing the data might not understand the relevance of the collected data and hence reports irrelevant data*".

There is a lack of communication between employees and top managers while defining a company's new sustainable strategy and the new set of KPIs to measure the company's sustainable performance. An evidential quote stated by a participant of the second focus group was: "*I expect that one of the barriers is the lack of communication between employees and management and this can lead to the employees ignoring the set of KPIs completely, so I suspect that implementing the sustainability concept requires that managers have an open communication channel with the employees"*.

E. Difficulty in Identification of the Appropriate KPIs

Regarding the initial code extracted to support this sub-theme, it was observed there is a **difficulty in selecting the appropriate KPIs aligning with the company's sustainability strategy from the developed model**. An evidential quote revealed by a participant of the third focus group was: "*I think that the first barrier which a company faces is linking the KPIs with the company's sustainable strategy. From my experience, knowing first the company's strategy is a prerequisite for choosing the right KPIs which will assess the company's performance towards achieving its strategy"* and another participant added *"the company can struggle in identifying, defining, measuring and tracking the right KPIs which suit its sustainable goals and strategy"*.

F. Lack of Transparency

The initial code extracted to support this sub-theme is **transparency.** An evidential quote suggested by a participant in the seventh focus group was: "*I think one of the barriers facing our company when shifting towards sustainability is transparency."*

5.3.3 Benefits

The benefits emerging from the data could be expressed into several sub-themes, which are: supporting the company to be green, extending the company's social awareness, promoting the company's performance, monitoring sustainability progress, increasing trust, increasing employee safety, drawing the attention of employees and investors and improving company reputation. These sub-themes will be illustrated in the following section under the main theme of Benefits. Sub-themes are illustrated and under each sub-theme, the codes are identified and presented. Additionally, this research will present one example of the nodes which support each code.

A. Support the Company to be Green

In support of this sub-theme, it was observed that the **oil refining company should be assisted to develop environmental footprints.** An evidential quote stated by a respondent of the second focus group was *"I think companies will notice a reduction in their energy demand, less waste generated, material reuse and recycling, which can lead to less pollution, less cost and more profit. Therefore, these positive practices can indicate that a company should have the vision to implement sustainability practices and implement the developed KPIs in order to track and measure its performance towards sustainability as they will be of great benefit for the company"* and a further participant added that, *"Helping a company to measure its carbon footprints and manage its emissions will result in fewer government fines and more environmentally friendly practices will make the company save money and improve productivity".*

The developed model for sustainability **helps an oil refining company in reducing environmental incidents.** An evidential quote stated by a participant of the second focus group was: "*I think that implementing KPIs reduces environmental incidents and improves employee safety"*.

The developed model **should assist an oil refining company to have more environmentally friendly practices (less waste, less carbon emissions and recycling and reusing generated waste) leading to less pollution and less cost.** An evidential quote maintained by a participant of the fourth focus group was: "*In my opinion, sustainability practices can enhance a company to be green, so that the company seeks to cut carbon emissions and reduce its waste. In addition, sustainability practices support the company to increase eco-efficiency by conserving resources and attempting to find ways to recycle its equipment and materials' waste"*.

B. Enhancing Company Profitability

Regarding the first code extracted to support this sub-theme, it was **observed that an oil refining company helps in minimising energy usage, resulting in less energy demands, which leads to the enhancement of the company's profitability**. An evidential quote revealed by a participant of the third focus group was: "*it is realised that an oil refining company that starts implementing sustainability practices can use energy more efficiently"*.

C. Extending the Company's Social Awareness

Regarding the code extracted to support this sub-theme, was **social awareness is achieved by helping a company to think and support the community. The company will be**

appreciated and it will become a vital part of the company's surrounding community. An evidential quote stated by a participant of the second focus group was: "*I think that when the company has a sustainability vision and implements KPIs to measure and track its performance from the sustainability perspective, it considers the surrounding community. Therefore, the company will be welcomed and appreciated. In addition, the company will become a vital part of its local community"*.

D. Promoting Company's Performance

Regarding the initial code extracted to support this sub-theme, was **the company should be supported to have a different position in the market.** An evidential quote revealed by a participant of the third focus group was: "*In my opinion, the company will have a better image in the industry and the market"*.

Company's performance could also be promoted by **assisting a company to track and measure its current performance, to ensure that such performance matches the company's sustainable strategy.** An evidential quote made by the first focus group was: "*I think it easily makes the managers of each department and of the organisation as whole to follow up the performance of each unit, employee, piece of equipment and to easily determine the defenses or problems to resolve"*.

The company's performance could be promoted by **encouraging it to comply with the domestic and international rules and regulations.** An evidential quote revealed by the third focus group was: "*In my opinion, a company that has a sustainability strategy helps itself to comply with regulations and avoid any non-compliance costs"*.

E. Improving Company's Reputation

Regarding the first code which extracted to support this sub-theme, was **that company reputation is one of the benefits for a company**. An evidential quote stated by a participant of the second focus group was: "*In my opinion, good company reputation is one of the benefits gained when a company implements the developed model to track and measure its performance from the sustainability perspective frequently"*.

F. Draw the Attention of Employees and Investors

Regarding the initial code which support this sub-theme, **was to draw the attention of employees and investors.** An evidential quote maintained by a participant of the fourth focus group was: "*I believe that a company that has sustainable practices can attract a greater, more* *talented and qualified pool of employees. That is, employees would want to work with companies that ensure that they will have a healthy and motivating workplace".*

G. Increasing Employees' Safety

Regarding the first code extracted to support this sub-theme, was **employee safety.** An evidential quote maintained by a participant of the fourth focus group was: "*A company is enhanced to create decent and safe jobs for employees including diversity, equity and empowerment. Moreover, the company seeks to contribute to and support the community through investment and relationships".*

H. Increasing Trust and Transparency

Regarding the first code which support this sub-theme, was **observed that the company helps to retain the credibility and confidence of the shareholders and employees, in the meantime and in the future, as they will be reassured that the company will be concerned with the economic, social and environmental aspects.** An evidential quote stated by a respondent of the second focus group was: "*A company's sustainability practices build the credibility and confidence of both future and present employees, investors and suppliers. These parties expect that the company is concerned with the social and environmental responsibility".*

Also, the company can **develop credibility and transparency between the company and the government resulting in fewer complaints, less inspections and fewer fines**. An evidential quote stated by a respondent of the second focus group was: "*I think when a company has a sustainable system and KPIs to track and measure its performance from the sustainability practice, there will be credibility and transparency in the relationship between the company and the government. Consequently, this company will have fewer inspections, less fines and fewer complaints from its neighbors and the community".*

I. Monitoring Sustainability Progress

Regarding the initial code extracted to support this sub- theme, was **the developed model can be used as a tool that will guide the company to take the right steps in achieving the company's sustainability goals and objectives**. An evidential quote made by a respondent in the first focus group was: "*I think the integration between measures will help a company to* *know where it is in relation to where it wants to be, so the developed KPIs are navigation tools to achieve the company's strategy to be sustainable"*.

5.3.4 Drawbacks

The drawbacks emerging from the data could be expressed into several sub-themes, which are: company commitment, cost, insufficient experience to discuss drawbacks and the expectation that the advantages outweigh the drawbacks. These themes were illustrated in the following section under the main theme of Drawbacks. Sub-themes were illustrated and under each sub-theme, the codes were identified and presented. Additionally, this research presented one example of the nodes which support each code.

A. Company Commitments

Regarding the first code extracted to support this sub-theme, was noticed **that a company has to regularly consider the economic, social and environmental aspects**. An evidential quote stated by a participant of the second focus group was: "*I think one of the drawbacks of implementing the developed model is that it commits the company to frequently measure its performance from the sustainability context"*.

B. Cost

Regarding the initial code extracted to support this sub-theme, **it is realised that an oil refining company has a complex design and process, so to insert new KPIs in this complex process, the company will bear initial costs.** An evidential quote suggested by a participant of the seventh focus group was: "*At this stage, our company is making progress towards achieving the sustainability goals, so I think one of the drawbacks is the initial costs which the company bears to transfer its entire business strategy into a sustainable business strategy"* and another participant added that, "*Although from my perspective, all the high initial cost which the company bears at the beginning, the company will save in the long run because sustainability development plays an important role in minimising energy usages and waste costs. The fewer resources the company uses; the more money the company can save. Consequently, most of the company savings will come from the sustainability practices, which encourages the company to find ways to reduce energy usage, such as ways to reduce water usage and energy usage (like electricity, gas and fuel) and this means the company will cut carbon dioxide and greenhouse gas emissions. In addition, reduction in waste means recycling and using less material. Therefore, all the initial costs borne by the company at the beginning will be transferred in the long run into company savings"*.

5.3.5 Model Modification

In addition to the themes mentioned above, there were some recommendations and suggestions made by the focus group participants which ended in re-developing the performance measurement model. These modifications were expressed into the environmental theme, the economic and the social theme. The proposed modifications resulted in a third version of the comprehensive SC performance measurement model. The new version of the comprehensive SC performance measurement model from the sustainability perspective and specific to the oil refining sector was illustrated Figure 4.10 to 4.12.

A. Environmental Aspect

Regarding the code which extracted to support this sub-theme, which is the **environmental aspects**, it was observed that the environment aspect includes air emission reduction, energy and eco-systems. An evidential quote made by a participant in the first focus group was: "*I think you can add **"air emission reduction**" in the model because, as I have explained above, there are methods and systems to **reduce air emissions**"* and "*Please change "ISO 14001 certification" in the environment aspect model to "ISO certification"* as *a KPI."*

Based on the previous discussion, there was a development in the environmental aspect, which was illustrated in Figure 5.3.

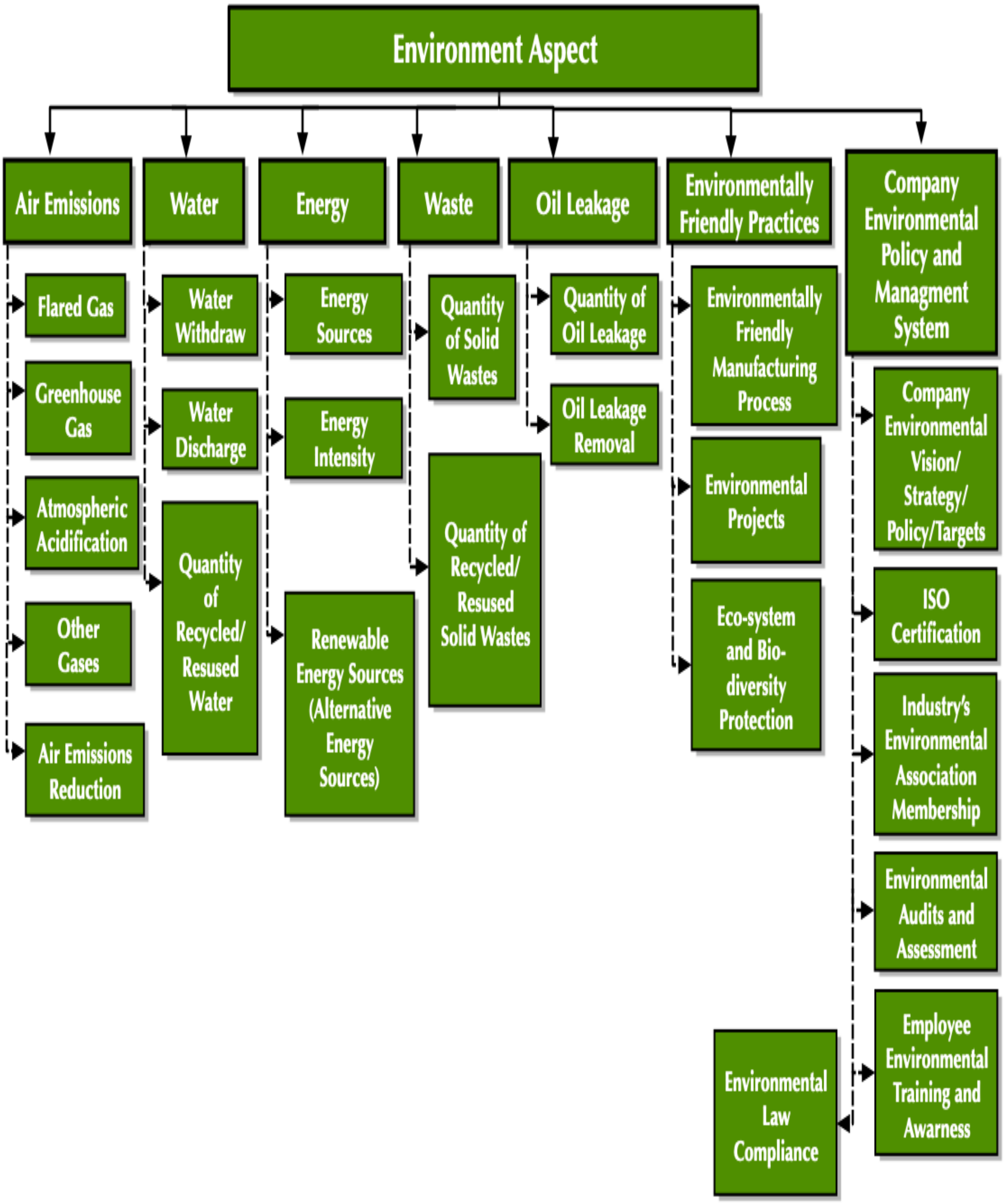

Figure 5.3. The modified model from the environmental perspective (3rd version).

B. Economic Aspect

Regarding the code which extracted to support this sub- theme, the **economic aspect**s, it was observed that there were recommendations to add change or exclude the following points from the economic aspect. Some additional points were mentioned, like certificates, following an evidential quote made by a participant of the first focus group was: "*I would like to thank you first for this session. Also, I advise you to modify the KPI which is "**ISO** 9001 **certification**" to "**ISO certification**" because there are many qualities of **ISO certificates**. I think stating **ISO certificates** in your model will be more comprehensive than determining one **certificate** in particular"*.

Table 5.4 shows the modified model from the economic perspective.

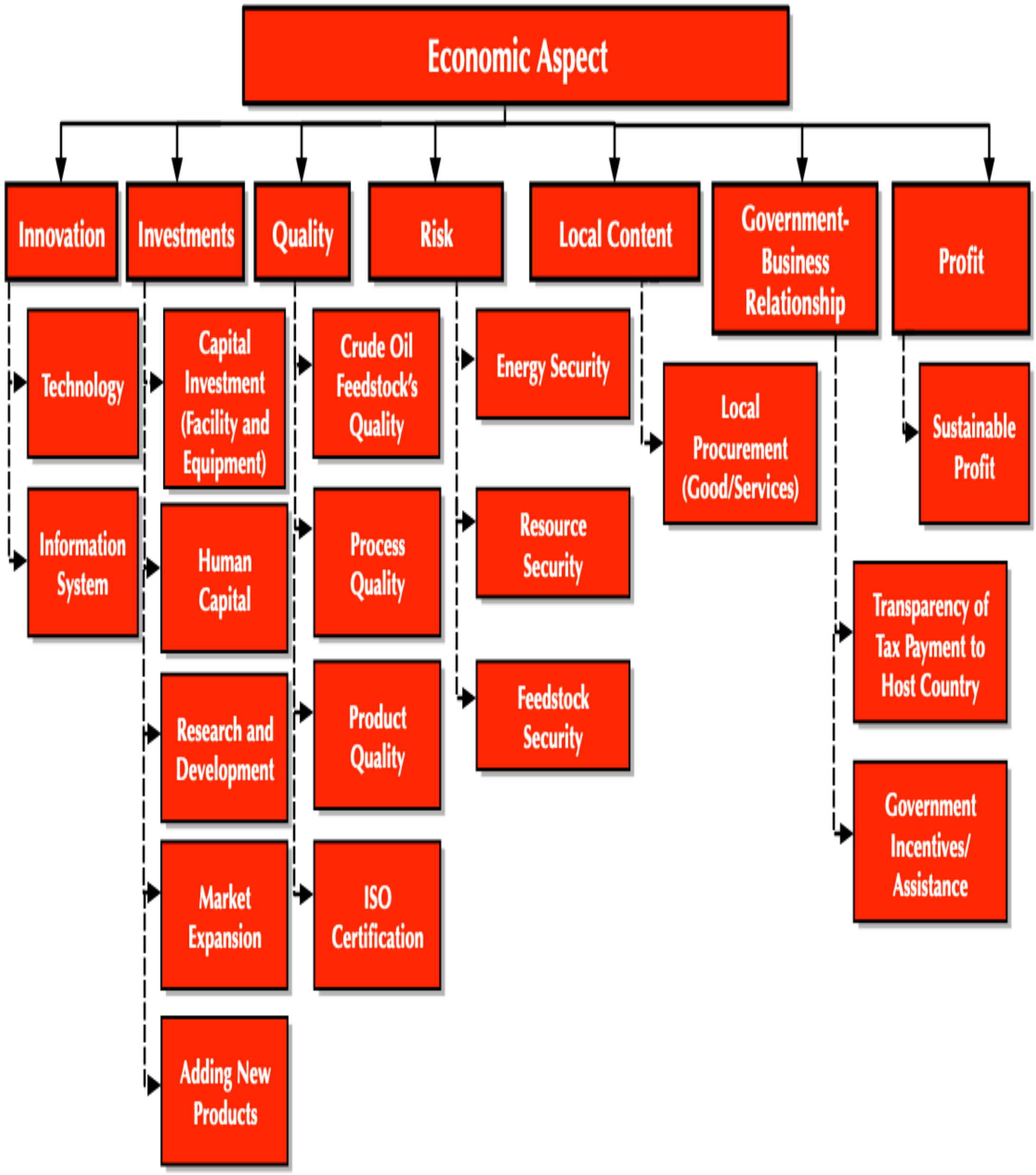

Figure 5.4. The modified model from the economic perspective (3rd version).

C. Social aspect

Regarding the code which extracted to support sub- theme, is **the social aspect**, it was observed that there are several points the participants suggested to add/modify/exclude from the social aspect. An evidential quote made by a respondent in the first focus group was: "*Also, I advise you to change the name of the KPI which is "**occupational safety and health**" to "**occupational health and safety**""* and "*I recommend that you add **Hazard and Operability study (HAZOP)** in the **social model** under the **occupational health and safety aspect,** as it is a tool currently used in some oil refining companies and this tool contributes to risk control within the company or a project"*.

After integrating this feedback, Figure 5.5 shows the modified developed model from the social perspective.

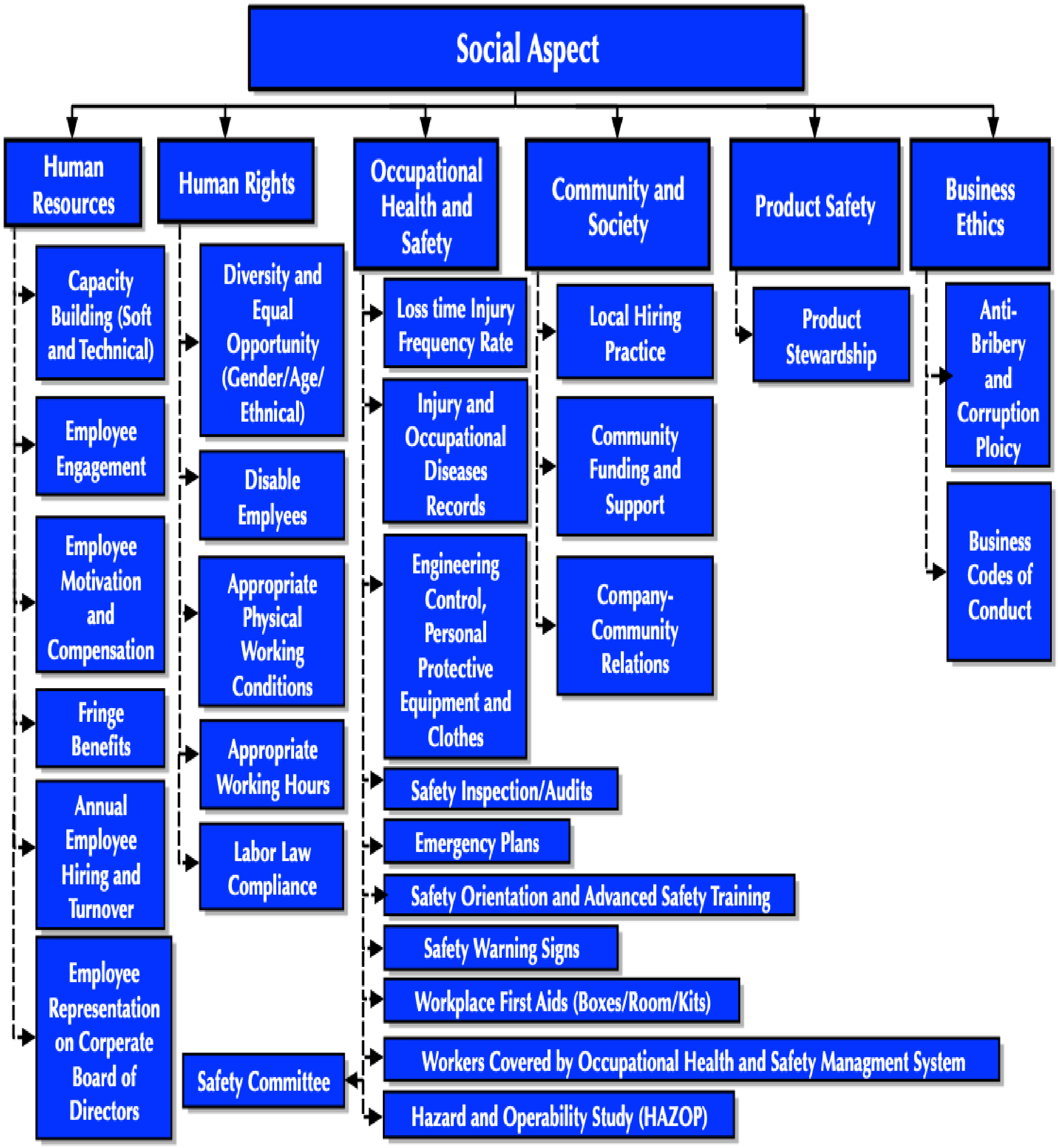

Figure 5.5. The modified model from the social perspective (3rd version).

5.3.5.1 Evaluating the effectiveness of the 3rd version of the proposed model for addressing the global challenges

This evaluation is an extension of the previous evaluation conducted in chapter 3, that was carried out on the initial proposed model and the second version of the model. Table 5.5 below sums up the evaluation of effectiveness of the third version of the proposed model in addressing the current global challenges facing the oil refining sector.

Table 5.5 Evaluating the effectiveness of the 3rd version of the proposed model in addressing the current global challenges of the oil refinery sector.

No.		KPIs' of 3rd version of the proposed model	
		Addressed	Not Addressed
Environmental			
1	Air emission reduction	√	
2	Recycling of wastewater	√	
3	Recycling of solid wastes	√	
4	Production of environmentally friendly products		√
5	Energy preservation in all oil refining processes	√	
6	Implementing new projects concerning environmentally friendly practices	√	
7	Protecting ecosystem	√	
Economic			
8	Complying with International standards	√	
9	Staying up to date with the latest developments and innovation	√	
10	Data integration		√
11	Risk management processes	√	
12	Building relationships with governments	√	
13	Investing in operations, processes, facilities, equipment and employees	√	
Social			
14	Social responsibility	√	
15	HAZOP	√	

This table shows that many of the global challenges facing the sector were addressed by 3rd version of the proposed model. However, two of the identified challenges, namely production of environmentally friendly products and data integration, were not addressed. Accordingly, 3rd version of the proposed model underwent further modifications via integrating data from an online global survey, thus allowing addressing enable more of the current global challenges.

5.4 Summary

This chapter presented the results of the conducted focus group questionnaire with company managers in the Egyptian oil refining sector. The focus group session highlighted current sustainability practice in the Egyptian oil refining sector and identified the guidelines, in the form of procedures, barriers, benefits and drawbacks, that may encounter the oil refining companies upon implementing the proposed model. These guidelines can be considered as a roadmap which is required to help in successful implementation of the proposed model. The focus group questionnaire sought to gather the perspectives of company managers in the Egyptian oil refining sector on the proposed model, so they have the opportunity to modify/add/exclude any aspects of the KPIs set in the proposed performance measurement models. Suggested modifications resulted in the development of the third version of the proposed model, that was assessed in terms of its effectiveness in terms of addressing the identified current global challenges. This assessment revealed that there are still some challenges that remained unaddressed. Therefore, additional modifications were still required to address more of the identified current global challenges. In this way, the outcomes obtained from conducting the focus group were used to demonstrate the applicability of the proposed model.

To analyse the conducted focus group questionnaire, NVivo-12 software was utilised to assist the researcher in extracting the most frequently used words via word frequency clouds and tree-mapping functions. These words were presented and summarised according to the nodes created: measure, sustainability, strategy, KPIs, awareness, barriers, economic, drawbacks, practicing, social, environmental. Accordingly, these words were grouped up under different sub-themes based on similarity and then tailored under the identified main themes.

In the next chapter, the applicability of the modified proposed model was tested via consideration of the relationships between the identified research variables formulated in the research hypotheses (see chapter 2). In other words, this research sought to test the applicability of these proposed models on a wider scale, to ensure that the proposed model can be applied in practice on an international scale. The oil refining industry has to follow strict international rules and regulations, so it is important to ensure that the proposed model considers the international context and this was achieved via a survey, distributed globally, to gather the perspective of experts, including academic practitioners and company managers.

Chapter 6: Online Survey on Performance Measurement in the Oil Refining Sector: A Global Perspective

6.1 Introduction

This chapter discussed the fourth research phase, as identified in chapter 4 and the fourth research objective and question (see chapter 1). The chapter presented the outcomes of the online survey.

This online survey sought to gather the perspectives of global experts in the oil refining sector, including academics and practitioners Since, the main aim of this study is to develop a comprehensive performance measurement model capable of integrating the three pillars of sustainability, incorporating the oil refining characteristics and addressing the current global challenges, it is therefore, crucial to comprehend how the proposed model might be applicable and relevant in various global contexts. The composition of both perspectives can assist in improving the usefulness and quality of the outcomes. The online survey facilitates consideration of the nature of the oil refining industry and its adherence to the international rules and regulations through obtaining a wide variety of opinions with minimal effort and expense, particularly since they are geographically distant. In this way, the data gathered from the online survey was expected to test the applicability of the proposed model in international context. These data would then be analysed and converted into numerical data to test the relationships between the identified research variables, that is the research hypotheses as pointed out previously in Chapter 2 in Section 2.6.5.

The research hypotheses tested in this chapter, were formulated based on previous studies such as; Kazemi (2016), Anghelei (2017), Mojarad et al. (2018), Kalinina et al. (2019), and Barforoush et al. (2020) these studies have explored performance measurement for sustainability in the oil refining sector. Reviewing these papers highlighted the fact that the majority of the studies fail to integrate the three pillars of sustainability for effectively measuring sustainability practice. The models utilised in the previous papers focused on only one or two dimensions of sustainability, whereas other dimensions with equal significance were overlooked. In addition, the models referred in these studies failed to effectively address the challenges and global trends in the oil refining industry. It is essential to incorporate these challenges into company visions, strategies and performance measurement systems to effectively monitor and evaluate performance and to ensure compliance with industry trends and company objectives. Addressing these trends would assist oil refining companies to increase their competitiveness and enable them to better adapt to evolving trends. Moreover, these studies were limited by their reliance on a single case study and fail to carry out a comparative analysis. It is beneficial to consider multiple case studies, compare findings with existing models and aim for internationalisation, ensuring broader applicability and validation of the models referred to in these studies.

In addition, practitioners in the industry pointed out through conducting the exploratory interviews that some companies still count on the widely used performance measurement models in the oil refining sector. Deploying these models will not provide a comprehensive assessment of sustainability practices as not all the required dimensions of sustainability are integrated and traditional metrics are relied upon.

It is clear there are shortcomings in how sustainability practice is currently monitored and evaluated within the industry. This can result in incomplete measurement of performance which will ultimately have an adverse impact on company's performance overall.

Based on the findings of the previous studies, the first and second research hypotheses were formulated. For the first, it was hypothesised that existing models may not impact company's performance significantly in terms of the environmental, economic and social aspects. The first hypothesis therefore, examined the relationship between the existing key indicators on company's performance in terms of the economic, environmental and social aspects. The first research hypothesis is subdivided into sub-hypotheses H1.1, H1.2 and H1.3; which were tested separately. Each hypothesis examined the relationship from a different aspect. H1.1 tested the relationship from an economic aspect, H1.2 tested the relationship from an environmental aspect and H1.3 tested relationships from a social aspect.

The second hypotheses evaluated the effectiveness of the proposed model from a global perspective in comparison with other existing models, in terms of environmental, economic and social aspects. The second research hypothesis was subdivided into sub-hypothesis H2.1, H2.2 and H2.3 and each was tested separately. H2.1 tested the effectiveness of the proposed model from an economic aspect, H2.2 tested the effectiveness of the proposed model from an environmental aspect and H2.3 tested effectiveness of the proposed model from a social aspect. Accordingly, the hypotheses are as follows:

H1: The currently used key performance indicators will not yield a noticeable impact on company's performance in terms of the environmental, economic and social aspects.

H1.1: The currently used environmental key performance indicators will not yield a noticeable impact on company’s performance in terms of the environmental aspect.

H1.2: The currently used economic key performance indicators will not yield a noticeable impact on company’s performance in terms of the economic aspect.

H1.3: The currently used social key performance indicators will not yield a noticeable impact on company’s performance in terms of the social aspect.

H2: There is a significant difference between the developed model and traditional models in terms of their impact on company’s performance with regard to the environmental, economic and social aspects.

H2.1: There is a significant difference between the developed model and current models in terms of their impact on company’s performance with regard to the environmental aspects.

H2.2: There is a significant difference between the developed model and traditional models in terms of their impact on company’s performance with regard to of the economic aspects.

H2.3: There is a significant difference between the developed model and traditional models in terms of their impact on company’s performance with regard to the social aspects.

These hypotheses were tested in the following sections of this chapter. The main aim of the survey was to test the relationships between the variables formulated in the form of hypothesis. That’s to say that the outcome of survey analysis can assist this research in testing the applicability of the proposed model on a global scale by comparing the proposed model's effectiveness to that of the existing models in terms of measuring company’s performance related to the economic, environmental and social aspects. As this survey sought to gather global perspective from researchers and oil refining company managers, it helped the researcher in gathering multiple viewpoints, beliefs and experiences from different cultures. In addition, gathering multiple perspectives from researchers and managers provided better understanding and reduced conflicts and the bias. The survey results also supported the perceptions gained in the focus groups.

The remainder of the chapter was designed as follows: Section 6.2 verified the survey data, identifying the survey design by discussing the criteria for selecting the survey’s participants and the desired outcome of the surveys’ questions, additionally testing data quality before any further analysis to check the data gathered for the potential of non-responses biased. Section

6.3 a descriptive analysis which is presented for both; the respondent profile and the research variables through calculating the means and frequencies of the research variables. Section 6.4 tested research hypotheses using correlation, regression and Mann-Whitey analysis. Section 6.4 presented a summary of the results displayed in the analysis.

6.2Verifying the Survey Data

This section clarified the design of the survey by identifying the survey questions and the desired outcome of these questions. The criteria for selecting survey participants are also outlined. Besides, testing data quality before any further analysis to check the data gathered for the potential of non-responses biased.

6.2.1 Survey Design

The survey was comprised of five main sections. The first section was comprised of demographic questions, such as the respondent’s profession and department. The second section was concerned with collecting data regarding the oil refining sector. Next, section three explored respondents’ opinions regarding the proposed performance measurement model. Section four sought opinions regarding the proposed guidelines, such as procedures, barriers, benefits and drawbacks, that may encounter oil refining companies upon implementing the proposed performance measurement model. Section five included one open question for participants should they wish to offer any further information that may assist in the development of the proposed performance measurement model.

A pilot study was incorporated in the design to ensure that participants are able to answer the survey questions smoothly. Accordingly, the survey was sent to approximately 15 participants who were asked to provide feedback about the manageability of the survey after completion. As a further clarification, the questions were pre-tested and the results of the pre-test were used to review the questionnaire. The pre-testing was used to assess the needed time as well as the wording, clarity, sequence and appropriateness of the questions. Pre-testing provided the researcher the opportunity to modify the survey questions and sections based on the pretesting participant’s comments.

Accordingly, the survey was distributed globally to academic researchers and oil refining company managers. Researchers with an academic background in oil refining, performance management, or sustainability were targeted and complemented by oil refining company managers with professional experience in the oil refining field. The diversity of experience in the oil refining sector enabled the researcher to gain a broad range of views and perspectives to verify the survey objectives. Since the survey sought to gather a global perspective of oil refining experts' opinions, collecting data for the whole population would be impossible because it is large and geographically dispersed. Therefore, sub-groups of the population were identified forming an optimum research sample size to which the online survey questionnaire was sent. The sampling size and the type selected for this phase were previously discussed (see Chapter 4). Forming the sample, 626 participants (243 managers and 383 researchers) were targeted to send invitation letters. Fifty-one percent of the participants responded to the survey, so the total number of participants' responses was 323 (154 managers and 169 researchers). This percentage is considered higher than previous studies which conducted online surveys in the same sector. By comparison, other researchers exploring the same field were only able to obtain responses from 20 to 40 percent of the sampling size that they specified in their research (Parast & Adams, 2012; Menhat, 2017).

The following section presented the survey results as the analysis was carried out using Statistical Package for Social Science (SPSS) 26 software. This package is typically used for analysing data collected through survey questionnaires. A descriptive analysis was presented for both the respondent profile and the research variables, by calculating the means and frequencies of the research variables as well as testing the research hypotheses using correlation, regression and the Mann-Whitey analysis model. This chapter will outline the main findings and results after running the data analysis.

The next section also presented the method utilised to check the data gathered from the survey for the potential of non-response bias.

6.2.2 Testing the Survey's Data Quality

To test the possibility of non-response bias data, the responses were separated into two waves: early responses representing the first wave and late responses representing the second one. The analysis was done by comparing the responses from the first wave with responses from the second wave through using t-test. Previous studies in the same field used the same t-test to check the potential of non-response bias in the responses they gathered through their survey (Wan Ahmad et al., 2016; Menhat, 2017). In this study, the researcher aimed at testing the data quality for the following separately. Firstly, responses were tested for each of the KPIs from the environmental, economic and social aspects individually. These KPIs are currently used in the oil refining sector. The responses which represent the currently used KPIs were gathered to gain a comprehensive understanding of current practice in the oil refining sector. Secondly, the researcher tested the responses gathered regarding the company's performance upon referring to the currently used KPIs in the oil refining sector. These responses were gathered to better understand the effectiveness of the currently used KPIs on company's performance. As well as, testing the data quality regarding the company's performance upon referring to the KPIs set in the proposed performance measurement model, these responses were gathered to have a deep understanding of the effectiveness of the proposed model on companies' performance. Since, these data are needed to test the research hypotheses. Table 6.1, Table 6.2, Table 6.3 and Table 6.4 show the results of two independent samples T-test including data from the first wave (early responses) and comparing these to data from the second wave of responses (late responses) for each of the previously mentioned aspects.

The aim of this research was to gain a comprehensive insight from researchers concerned with the oil refining sector as well as company managers in the oil refining sector. Therefore, in section 6.3 and 6.4 an individual analysis is set out focusing on the responses gathered from researchers on one side and company managers on the other side to gain a thorough understanding of their perspectives individually. However, while later sections differentiated the responses from the academics and company managers, in this section, there was no segregation of the responses as the aim in this section was to assess the data's overall impartially quality.

Table 6.1. Data quality for environmental KPIs currently used in the oil refining sector.

Environmental KPIs	t	Sig	Environmental KPIs	T	Sig
Flared gas	-0.61	0.54	Quantity of recycled/ reused solid waste	-0.81	0.42
Greenhouse gas	-0.14	0.89	Quantity of oil leakage	0.47	0.64
Atmospheric acidification	-2.98	0.00	Quantity of leakage removal	1.11	0.27
Other gases	-1.37	0.17	Environmentally friendly manufacturing processes	-1.42	0.16
Air emissions reduction	-0.57	0.57	Environmental projects	-1.64	0.10
Water withdraws	0.15	0.88	Eco-system and bio-diversity protection	-1.01	0.32
Water discharge	0.09	0.93	Company environmental vision/ strategy/policy/ targets	1.80	0.07
Quantity of recycled/ reused water	-2.27	0.02	ISO certification	-0.23	0.82
Energy sources	-0.27	0.78	Industry environmental association membership	1.21	0.23
intensity Energy	1.37	0.17	Environmental audits and assessment	-3.26	0.00
Renewable energy sources	-0.31	0.75	Employee environmental training and awareness	-0.90	0.37
Quantity of solid wastes	-0.02	0.99	Environmental law compliance	-0.57	0.57

According to the Table 6.1, in the majority of the environmental KPIs there was no significant difference between the responses of the two waves, so there is no non-response bias except for atmospheric acidification and environmental audits and assessment.

Table 6.2. Data quality for economic KPIs currently used in the oil refining sector

Economic KPIs	t	Sig	Economic KPIs	t	Sig
Technology	0.147	0.883	Product quality	-2.245	0.025
Information system	-0.207	0.836	ISO certification	-0.098	0.922
Capital investment	0.094	0.925	Energy security	0.728	0.467
Human capital	-3.833	0.000	Resource security	-0.868	0.386
Research and development	-2.017	0.045	Feedstock security	-2.178	0.030
Market expansion	1.002	0.317	Local procurement	1.714	0.088
Adding new products	0.097	0.922	Transparency of tax payment to host country	-1.715	0.087
Crude oil feedstock quality	0.468	0.640	Government incentives/ assistance	-0.029	0.977
Process quality	1.688	0.092	Sustainable profit	-1.965	0.050

According to the Table 6.1, for the majority of the economic KPIs, there was no significant difference between the responses of the two waves, so there is no non-response bias except for human capital, feedstock security, research and development and product quality.

Table 6.3. Data quality for social KPIs currently used in the oil refining sector.

Social KPIs	t	Sig	Social KPIs	t	Sig
Capacity building (soft and technical)	-0.500	0.618	Safety Inspection/ Audits	1.311	0.191
Employee engagement	-3.714	0.000	Emergency Plans	-1.014	0.312
Employee motivation and compensation	-1.485	0.139	Safety Orientation and Advanced Safety Training	1.002	0.317
Fringe benefits	0.113	0.910	Safety Warning Signs	-0.157	0.875
Annual employee hiring and turnover	0.563	0.574	Workplace First Aids (Boxes/Rooms/Kits)	0.283	0.777
Employee representation on corporate board of directors	-1.882	0.061	Workers Covered by Occupational Health and Safety Management System	1.369	0.172
Diversity and equal opportunity (Gender/ Age/ Ethnicity)	-1.140	0.255	Hazard and Operability Study (HAZOP)	1.709	0.088
Disabled employees	0.515	0.607	Safety Committee	0.147	0.883
Appropriate Physical Working Conditions	-1.825	0.069	Local Hiring Practice	1.129	0.260
Appropriate Working Hours	1.245	0.214	Community Funding and Support	0.725	0.469
Labour Law Compliance	1.556	0.121	Company-Community Relations	0.329	0.742
Loss time injury Frequency Rate	1.695	0.091	Product Stewardship	-1.498	0.135
Injury and Occupational Diseases Records	0.770	0.442	Anti-bribery and Corruption Policy	3.230	0.001
Engineering Control, Personnel Protective Equipment and Clothes	-2.362	0.019	Business Codes of Conduct	-0.662	0.508

According to the Table 6.3, for the majority of the environmental KPIs, there was no significant difference between the responses of two waves, so there is no non-response bias except for employee engagement and engineering control, personnel protective equipment and clothes and anti-bribery and corruption policy.

Overall, it was clear that, 90% of the previously mentioned KPIs show non-response bias where their significance was higher than 0.05 (sig>0.05). However, while there are some KPIs where the significance was lower than 0.05, which means these KPIs should be deleted, the researcher did not delete such KPIs because they were gathered through several stages including conducting a literature review and carrying out focus group sessions.

Table 6.4. Data quality for company's performance

Company's performance in terms of the environmental, economic and social aspect	KPIs of existing models		KPIs of the proposed model	
	T	Sig	t	Sig
1- Reducing air emissions, oil leakage, water withdrawal, water discharge and solid waste	0.767	0.444	-0.142	0.887
2- Considering energy efficiency, environmentally friendly practices and environmental policy and management system	-0.418	0.676	-0.316	0.752
3- Supporting innovation, investment, quality, reduced risk, local content and government-business relationships	0.722	0.471	0.241	0.810
4- Appreciating employee rights and occupational health and safety	-0.576	0.565	-1.173	0.242
5- Respecting community, society and business ethics	0.046	0.963	-0.542	0.588
6- Achieving growth, better performance profitability	-0.051	0.959	-0.348	0.728

Table 6.4 shows that there are no significant differences between the responses of the two waves, so there is no non-response bias where significance was higher than 0.05 (sig>0.05).

In the next section, the researcher presents the descriptive analysis for the respondent profile and the research variables by calculating the means and frequencies of the research variables.

6.3 Descriptive Analysis

Descriptive statistics is a tool to examine the features of certain datasets. Data was described here using tables of frequency that show the number and the percentage of how many times each variable was repeated. The next section presented the descriptive analysis for both the respondent profile and the research variables.

6.3.1 Descriptive Analysis of Respondents' Profile

Descriptive analysis was used to present a short summary about the respondents and how the diversification has been applied to select a representative sample. Data was described here using tables of frequency, that show the number and the percentage of respondents participating in the questionnaire under each category. Table 6.5 represents the profile of respondents that participated in this study, in consideration of their work, department and the current models used in the oil refining sector.

Table 6.5. Descriptive analysis of respondents' profiles.

Aspect	Category	Frequency	Percentage (%)
Respondents' work	Researcher	162	50.2
	Manager in oil refining company	161	49.8
	Total	323	100.0
Respondents' department	**Category**	**Frequency**	**Percentage (%)**
	Environmental	73	22.6
	Financial	18	5.6
	Human Resources	27	8.4
	Health and Safety	56	17.3
	SC	75	23.2
	Quality assurance	31	9.6
	Sustainability	12	3.7
	Others	31	9.6
	Total	323	100.0

As shown in the table, the total sample participating in the research is n=323 respondents. Participants were subdivided into researchers and managers. Researchers show the highest percentage with 50.2 % (n=162); in contrast to managers with around 49.8 % (n=161). For the respective department, most respondents were from the SC department with a value of 23.2% (n=75).

For the model currently used, some respondents did not mention a specific model and most respondents refer to models such as SCOR, BSC, or KPIs that are related to the petroleum authority, or environmental or quality models, or customised KPIs. Therefore, it is clear that oil refining companies are still using the aforementioned performance measurement models

Descriptive Analysis of Research Variables

The data described here used tables of frequency and percentages as well as calculating the mean for each research variable. In the next section, frequency and percentages were calculated for each of the research variables. Items were measured on the five-point Likert scale (1: strongly disagree, 2: disagree, 3: neutral, 4: agree, 5: strongly agree). If the mean value of item was less than or equal to 1.79, it was considered strongly disagree, between 1.8 to 2.59 is considered disagree, between 2.6 to 3.39 is considered neutral, between 3.4 to 4.19 is considered agree and 4.2 and higher is strongly agree.

As previously mentioned, the survey aimed at identifying the environmental, economic and social KPIs currently used by the oil refining sector. Additionally, it also attempted to test the impact of each of these indicators separately on the companies' performance regarding the social performance, economic performance and environmental performance. For example, the impact of the social indicators currently adopted in the oil refining sector and the current companies' social performance were tested. The same was repeated with the other dimensions of sustainability (economic and environmental). In addition, the survey attempted to test the effectiveness of the proposed model by testing the significant difference of the current performance of oil refining companies in comparison with the expected companies' performance when referring to the proposed model. The expected performance of companies regarding the three dimensions of sustainability were tested independently. For example, the current companies' performance regarding the social aspect were tested in comparison with the expected companies' performance regarding the social aspect when referring to the proposed model. The same was repeated with the other aspects (economic and environmental). Additionally, the survey aimed at gathering respondents' perspectives about the procedures, barriers, benefits and drawbacks extracted from the focus group analysis. Furthermore, the survey also sought to understand the impact of referring to the proposed model while following the proposed guidelines in terms of procedures, benefits, barriers and drawbacks.

Therefore, the researcher sought to a conduct descriptive analysis for responses gathered from academic researchers and company managers to gain a thorough understanding of their separate perspectives. Firstly, a descriptive analysis was carried out to understand the company's performance when referring to the currently used KPIs in the oil refining sector (see Table 6.6, 6.7), identifying the environmental, economic and social KPIs used in the oil refining sector (see Tables 6.8, 6.9, 6.10, 6.11, 6.12 and 6.13) and additionally, defining the company's expected performance when referring to the proposed KPIs (see Table 6.14, 6.15). Additionally, the researcher sought to understand the determinates including procedures, barriers, benefits and drawbacks encountered by oil refining companies when referring to the model (see Table 6.16, 6.17, 6.18, 6.19, 6.20, 6.21, 6.22, 6.23). Finally, the researcher also attempted to understand the link between referring to the KPIs stated in the proposed model and following the expected procedures and avoiding the barriers and drawbacks on company's performance (see Table 6.24). The following tables show the frequency, percentage and the mean for each research variable.

Table 6.6. Descriptive analysis of company's performance when referring to the currently used KPIs in the oil refining sector according to researchers

Company's performance regarding the environmental, economic and social aspect		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Reducing air emissions, oil leakage, water withdrawal, water discharge and solid waste	No.	8	35	12	78	11	3.34
	%	5.6	24.3	8.3	54.2	7.6	
Considering energy efficiency, environmentally friendly practices and environmental policy and management system	No.	20	77	12	29	6	2.47
	%	13.9	53.5	8.3	20.1	4.2	
Supporting innovation, investment, quality, reduced risks, local content and government-business relationships	No.	12	51	21	46	14	2.99
	%	8.3	35.4	14.6	31.9	9.7	
Appreciating employee rights and occupational health and safety	No.	6	95	14	27	2	2.47
	%	4.2	66.0	9.7	18.8	1.4	
Respecting community, society and business ethics	No.	23	82	12	27	0	2.3
	%	16.0	56.9	8.3	18.8	0	
Achieving growth, better performance and profitability	No.	0	42	16	66	20	3.44
	%	0	29.2	11.1	45.8	13.9	

Table 6.7. Descriptive analysis of company's performance when referring to the currently used KPIs in the oil refining sector according to managers

Company's performance regarding the environmental, economic and social aspect		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Reducing air emissions, oil leakage, water withdrawal, water discharge and solid wastes	**No.**	3	27	17	47	24	3.53
	%	2.5	22.9	14.4	39.8	20.3	
Considering energy efficiency, environmentally friendly practices and environmental policy and management system	**No.**	3	66	12	21	16	2.84
	%	2.5	55.9	10.2	17.8	13.6	
Supporting innovations, investments, quality, less risks, local content and government- business relationship	**No.**	6	35	13	40	24	3.35
	%	5.1	29.7	11.0	33.9	20.3	
Appreciating employees' rights and occupational health and safety	**No.**	6	61	13	37	1	2.71
	%	5.1	51.7	11.0	31.4	0.8	
Respecting community, society and business ethics	**No.**	9	74	14	21	0	2.4
	%	7.6	62.7	11.9	17.8	0	
Achieving growth, better performance and profitability	**No.**	0	27	8	57	26	3.69
	%	0.0	22.9	6.8	48.3	22.0	

The tables showed that most of the participants agreed that the currently used KPIs in the oil refining sector can help companies to reduce air emissions, oil leakage, water withdrawal, water discharge and solid waste. Similarly, the participants agreed that the currently used KPIs in the oil refining sector can assist oil refining companies to achieve growth and have better performance and profitability. On the other hand, few participants agreed that the currently used KPIs in the oil refining sector can support innovation, investment, quality, reduced risks, local content and government-business relationships. However, the researchers and managers demonstrated that the currently used KPIs in the oil refining sector still, although insufficiently, can help the oil refining companies to consider energy efficiency, environmentally friendly practices and environmental policy and management systems. Participants agree that the currently used KPIs in the oil refining sector inappropriately can help oil refining companies regarding community, society and business ethics. it was clear that the KPIs used in the oil refining sector need to address more aspects vital to oil refining companies, so they can effectively measure their performance from the sustainability perspective as well as the oil refining sector still need to refer to more KPIs to enhance the sustainability practice of the oil refining companies.

Table 6.8. Descriptive analysis of the environmental KPIs currently used in the oil refining sector according to researchers

Environmental KPIs		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Flared Gas	**No.**	7	17	10	118	10	3.66
	%	4.3	10.5	6.2	72.8	6.2	
Greenhouse Gas	**No.**	3	45	11	92	11	3.39
	%	1.9	27.8	6.8	56.8	6.8	
Atmospheric Acidification	**No.**	0	109	16	36	1	2.56
	%	0	67.3	9.9	22.2	0.6	
Other Gases	**No.**	10	101	13	36	2	2.5
	%	6.2	62.3	8.0	22.2	1.2	
Air Emissions Reduction	**No.**	5	113	7	36	1	2.48
	%	3.1	69.8	4.3	22.2	0.6	
Water Withdrawal	**No.**	6	106	14	36	0	2.49
	%	3.7	65.4	8.6	22.2	0	
Water Discharge	**No.**	2	51	12	91	6	3.3
	%	1.2	31.5	7.4	56.2	3.7	
Quantity of Recycled/ Reused Water	**No.**	6	117	12	27	0	2.37
	%	3.7	72.2	7.4	16.7	0	
Energy Sources	**No.**	5	107	7	41	2	2.56
	%	3.1	66.0	4.3	25.3	1.2	
Energy Intensity	**No.**	4	45	7	102	4	3.35
	%	2.5	27.8	4.3	63.0	2.5	
Renewable Energy Sources	**No.**	14	107	13	24	4	2.36
	%	8.6	66.0	8.0	14.8	2.5	
Quantity of Solid Wastes	**No.**	7	48	7	96	4	3.26
	%	4.3	29.6	4.3	59.3	2.5	

Environmental KPIs (Cont.)		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Quantity of Recycled/ Reused Solid Wastes	**No.**	10	105	4	42	1	2.5
	%	6.2	64.8	2.5	25.9	0.6	
Quantity of Oil Leakage	**No.**	4	35	10	109	4	3.46
	%	2.5	21.6	6.2	67.3	2.5	
Quantity of Leakage Removal	**No.**	3	47	7	105	0	3.32
	%	1.9	29.0	4.3	64.8	0	
Environmentally Friendly Manufacturing Processes	**No.**	11	115	10	25	1	2.32
	%	6.8	71.0	6.2	15.4	0.6	
Environmental Projects	**No.**	7	106	12	36	1	2.49
	%	4.3	65.4	7.4	22.2	0.6	
Eco-system and Bio-diversity protection	**No.**	20	101	11	30	0	2.31
	%	12.3	62.3	6.8	18.5	0	
Environmental Vision/ Strategy/Policy/ Targets	**No.**	8	114	6	32	2	2.42
	%	4.9	70.4	3.7	19.8	1.2	
ISO Certification	**No.**	0	16	11	127	8	3.78
	%	0	9.9	6.8	78.4	4.9	
Environmental association membership	**No.**	6	102	15	39	0	2.54
	%	3.7	63.0	9.3	24.1	0	
Environment Audits and Assessment	**No.**	0	21	15	113	13	3.73
	%	0	13.0	9.3	69.8	8.0	
Environmental Training and Awareness	**No.**	8	103	13	38	0	2.5
	%	4.9	63.6	8.0	23.5	0	
Environmental law compliance	**No.**	0	7	16	117	22	3.95
	%	0	4.3	9.9	72.2	13.6	

Table 6.9. Descriptive analysis of the environmental KPIs currently used in the oil refining sector according to managers

Environmental KPIs		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Flared Gas	**No.**	4	20	6	120	11	3.71
	%	2.5	12.4	3.7	74.5	6.8	
Greenhouse Gas	**No.**	2	31	15	104	9	3.54
	%	1.2	19.3	9.3	64.6	5.6	
Atmospheric Acidification	**No.**	3	95	13	47	3	2.7
	%	1.9	59.0	8.1	29.2	1.9	
Other Gases	**No.**	5	99	13	40	4	2.62
	%	3.1	61.5	8.1	24.8	2.5	
Air Emissions Reduction	**No.**	6	92	13	49	1	2.67
	%	3.7	57.1	8.1	30.4	0.6	
Water Withdrawal	**No.**	6	104	11	38	2	2.54
	%	3.7	64.6	6.8	23.6	1.2	
Water Discharge	**No.**	2	45	14	87	13	3.4
	%	1.2	28.0	8.7	54.0	8.1	
Quantity of Recycled/ Reused Water	**No.**	7	98	13	36	7	2.61
	%	4.3	60.9	8.1	22.4	4.3	
Energy Sources	**No.**	5	109	13	32	2	2.48
	%	3.1	67.7	8.1	19.9	1.2	
Energy Intensity	**No.**	6	37	11	99	8	3.41
	%	3.7	23.0	6.8	61.5	5.0	
Renewable Energy Sources	**No.**	10	97	10	40	4	2.57
	%	6.2	60.2	6.2	24.8	2.5	
Quantity of Solid Wastes	**No.**	2	45	6	99	9	3.42
	%	1.2	28.0	3.7	61.5	5.6	

Environmental KPIs (Cont.)		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Quantity of Recycled/ Reused Solid Wastes	**No.**	7	105	16	32	1	2.47
	%	4.3	65.2	9.9	19.9	0.6	
Quantity of Oil Leakage	**No.**	3	27	18	111	2	3.51
	%	1.9	16.8	11.2	68.9	1.2	
Quantity of Leakage Removal	**No.**	0	51	6	104	0	3.33
	%	0	31.7	3.7	64.6	0	
Environmentally Friendly Manufacturing Processes	**No.**	6	119	9	25	2	2.37
	%	3.7	73.9	5.6	15.5	1.2	
Environmental Projects	**No.**	7	101	15	38	0	2.52
	%	4.3	62.7	9.3	23.6	0	
Eco-system and Bio-diversity protection	**No.**	23	101	12	25	0	2.24
	%	14.3	62.7	7.5	15.5	0	
Companies' Environmental Vision/ Strategy/Policy/ Targets	**No.**	10	101	13	36	1	2.48
	%	6.2	62.7	8.1	22.4	0.6	
ISO Certification	**No.**	1	10	17	125	8	3.8
	%	0.6	6.2	10.6	77.6	5.0	
Industry`s environmental association membership	**No.**	17	89	15	40	0	2.48
	%	10.6	55.3	9.3	24.8	0	
Environment Audits and Assessment	**No.**	25	12	111	13	0	3.7
	%	15.5	7.5	68.9	8.1	0	
Employees' Environmental Training and Awareness	**No.**	7	95	14	40	5	2.63
	%	4.3	59.0	8.7	24.8	3.1	
Environmental law compliance	**No.**	0	3	7	126	25	4.07
	%	0	1.9	4.3	78.3	15.5	

according to the previous table, it is clear that some KPIs received a strong agreement, which means they are commonly used by oil refining companies to measure the company's performance from the environmental perspective. These KPIs are flared gas, water discharge, energy intensity, quantity of solid waste, quantity of oil leakage, quantity of oil leakage removal, ISO certification, environmental audits and association, environmental law compliance. On the contrary, there are other environmental KPIs which received a slight agreement, which means that oil refining sector slightly uses these environmental KPIs to measure oil refining companies' performance from the environmental aspect. These KPIs are atmospheric acidification, other gases, air emissions reduction, water withdrawal, quantity of recycled-reused water, energy sources, renewable energy sources, quantity or recycled/re-used solid waste, environmentally friendly manufacturing process, environmental projects, eco-system and bio-diversity protection, environmental vision/strategy/policy/targets, environmental association membership and environmental training and awareness. Accordingly, companies should take into account the KPIs that received less attention from oil refining companies since these KPIs are relevant to the oil refining sector. Since these KPIs can help oil refining companies to monitor, track and measure company's performance from various environmental perspectives, this can lead to enhancement in environmental performance as well as sustainability practices for companies within the oil refining sector.

Table 6.10 Descriptive analysis of the economic KPIs currently used in the oil refining sector according to researchers

Economic KPIs		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Technology	**No.**	21	102	6	31	2	2.33
	%	13.0	63.0	3.7	19.1	1.2	
Information Systems	**No.**	10	94	16	41	1	2.56
	%	6.2	58.0	9.9	25.3	0.6	
Capital Investment	**No.**	0	2	1	123	36	4.19
	%	0	1.2	0.6	75.9	22.2	
Human Capital	**No.**	0	28	14	109	11	3.64
	%	0	17.3	8.6	67.3	6.8	
Research and Development	**No.**	0	33	8	117	4	3.57
	%	0	20.4	4.9	72.2	2.5	
Market Expansion	**No.**	0	41	16	95	10	3.46
	%	0	25.3	9.9	58.6	6.2	
Adding New Products	**No.**	0	40	15	103	4	3.44
	%	0	24.7	9.3	63.6	2.5	
Crude Oil Feedstock Quality	**No.**	0	13	10	133	6	3.81
	%	0	8.0	6.2	82.1	3.7	
Process Quality	**No.**	0	1	1	138	22	3.8
	%	0	0.6	0.6	85.2	13.6	
Product Quality	**No.**	0	1	1	138	22	4.12
	%	0	0.6	0.6	85.2	13.6	
ISO Certification	**No.**	0	33	12	109	8	3.57
	%	0	20.4	7.4	67.3	4.9	
Energy Security	**No.**	5	37	15	100	5	3.39
	%	3.1	22.8	9.3	61.7	3.1	
Resource Security	**No.**	2	28	11	115	6	3.59
	%	1.2	17.3	6.8	71.0	3.7	

Economic KPIs (Cont.)		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Means
Feedstock Security	**No.**	3	51	15	84	9	3.28
	%	1.9	31.5	9.3	51.9	5.6	
Local Procurement	**No.**	11	114	11	26	0	2.32
	%	6.8	70.4	6.8	16.0	0	
Transparency of Tax Payment to Host Country	**No.**	1	33	14	109	5	3.52
	%	0.6	20.4	8.6	67.3	3.1	
Government Incentives/Assistance	**No.**	10	94	18	37	3	2.56
	%	6.2	58.0	11.1	22.8	1.9	
Sustainable profit	**No.**	30	132	0	0	0	1.81
	%	18.5	81.5	0	0	0	

Table 6.11. Descriptive analysis of the economic KPIs currently used in the oil refining sector according to managers

Economic KPIs		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Technology	**No.**	23	83	17	38	0	2.42
	%	14.3	51.6	10.6	23.6	0	
Information Systems	**No.**	15	97	17	32	0	2.41
	%	9.3	60.2	10.6	19.9	0	
Capital Investment	**No.**	0	0	5	121	35	4.19
	%	0	0	3.1	75.2	21.7	
Human Capital	**No.**	0	27	14	105	15	3.67
	%	0	16.8	8.7	65.2	9.3	
Research and Development	**No.**	0	23	12	123	3	3.66
	%	0	14.3	7.5	76.4	1.9	
Market Expansion	**No.**	0	40	15	101	5	3.44
	%	0	24.8	9.3	62.7	3.1	
Adding New Products	**No.**	1	39	20	96	5	3.4
	%	0.6	24.2	12.4	59.6	3.1	
Crude Oil Feedstock Quality	**No.**	0	14	8	136	3	3.8
	%	0	8.7	5.0	84.5	1.9	
Process Quality	**No.**	0	20	10	129	2	3.7
	%	0	12.4	6.2	80.1	1.2	
Product Quality	**No.**	0	1	1	124	35	4.2
	%	0	0.6	0.6	77.0	21.7	
ISO Certification	**No.**	0	35	15	104	7	3.52
	%	0	21.7	9.3	64.6	4.3	
Energy Security	**No**	2	44	14	96	5	3.36
	%	1.2	27.3	8.7	59.6	3.1	

Economic KPIs (Cont.)		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Means
Resource Security	**No.**	0	22	14	119	6	3.68
	%	0	13.7	8.7	73.9	3.7	
Feedstock Security	**No.**	0	40	10	94	17	3.55
	%	0	24.8	6.2	58.4	10.6	
Local Procurement	**No.**	2	117	15	27	0	2.42
	%	1.2	72.7	9.3	16.8	0	
Transparency of Tax Payment to Host Country	**No.**	9	27	13	109	3	3.43
	%	5.6	16.8	8.1	67.7	1.9	
Government Incentives/Assistance	**No.**	18	93	10	39	1	2.45
	%	11.2	57.8	6.2	24.2	0.6	
Sustainable profit	**No.**	21	140	0	0	0	1.87
	%	13.0	87.0	0	0	0	

It is clear from this table, that some KPIs were in the agreement zone, which means they are commonly used by oil refining companies. These KPIs are capital investment, human capital, research and development, market expansion, adding new products, crude oil feedstock quality, process quality, product quality, ISO certification, energy security, feedstock security and transparency of tax payment to host country. On the contrary, other KPIs were not strongly agreed by respondents which means that they are rarely used by oil refining companies. These KPIs are technology, information systems, local procurement, government incentives/ assistance, sustainable profit. Accordingly, companies should pay more attention to these less frequently relied upon indicators as these KPIs reflect the characteristics of the oil refining sector from the economic aspect and they will contribute to enhancing companies' economic performance and sustainability practices.

Table 6.12. Descriptive analysis of the social KPIs currently used in the oil refining sector according to researchers

Social KPIs		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Capacity Building (Soft and Technical)	**No.**	1	49	5	89	18	3.46
	%	0.6	30.2	3.1	54.9	11.1	
Employee Engagement	**No.**	14	108	19	19	2	2.3
	%	8.6	66.7	11.7	11.7	1.2	
Employee Motivation and Compensation	**No.**	11	100	7	44	0	2.52
	%	6.8	61.7	4.3	27.2	0	
Fringe Benefits	**No.**	12	82	4	59	5	2.77
	%	7.4	50.6	2.5	36.4	3.1	
Annual Employee Hiring and Turnover	**No.**	4	38	11	98	11	3.46
	%	2.5	23.5	6.8	60.5	6.8	
Employee Representation on Corporate Board of Directors	**No.**	16	94	8	44	0	2.49
	%	9.9	58.0	4.9	27.2	0	
Diversity and Equal Opportunity (Gender/ Age/ Ethnicity)	**No.**	10	102	9	39	2	2.51
	%	6.2	63.0	5.6	24.1	1.2	
Disabled Employees	**No.**	10	112	6	34	0	2.4
	%	6.2	69.1	3.7	21.0	0	
Appropriate Physical Working Conditions	**No.**	5	122	9	26	0	2.35
	%	3.1	75.3	5.6	16.0	0	
Appropriate Working Hours	**No.**	2	33	10	102	15	3.59
	%	1.2	20.4	6.2	63.0	9.3	
Labour Law Compliance	**No.**	0	21	11	117	13	3.75
	%	0	13.0	6.8	72.2	8.0	
Loss time injury Rate	**No.**	3	57	7	95	0	3.2
	%	1.9	35.2	4.3	58.6	0	

Social KPIs (Cont.)		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Injury and Occupational Diseases Records	No.	0	30	7	115	10	3.65
	%	0	18.5	4.3	71.0	6.2	
Engineering Control, Personnel Protective Equipment and Clothes	No.	0	32	9	114	7	3.59
	%	0	19.8	5.6	70.4	4.3	
Safety Inspection/Audits	No.	0	0	0	140	22	4.14
	%	0	0	0	86.4	13.6	
Emergency Plans	No.	0	14	8	132	8	3.83
	%	0	8.6	4.9	81.5	4.9	
Safety Orientation and Advanced Safety Training	No.	7	8	140	7	0	3.91
	%	4.3	4.9	86.4	4.3	0	
Safety Warning Signs	No.	9	66	6	81	0	2.98
	%	5.6	40.7	3.7	50.0	0	
Workplace First Aid (Boxes/Rooms/Kits)	No.	14	78	4	66	0	2.75
	%	8.6	48.1	2.5	40.7	0	
Workers Covered by Occupational Health and Safety Management System	No,	11	80	6	59	6	2.81
	%	6.8	49.4	3.7	36.4	3.7	
Hazard and Operability Study (HAZOP)	No.	10	90	4	40	18	2.79
	%	6.2	55.6	2.5	24.7	11.1	
Safety Committee	No.	7	51	16	78	10	3.2
	%	4.3	31.5	9.9	48.1	6.2	
Local Hiring Practice	No.	7	124	7	24	0	2.3
	%	4.3	76.5	4.3	14.8	0	
Community Funding and Support	No.	14	99	15	32	2	2.44
	%	8.6	61.1	9.3	19.8	1.2	
Company-Community Relations	No.	14	121	7	18	2	2.22
	%	8.6	74.7	4.3	11.1	1.2	
Product Stewardship	No.	24	75	8	53	2	2.59
	%	14.8	46.3	4.9	32.7	1.2	
Ant-bribery and corruption policy	No.	13	87	14.8	38	0	2.54
	%	8.0	53.7	24	23.5	0	
Business Codes of Conduct	No.	4	91	24	41	2	2.67
	%	2.5	56.2	14.8	25.3	1.2	

Table 6.13. Descriptive analysis of the social KPIs currently used in the oil refining sector according to managers' responses

Social KPIs		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Capacity Building (Soft and Technical)	**No.**	0	50	8	85	18	3.44
	%	0	31.1	5.0	52.8	11.2	
Employee Engagement	**No.**	10	91	20	38	2	2.57
	%	6.2	56.5	12.4	23.6	1.2	
Employee Motivation and Compensation	**No.**	6	80	10	65	0	2.83
	%	3.7	49.7	6.2	40.4	0	
Fringe Benefits	**No.**	18	73	11	56	3	2.71
	%	11.2	45.3	6.8	34.8	1.9	
Annual Employee Hiring and Turnover	**No.**	2	19	17	109	14	3.71
	%	1.2	11.8	10.6	67.7	8.7	
Employee Representation on Corporate Board of Directors	**No.**	8	71	14	68	0	2.88
	%	5.0	44.1	8.7	42.2	0	
Diversity and Equal Opportunity (Gender/ Age/ Ethnicity)	**No.**	14	83	12	51	1	2.64
	%	8.7	51.6	7.5	31.7	0.6	
Disabled Employees	**No.**	14	117	13	16	1	2.21
	%	8.7	72.7	8.1	9.9	0.6	
Appropriate Physical Working Conditions	**No.**	7	90	8	48	8	2.75
	%	4.3	55.9	5.0	29.8	5.0	
Appropriate Working Hours	**No.**	1	14	14	117	15	3.81
	%	0.6	8.7	8.7	72.7	9.3	
Labour Law Compliance	**No.**	0	11	10	124	16	3.9
	%	0	6.8	6.2	77.0	9.9	
Loss time injury n Rate	**No.**	11	59	1	89	1	3.06
	%	6.8	36.6	0.6	55.3	0.6	
Injury and Occupational Diseases Records	**No.**	0	13	12	133	3	3.78
	%	0	8.1	7.5	82.6	1.9	
Engineering Control, Personnel Protective Equipment and Clothes	**No.**	0	19	4	119	19	3.86
	%	0	11.8	2.5	73.9	11.8	
Safety Inspection/Audits	**No.**	0	0	5	132	24	4.12
	%	0	0	3.1	82.0	14.9	
Emergency Plans	**No.**	0	14	10	129	8	3.81
	%	0	8.7	6.2	80.1	5.0	

Social KPIs (Cont.)		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Safety Orientation and Advanced Safety Training	**No.**	0	2	9	129	21	4.05
	%	0	1.2	5.6	80.1	13.0	
Safety Warning Signs	**No.**	4	81	11	65	0	2.85
	%	2.5	50.3	6.8	40.4	0	
Workplace First Aid(Boxes/Rooms/Kits)	**No.**	8	87	14	52	0	2.68
	%	5.0	54.0	8.7	32.3	0	
Workers Covered by Occupational Health and Safety Management System	**No.**	6	72	6	72	5	2.99
	%	3.7	44.7	3.7	44.7	3.1	
Hazard and Operability Study (HAZOP)	**No.**	11	96	9	35	10	2.61
	%	6.8	59.6	5.6	21.7	6.2	
Safety Committee	**No.**	3	54	11	88	5	3.24
	%	1.9	33.5	6.8	54.7	3.1	
Local Hiring Practice	**No.**	6	107	15	33	0	2.47
	%	3.7	66.5	9.3	20.5	0	
Community Funding and Support	**No.**	16	93	13	38	0	2.47
	%	9.9	57.8	8.1	23.6	0	
Company-Community Relations	**No.**	7	121	7	26	0	2.32
	%	4.3	75.2	4.3	16.1	0	
Product Stewardship	**No.**	6	26	8	111	10	3.58
	%	3.7	16.1	5.0	68.9	6.2	
Ant-bribery and corruption policy	**No.**	13	83	23	42	0	2.58
	%	8.1	51.6	14.3	26.1	0	
Business Codes of Conduct	**No.**	11	86	16	44	4	2.65
	%	6.8	53.4	9.9	27.3	2.5	

As per the previous table, it is clear that some KPIs had been in the agreement zone, which signifies that they are frequently used by oil refining companies. These KPIs are capacity building (soft and technical), annual employee hiring and turnover, appropriate working hours, labour law compliance, loss time injury frequency rate, injury and occupational diseases records, engineering control, personnel protective equipment and clothes, safety inspections and audits, emergency plans, safety orientation and advanced safety training, safety committee, product stewardship). This is in contrast to other KPIs which were not strongly approved by respondents, which means that they are not commonly adopted by oil refining companies. These KPIs are employee engagement, employee motivation and compensation, fringe benefits, employee representation on corporate board of directors, diversity and equal opportunity (gender, age, ethnicity), disabled employees, appropriate physical working conditions, safety warning signs, workplace first aid (boxes/rooms/kits), workers covered by occupational health and safety management system, hazard and operability (HAZOP), local hiring practice, community funding and support, company- community relations, anti-bribery and corruption policy and business codes of conduct. Accordingly, companies should pay more attention to these social indicators that are slightly used as these KPIs reflect the features of the oil refining sector from the social aspect. These indicators are expected to help companies' social performance as well as to enhance the company's sustainability practices.

Table 6.14. Descriptive analysis of company's performance when referring to the proposed model according to researchers

Company's performance regarding environmental, economic and social aspects		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Reducing air emissions, oil leakage, water withdrawal, water discharge and solid wastes	**No**	0	12	10	117	23	3.93
	%	0	7.4	6.2	72.2	14.2	
Considering energy efficiency, environmentally friendly practices and environmental policy and management system	**No.**	5	38	22	73	24	3.45
	%	3.1	23.5	13.6	45.1	14.8	
Supporting innovations, investments, quality, less risks, local content and government- business relationship	**No.**	0	2	17	101	42	4.13
	%	0	1.2	10.5	62.3	25.9	
Appreciating employee rights and occupational health and safety	**No.**	0	13	15	112	22	3.88
	%	0	8.0	9.3	69.1	13.6	
Respecting community, society and business ethics	**No.**	0	14	9	124	15	3.86
	%	0	8.6	5.6	76.5	9.3	
Achieving growth, better performance and profitability	**No.**	0	3	25	116	18	3.92
	%	0	1.9	15.4	71.6	11.1	

Table 6.15. Descriptive analysis of company's performance when referring to the proposed model according to managers

Company's performance regarding environmental, economic and social aspects		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Reducing air emissions, oil leakage, water withdrawal, water discharge and solid wastes	**No.**	3	6	21	96	35	3.96
	%	1.9	3.7	13.0	59.6	21.7	
Considering energy efficiency, environmentally friendly practices and environmental policy and management system	**No.**	0	15	17	95	34	3.92
	%	0	9.3	10.6	59.0	21.1	
Supporting innovations, investments, quality, less risks, local content and government- business relationship	**No.**	0	8	23	101	29	3.94
	%	0	5.0	14.3	62.7	18.0	
Appreciating employee rights and occupational health and safety	**No.**	0	8	12	111	30	4.01
	%	0	5.0	7.5	68.9	18.6	
Respecting community, society and business ethics	**No.**	0	16	17	120	8	3.75
	%	0	9.9	10.6	74.5	5.0	
Achieving growth, better performance and profitability	**No.**	0	1	27	87	46	4.11
	%	0	0.6	16.8	54.0	28.6	

According to the table, it was clear that the expected performance of the proposed model is mainly in the agreement zone. Most of the respondents agreed that referring to the proposed KPIs might provide oil refining companies with the opportunity to enhance sustainability practices as a result of having more KPIs than the currently used models. Consequently, it is expected that the proposed model will assist companies to measure their performance regarding the social, environmental and economic aspects which are expected to enhance sustainability practices for companies in the oil refining sector.

Table 6.16. Descriptive analysis of the procedures' themes according to researchers

Procedures' Themes		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Selecting the appropriate KPIs	**No.**	0	2	9	115	36	4.14
	%	0	1.2	5.6	71.0	22.2	
Carrying out simulation phases	**No.**	9	47	27	75	4	3.11
	%	5.6	29.0	16.7	46.3	2.5	
Setting sustainable strategy	**No.**	0	0	14	67	81	4.41
	%	0	0	8.6	41.4	50.0	
Considering the company's resources	**No.**	10	40	18	85	9	3.27
	%	6.2	24.7	11.1	52.5	5.6	
Communicating with employees	**No.**	7	59	12	68	16	3.17
	%	4.3	36.4	7.4	42.0	9.9	
Convincing top managers of sustainable vision	**No.**	7	47	19	76	13	3.25
	%	4.3	29.0	11.7	46.9	8.0	

Table 6.17. Descriptive analysis of the procedures' themes according to managers

Procedures' Themes		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Selecting the appropriate KPIs	**No.**	0	0	17	108	36	4.12
	%	0	0	10.6	67.1	22.4	
Carrying out simulation phases	**No.**	3	43	27	76	12	3.32
	%	1.9	26.7	16.8	47.2	7.5	
Setting sustainable strategy	**No.**	0	0	11	92	58	4.29
	%	0	0	6.8	57.1	36.0	
Considering the company's resources	**No.**	5	36	12	95	13	3.47
	%	3.1	22.4	7.5	59.0	8.1	
Communicating with employees	**No.**	4	30	16	93	18	3.57
	%	2.5	18.6	9.9	57.8	11.2	
Convincing top managers with sustainable vision	**No.**	2	54	18	69	18	3.29
	%	1.2	33.5	11.2	42.9	11.2	

It is clear from the table that most of the procedures themes were in the agreement zone, as a large number of the participants agreed upon the expected procedures encountered by the oil refining sector when implementing the proposed model.

Table 6.18. Descriptive analysis of the barriers' themes according to researchers

Barriers' Themes		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Insufficient financial resources and efforts	No.	5	59	21	63	14	3.14
	%	3.1	36.4	13.0	38.9	8.6	
Absence of Management support	No.	7	51	13	66	25	3.31
	%	4.3	31.5	8.0	40.7	15.4	
Limited awareness of the sustainability theme	No.	8	51	19	65	19	3.22
	%	4.9	31.5	11.7	40.1	11.7	
Internal communication deficiency	No.	4	79	14	54	11	2.93
	%	2.5	48.8	8.6	33.3	6.8	
Inappropriate identification of the KPIs	No.	13	62	16	63	8	2.94
	%	8.0	38.3	9.9	38.9	4.9	
Lake of transparency	No.	9	30	11	92	20	3.52
	%	5.6	18.5	6.8	56.8	12.3	

Table 6.19. Descriptive analysis of the barriers' themes according to managers.

Barriers' Themes		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Insufficient financial resources and efforts	No.	5	41	21	79	15	3.36
	%	3.1	25.5	13.0	49.1	9.3	
Absence of Management support	No.	12	53	18	61	17	3.11
	%	7.5	32.9	11.2	37.9	10.6	
Limited awareness of the sustainability theme	No.	7	52	26	64	12	3.14
	%	4.3	32.3	16.1	39.8	7.5	
Internal communication deficiency	No.	4	69	23	61	4	2.95
	%	2.5	42.9	14.3	37.9	2.5	
Inappropriate identifying of the KPIs	No.	10	58	13	67	13	3.09
	%	6.2	36.0	8.1	41.6	8.1	
Lake of transparency	No.	19	32	19	59	32	3.33
	%	11.8	19.9	11.8	36.6	19.9	

As per the table most of the barriers had been in the agreement zone according to the respondents except the internal communication deficiency which received the least agreement. A large number of respondents approved that the previously mentioned barriers are the expected barriers that might be encountered by oil refining companies while implementing the proposed model. However, many participants agree that the internal communication deficiency might not be among the obstacles expected by oil refining companies if they are encouraged to adopt the proposed model.

Table 6.20. Descriptive analysis of the benefits' themes according to researchers

Benefits' Themes		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Supporting companies to be green	**No.**	0	29	12	95	26	3.73
	%	0	17.9	7.4	58.6	16.0	
Extending companies' social awareness	**No.**	2	39	14	95	12	3.47
	%	1.2	24.1	8.6	58.6	7.4	
Enhancing companies' profitability	**No.**	0	37	16	92	17	3.55
	%	0	22.8	9.9	56.8	10.5	
Promoting companies' performance	**No.**	2	49	13	78	20	3.4
	%	1.2	30.2	8.0	48.1	12.3	
Monitoring sustainability progress	**No.**	0	0	13	112	37	4.15
	%	0	0	8.0	69.1	22.8	
Increasing trust and transparency	**No.**	0	20	11	110	21	3.81
	%	0	12.3	6.8	67.9	13.0	
Increasing employee safety	**No.**	3	41	9	98	11	3.45
	%	1.9	25.3	5.6	60.5	6.8	
Drawing the attention of employees and investors	**No.**	12	62	17	69	2	2.92
	%	7.4	38.3	10.5	42.6	1.2	
Improved company reputation	**No.**	0	31	10	99	22	3.69
	%	0	19.1	6.2	61.1	13.6	

Table 6.21. Descriptive analysis of the benefits' themes according to managers

Benefits' Themes		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Supporting companies to be green	**No.**	4	18	10	94	35	3.86
	%	2.5	11.2	6.2	58.4	21.7	
Extending companies' social awareness	**No.**	1	36	15	97	12	3.52
	%	0.6	22.4	9.3	60.2	7.5	
Enhancing companies' profitability	**No.**	1	25	15	94	26	3.74
	%	0.6	15.5	9.3	58.4	16.1	
Promoting companies' performance	**No.**	0	44	13	78	26	3.53
	%	0	27.3	8.1	48.4	16.1	
Monitoring the sustainability progress	**No.**	0	0	10	111	40	4.19
	%	0	0	6.2	68.9	24.8	
Increasing trust and transparency	**No.**	0	27	23	81	30	3.71
	%	0	16.8	14.3	50.3	18.6	
Increasing employees' safety	**No.**	2	36	17	96	10	3.47
	%	1.2	22.4	10.6	59.6	6.2	
Drawing attention of employees and investors	**No.**	6	71	16	59	9	2.96
	%	3.7	44.1	9.9	36.6	5.6	
Company's reputation	**No.**	0	16	9	108	28	3.92
	%	0	9.9	5.6	67.1	17.4	

Most of the benefits in this table are reflected in the agreement zone, with the exception of drawing the attention of employees and investors. That is to say, most of the participants agree that these are some of the expected benefits that oil refining companies might gain from adopting the proposed model. This is in contrast to the benefit of drawing the attention of the employees and the investors, which was not in the agreement zone by a large number of respondents as one of the gains of referring to the proposed model.

Table 6.22. Descriptive analysis of the drawbacks' themes according to researchers

Drawbacks' Themes		Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Commitment to the company	**No.**	10	37	15	92	8	3.31
	%	6.2	22.8	9.3	56.8	4.0	
Cost	**No.**	15	109	11	27	0	2.31
	%	9.3	67.3	6.8	16.7	0	

Table 6.23. Descriptive analysis of the drawbacks' themes according to managers

Drawbacks' Themes		Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Mean
Commitment to the company	**No.**	9	62	22	60	8	2.98
	%	5.6	38.5	13.7	37.3	5.0	
Cost	**No.**	15	89	20	37	0	2.49
	%	9.3	55.3	12.4	23.0	0	

The previous tables show that most of the participants agreed that commitment is expected to be a drawback that oil refining companies might encounter while referring to the proposed model. However, cost received the least agreement, as the tables show that the majority of the respondents did not consider it among the disadvantages of adopting the proposed model.

Table 6.24. Descriptive analysis of the relationship between referring to the proposed model and following the guidelines

Opinions	Researchers		Managers	
	No.	%	No.	%
Disagree	18	11.1	20	12.4
Neutral	12	7.4	9	5.6
Agree	114	70.4	105	65.2
Strongly agree	18	11.1	27	16.8
Total	162	100.0	161	100.0

As per the previous table, it is clear that 67.8 % of the respondents were for the idea “there is a relationship between referring to the proposed model, following the previous procedures fulfilment, barriers avoidance, benefits achievement and drawbacks minimisation will affect companies’ performance", while 11.8 % were against the idea.

The following graph illustrated in Figure 6.1, presents participants’ responses describing the expected relationship between following the proposed KPIs and guidelines and its impact on company’s performance.

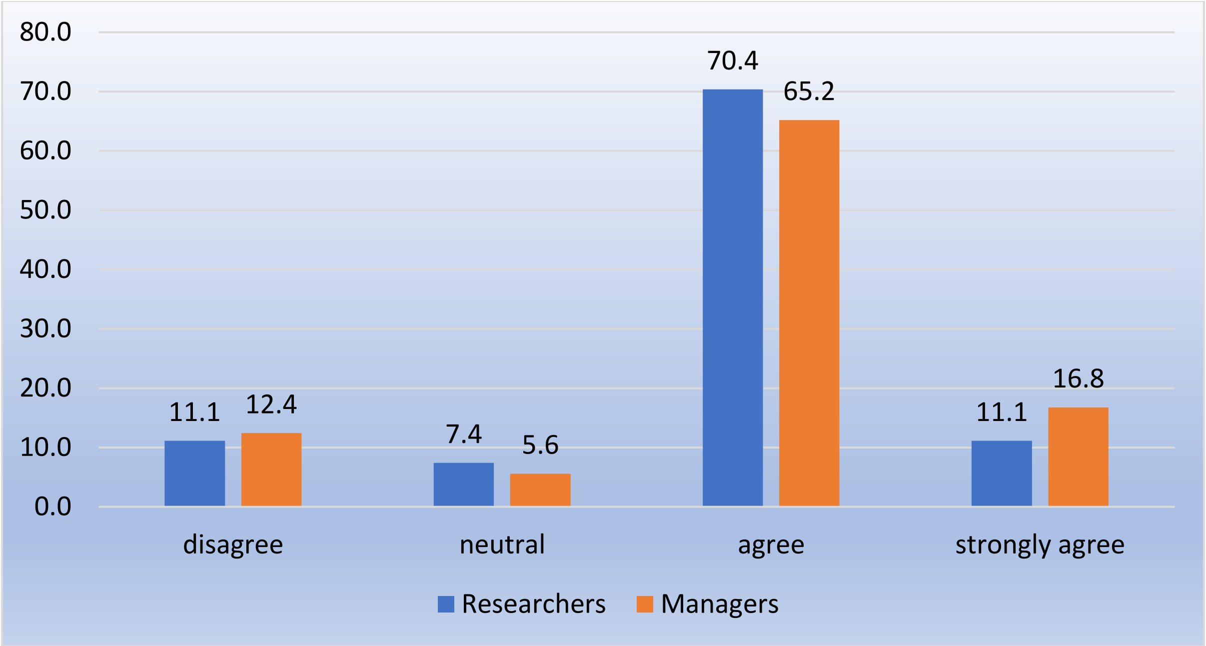

Figure 6.1. Participant responses describing the relationship between referring to the proposed model and following the guidelines.

As per this graph most respondents agree with the recommendation that oil refining companies refer to the proposed performance measurement model, as it is expected that referring to the proposed model can assist companies to measure their performance more effectively from the sustainability perspective. Additionally, respondents expect that integrating the proposed model by following the guidelines will have a greater impact on oil refining companies' sustainability performance.

Following this outline of the outcomes around each of the variables in the research hypothesis, in the next section the researcher tested the relationship between the variables.

6.4Relationship Between Variables

In this section, the researcher tested the relationship between the variables using different infernal analysis. Accordingly, H1.1, H1.2 and H1.3 were tested using correlation and regression analysis, while H2.1, H2.2 and H2.3 used the appropriate test based on the normality of data. If the data were normally distributed, the researcher can use the T-test and if the i the data was not normally distributed, the researcher can use the Mann-Whitney test.

For the data used in testing the variables, Environmental KPIs were formed by summarising the respondents' opinions regarding the environmental KPIs (flared gas, greenhouse gas, etc.). Additionally, the economic KPIs were formed by summarising the respondents' opinions concerning the economic KPIs (technology, information system, etc.). Likewise, the social

KPIs were formed by summarising the respondents` opinions on social KPIs (capacity building, soft and technical, employee engagement, etc.). Each of the environmental, economic and social performance opinions was subdivided into two categories as follows: the opinions relevant to the aspects of environmental performance which are: reducing air emissions, oil leakage, water withdrawal, water discharge and solid wastes in addition to considering energy efficiency, environmentally friendly practices and environmental policy and management system. Also, the economic performance was formed through summing up the respondents' opinions related to the aspects of the economic performance items which are supporting innovations, investments, quality, less risks, local content and government- business relationship along with achieving growth, better performance and profitability. In addition, the social performance was formed through summing up the respondents' opinions about the aspects of the social performance which are appreciating employees' rights and occupational health and safety along with respecting community, society and business ethics, employee engagement, etc...

6.4.1 Testing H1

In these sections, the researcher sought to build linear regression models for measuring the impact of the environmental, economic and social KPIs currently used in the oil refining sector on current company's performance with specific regard to the environmental, economic and social aspects. Linear Regression Model is a statistical model that represents the impact and the value of the impact of independent variable (the one which affects) on the dependent variable (the one which is affected by).

The correlation and the regression between each of the environmental, economic and social KPIs currently used in the oil refining sector were tested as well as their impact on current company's performance regarding the economic, environmental and social aspects. The purpose of deploying the correlation analysis was to identify if there is a relationship between the environmental, economic and social KPIs currently used in the oil refining sector with the current company's performance. Each pillar was measured separately through regression analysis to find out the extent of the effect and the value of the environmental, economic and social KPIs on the current company's performance.

As an illustration, every pillar of sustainability (environmental, economic or social) was measured separately. For example, the environmental KPIs currently used in the oil refining sector and the current environmental company's performance was measured through the correlation and the regression analyses and this represents the first hypothesis (H1.1). The same was repeated to the economic aspect representing the second hypothesis (H1.2). Finally, the social KPIs currently used in the oil refining sector and the current social company's performance were measured through the correlation and regression analyses; this represented the third hypothesis (H1.3). Additionally, there was an individual analysis focusing on the responses gathered from researchers and company managers to gain a thorough understanding of their perspectives individually.

The Pearson Correlation Coefficient is a measurement for association between two continuous variables such as an environmental KPI and environmental performance. It ranges from -1 (negative correlation) to 1 (positive correlation). Values between 0.1 to 0.35 indicate weak correlation, between 0.36 to 0.7 indicate moderate correlation and greater than 0.7 indicate strong correlation.

6.4.1.1 Testing H1.1

H1.1 tests whether the environmental KPIs currently used in the oil refining sector have a significant impact on environmental performance of companies while referring to the currently used models in the oil refining sector.

In this part, the environmental KPIs currently used in the oil refining sector are the independent variable while environmental performance of companies is the dependent variable while referring to the currently used model.

Table 6.25. Correlation between the environmental KPIs currently used and environmental performance

Research variables	Researchers	Managers
Environmental KPIs currently used in the oil refining sector	0.6^{**}	0.5^{**}

By constructing the correlation model illustrated in Table 6.25, the results showed that there was a significant correlation between the environmental KPIs currently used in the oil refining sector and the environmental performance while referring to the currently used models in the oil refining sector. The type of correlation was moderate for both researchers and managers where the Pearson Correlation Coefficients respectively value 0.6, 0.5 which ranges from (0.35 to 0. 7).

Table 6.26. Regression analysis of the environmental KPIs currently used on environmental performance

Independent	Researchers			Managers		
	Beta	t	Sig	Beta	t	Sig
Constant	0.447	11.02	0.0001	0.37	12	0.0001
Environmental KPIs currently used in the oil refining sector	0.136	1.58	0.001	0.21	4.5	0.001

By constructing the simple regression model illustrated in Table 6.26, the results showed that the environmental KPIs currently used in the oil refining sector have a noticeable impact on the current environmental company's performance, where the coefficient is 0.136 for researchers and 0.21 for managers, which means that any increment in environmental KPIs will cause increment in environmental performance by 0.136 unit for researchers and 0.21 for managers Thus, the first hypothesis will be accepted.

6.4.1.2 Testing H1.2

H1.2 states that the economic KPIs currently used in the oil refining sector might have a significant impact on the current economic performance of companies while referring to the currently used models.

In this part, the economic KPIs currently used in the oil refining sector are the independent variable while current economic company's performance is the dependent variable.

Table 6.27. Correlation between economic KPIs currently used and economic performance

Research variables	Researchers	Managers
Environmental KPIs currently used in the oil refining sector	0.6^{**}	0.5^{**}

By constructing the correlation model illustrated in Table 6.27, the results showed that there is a significant correlation between the economic KPIs currently used in the oil refining sector and economic performance when referring to the currently used models in the oil refining sector, where sig (2-tailed) = 0.0001 is less than 0.05. The type of correlation is moderate for both researchers and managers where the Pearson Correlation Coefficients are respectively valued at 0.5, 0.6, which ranges from (0.35 to 0. 7).

Table 6.28. Regression analysis of the economic KPIs currently used on economic performance

Independent	Researchers			Managers		
	Beta	t	Sig	Beta	T	Sig
(Constant)	0.319	7.056	0.0001	0.43	9.2	0.0001
Economic KPI currently used in the oil refining sector	0.398	4.941	0.0001	0.55	8.7	0.0001

By constructing the simple regression model illustrated in Table 6.28, it was clear that the economic KPIs currently used in the oil refining sector have a significant impact on economic performance when referring to the currently used models in the oil refining sector, where the coefficient is 0.398 for researchers and 0.55 for managers. This means that any increment in economic KPIs will cause increment in the economic performance by 0.398 unit for researchers and 0.55 for managers Thus, the second hypotheses were accepted.

6.4.1.3 Testing H1.3

H1.3 states that the social KPIs currently used in the oil refining sector might have a significant impact on the social performance of companies when referring to the currently used models in the oil refining sector.

In this part, social KPIs used in the oil refining sector was the independent variable while social company's performance when referring to the currently used models in the oil refining sector is the dependent variable.

Table 6.29. Correlation between the social KPIs currently used and social performance

Research Variables	Researchers	Managers
Social KPIs currently used in the oil refining sector	0.35^{**}	0.29^{**}

By constructing the correlation model in Table 6.29, it was clear there is a significant correlation between the social KPIs currently used in the oil refining sector and social performance when referring to the currently used models in the oil refining sector, where sig (2-tailed) = 0.0001 is less than 0.05. The correlation is weak where the correlation coefficient is 0.351 for researchers and 0.29 for managers, which ranges from (0.1 to 0.4).

Table 6.30. Regression analysis of the social KPIs currently used on the social performance

Independent	Researchers			Managers		
	Beta	t	Sig	Beta	T	Sig
(Constant)	0.242	7.793	0.0001	0.78	15.2	0.0001
Social KPIs currently used in the oil refining sector	0.34	6.053	0.0001	0.9	13.2	0.0001

By constructing the simple regression model illustrated in Table 6.30, it was clear that the social KPIs currently used in the oil refining sector have a noticeable impact on the social performance of companies when referring the currently used models in the oil refining sector, where the coefficient is 0.34 for researchers and 0.9 for managers, which means that any increment in social KPIs will cause increment in social performance by 0.34 unit for researchers and 0.9 for managers. Thus, the third hypothesis will be accepted.

6.4.2 Testing H2

The following section tested H2.1, H2.2 and H2.3 which state if there is a significant difference in the environmental, economic and social performance of companies between the currently used models in oil refining sector and the proposed model. Each of the environmental, economic, social statements used to measure the company's performance was subdivided into two statements. As an illustration, the environmental statement used to measure the company's performance from the environmental aspect was subdivided into two statements. The first statement is reducing air emissions, oil leakage, water withdrawal, water discharge and solid wastes. The second statement included considering energy efficiency, environmentally friendly practices, environmental policy and management system. Similarly, the economic aspect was subdivided into two statements. The first statement included supporting innovations, investments, quality, less risks, local content and government-business relationship. The second statement included achieving growth, better performance and profitability. The social aspect was also subdivided into two statements. The first statements included appreciating employees' rights and occupational health and safety. The second statement included respecting community, society and business ethics.

In these hypotheses, the researcher had to assess the normality condition of the data (i.e., whether the data is normally or not normally distributed) to determine the appropriate analysis to test the hypotheses. This was one of the preliminary steps required before the inferential analysis. Normality testing was one of the assumptions that had to be verified to determine if a data set is normally or not normally distributed. The normality of data should be verified as a preliminary step for inferential analysis as it determines whether the researcher could use parametric or non-parametric tests to respond to the research hypotheses. One of the most common methods to check the normality of a data set is the ***Kolmogorov-Smirnov test of normality***, which tests the normality assumption for samples greater than 50 observations. It assumes that the data is normally distributed based on significance value. If the significance value was greater than or equal to 0.05, it means that there is normality in the data. If the significance value is smaller than 0.05, it means that there is no normality in the data.

This following section verified the normality assumption for the environmental, economic and social performance regarding the currently used models the proposed model. Tables 5.21, 5.24 and 5.26 show the formal testing of normality assumption using Kolmogorov-Smirnov test. If the data was normally distributed, the researcher used the t test and if the data was not normally distributed, the researcher would use the Mann-Whitney test.

The normality test was deployed for each of the fourth, fifth and the sixth hypotheses and the results enable the researcher to determine the appropriate analysis method to test the last three hypotheses (H2.1, H2.2 and H2.3), which test whether there is a difference in performance between the currently used models in the oil refining sector and the proposed model based. To clarify, the difference in performance between the currently used model and the proposed model based on the first environmental statement that is, reducing air emissions, water withdrawal, water discharge and solid wastes. Likewise, the difference between the currently used models and the proposed model were measured based on the second environmental statement which includes considering energy efficiency, environmentally friendly practices, environmentally policy and management system. This will represent the (H2.1). The same was repeated to the other aspects (the economic and the social), thus representing the (H2.2) and (H2.3).

The H2.1 states that there is a significant difference in the environmental performance of companies between the currently used models in the oil refining and the proposed model.

6.4.2.1 Testing H2.1

Table 6.31. Normality test for the H2.1.

Environmental performance			Researchers		Managers	
			Currently used models	Proposed Model	Currently used models	Proposed Model
Reducing air emissions, oil leakage, water withdrawal, water discharge and solid wastes	Kolmogorov-Smirnov test	Static	0.308	0.368	0.412	0.456
		Sig	0.0001	0.0001	0.0001	0.0001
Considering energy efficiency, environmentally friendly practices and environmental policy and management system		Static	0.346	0.324	0.45	0.36
		Sig	0.0001	0.0001	0.0001	0.0001

By testing the normality of data in H2.1 using the Kolmogorov-Smirnov test of normality illustrated in Table , it was clear that there is no normality in environmental performance of companies according to nominal variables (currently used models in the oil refining sector and the proposed model) where values of significance are less than 0.05. which led to rejecting the null hypothesis of the test (there is normality). Consequently, non-parametric tests were used to describe the relationships between research variables. Mann-Whitney is considered one of the non-parametric tests which can be used to describe the relationship between research variables. The Mann-Whitney test was therefore the appropriate test for comparing environmental performance for the currently used models in the oil refining sector and for the proposed model, for both researchers and managers.

Table 6.32. Mann-Whitney test for the H2.1 for the first environmental statement.

Models	Researchers				Managers			
	M	SD	Z	Significance	M	SD	Z	Significance
Currently used models in oil refining sector	3.42	1.114	-5.71	0.001	3.8	1.4	-6.3	0.001
Proposed model	3.94	0.762			4.2	0.5		

M: Mean, SD: Standard Deviation, Z: Z test

The Mann-Whitney test was conducted to test the first environmental statement (previously mentioned) for the currently used model in the oil refining sector and the proposed model. As illustrated in Table 6.32, there was a significant difference between the currently used models in the oil refining sector and the proposed model based on the respondents' opinions with regard to reducing air emissions, oil leakage, water withdrawal, water discharge and solid waste, where significance=0.0001 which is less than (α=0.05). This means the values for the proposed model for researchers and managers respectively (3.94, 4.2) are higher than the values for the currently used models in the oil refining sector at (3.42, 3.8) and this is shown in Figure 6.2.

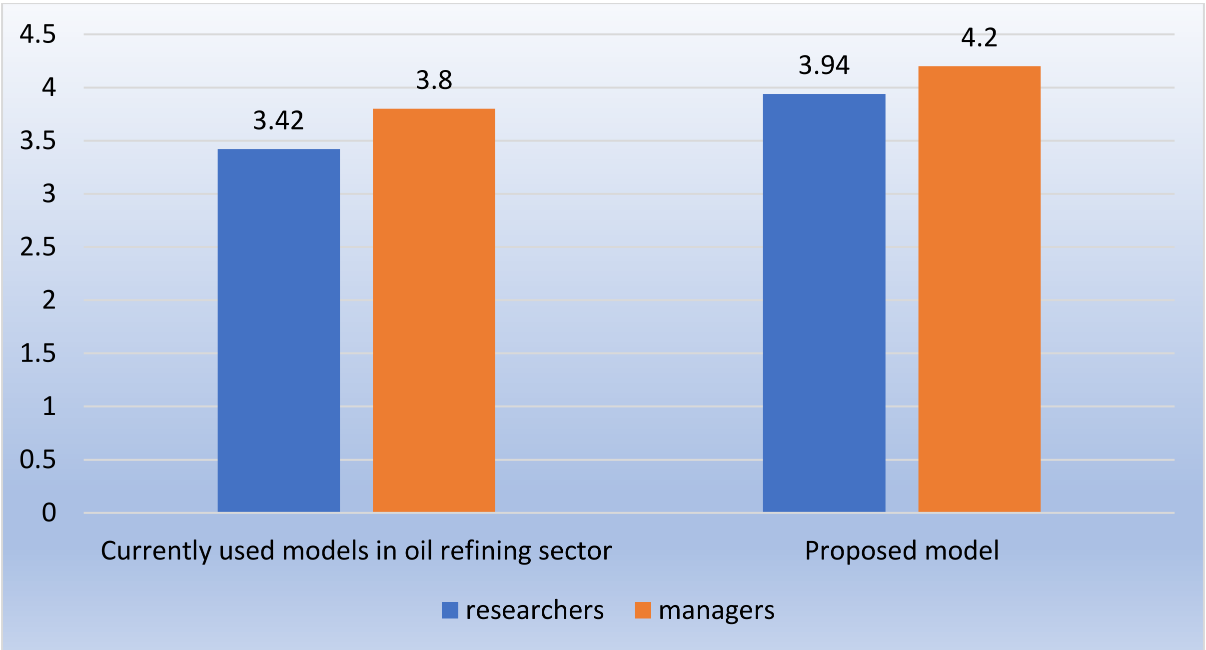

Figure 6.2. Comparison between the level of effectiveness of the currently used models in the oil refining sector and the proposed model regarding the first environmental statement.

Table 6.33. Mann- Whitney test of H2.1 for the second environmental statement

Models	**Researchers**				**Managers**			
	M	**SD**	**Z**	**Significance**	**M**	**SD**	**Z**	**Significance**
The currently used models in the oil refining sector	2.6	1.139	-10.5	0.0001	3.2	0.9	-8.3	0.0001
Proposed model	3.68	1			4.1	0.7		

M: Mean, SD: Standard Deviation, Z: Z test

The Mann-Whitney test was conducted on the second environmental statement (previously mentioned) for the currently used model in the oil refining sector and the proposed model as illustrated in Table The results show that there is a noticeable difference between the currently used models in the oil refining sector and the proposed model based on respondents' opinions of energy efficiency, environmentally friendly practices and environmental policy and management systems, where significance=0.0001, which is less than (α=0.05). The mean value for the proposed model (3.68) was higher than the values for the currently used model in the oil refining sector (2.64). This is illustrated in Figure 6.3 In line with this H2.1 was confirmed.

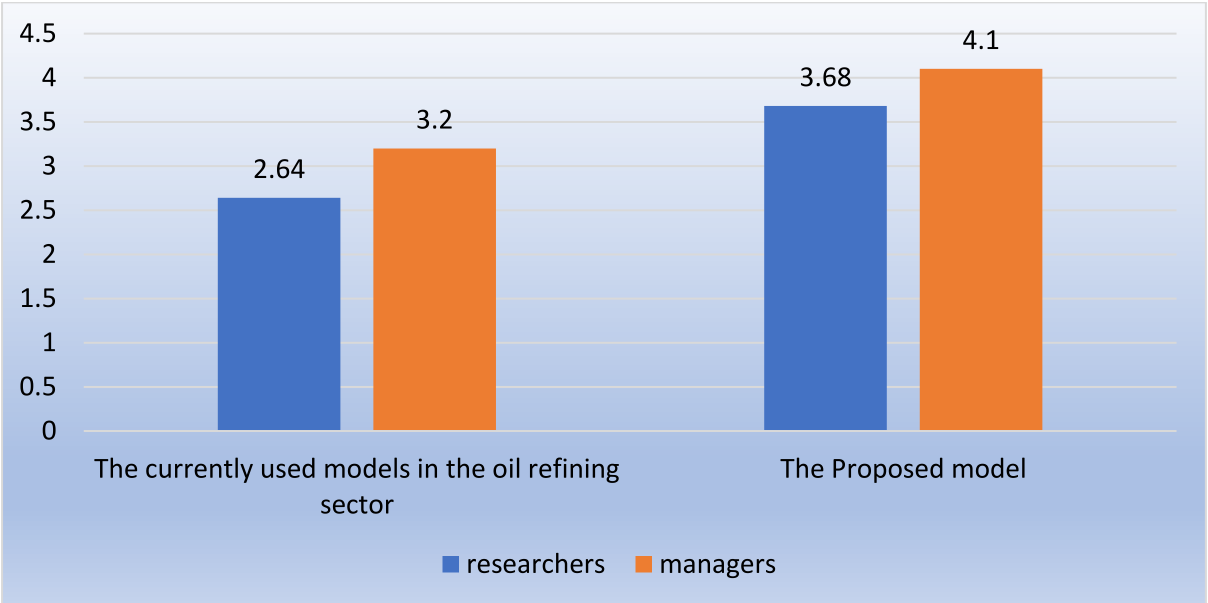

Figure 6.3. Compression between the level of effectiveness of the currently used models in the oil refining sector and the proposed model in considering the second environmental statement.

6.4.2.2 Testing H2.2

H2.2 states that there is a significant difference in economic performance between the currently used models in the oil refining and the proposed model.

Table 6.34. Normality test for the H2.2.

Economic performance			Researchers		Managers	
			Currently used models in the oil refining sector	**Proposed Model**	**Currently used models in the oil refining sector**	**Proposed Model**
Supporting innovation, investments quality, reduced risks, local content and government-business relationships	**Kolmogorov-Smirnov test**	**Static**	0.229	0.325	0.34	0.41
		Significance	0.0001	0.0001	0.0001	0.0001
Achieving growth, better performance and profitability		**Static**	0.307	0.319	0.33	0.52
		Significance	0.0001	0.0001	0.0001	0.0001

By testing the normality of data of H2.2 through the Kolmogorov-Smirnov test of normality, as illustrated in Table 6.34, it was concluded that there is no normality in (economic performance) according to nominal variables (the currently used models in the oil refining sector and the proposed model) where values of significance are less than 0.05. which led to rejecting the null hypothesis of the test (there is normality). The Mann-Whitney test is the appropriate test for comparing (economic performance) between the currently used models in the oil refining sector and the proposed model for both researchers and managers.

Table 6.35. Mann-Whitney test of H2.2 for the first economic statement.

Models	Researchers				Managers			
	M	**SD**	**Z**	**Significance**	**M**	**SD**	**Z**	**Significance**
Currently used models in the oil refining sector	3.15	1.22	-8.95	0.0001	2.4	0.8	-9.2	0.0001
Proposed model	4.03	0.68			3.5	0.6		

M: Mean, SD: Standard Deviation, Z: Z test

The Mann-Whitney test was conducted on the first economic statement (previously mentioned) for the currently used model in the oil refining sector and the proposed model. As illustrated in Table 6.35, there was a significant difference between the currently used model in the oil refining sector and the proposed model in terms of respondents' opinions concerning supporting innovation, investment, quality, reduced risks, local content and government-business relationships, where significance=0.0001, which is less than (α=0.05). The mean values for the proposed model for both researchers and managers respectively (4.03, 3.5) were higher than the values for the currently used model in the oil refining sector (3.15, 2.4). This is shown in Figure 6.4.

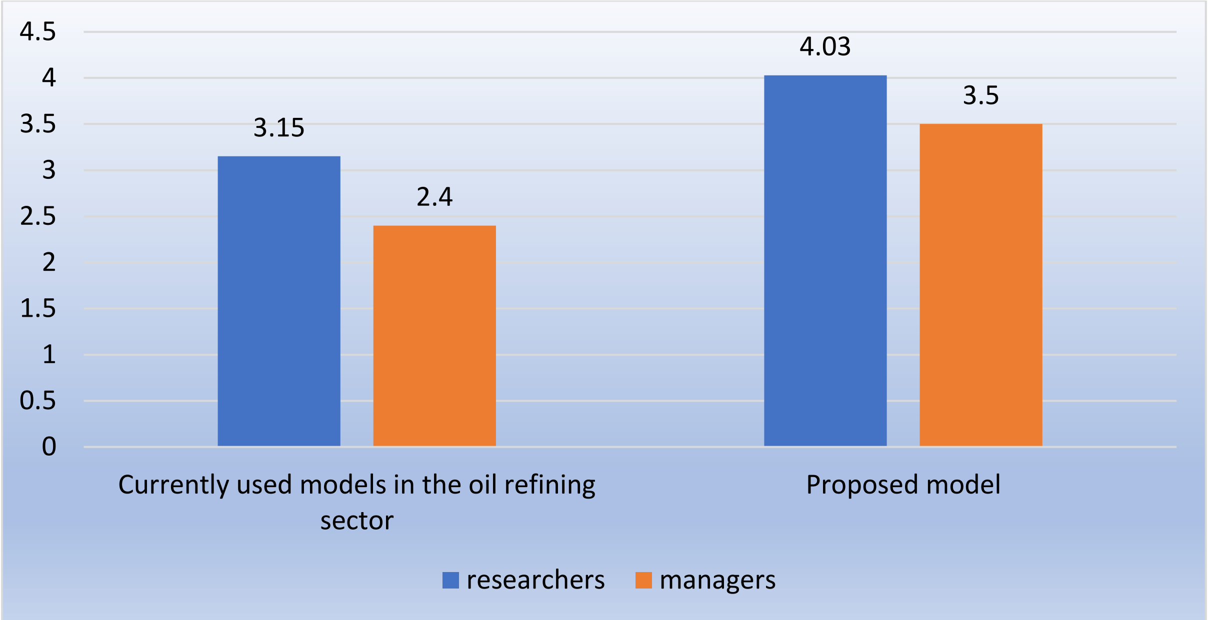

Figure 6.4. Comparison between the level of effectiveness of the currently used models in the oil refining sector and the proposed model regarding the first economic statements.

Table 6.36. Mann-Whitney test of H2.2 for the second economic statement.

Model	Researchers				Managers			
	M	**SD**	**Z**	**Significance**	**M**	**SD**	**Z**	**Significance**
Currently used models in the oil refining sector	3.56	1.062	-4.75	0.0001	3.9	0.9	-5.2	0.001
Proposed model	4.01	0.64			4.5	0.5		

M: Mean, SD: Standard Deviation, Z: Z test

The Mann-Whitney test was conducted on the second economic statement (previously mentioned) for the currently used models in the oil refining sector and the proposed model. As illustrated in Table 6.36, there was a significant difference between the currently used models in the oil refining sector and the proposed model in terms of respondents' opinions with regard to achieving growth, where significance=0.0001, which is less than (α=0.05). The mean values for the proposed model for both researchers and managers (4.01, 4.5) were higher than the values for the currently used models in the oil refining sector (3.56, 3.9). H2.2 was therefore accepted. This was illustrated in Figure 6.5.

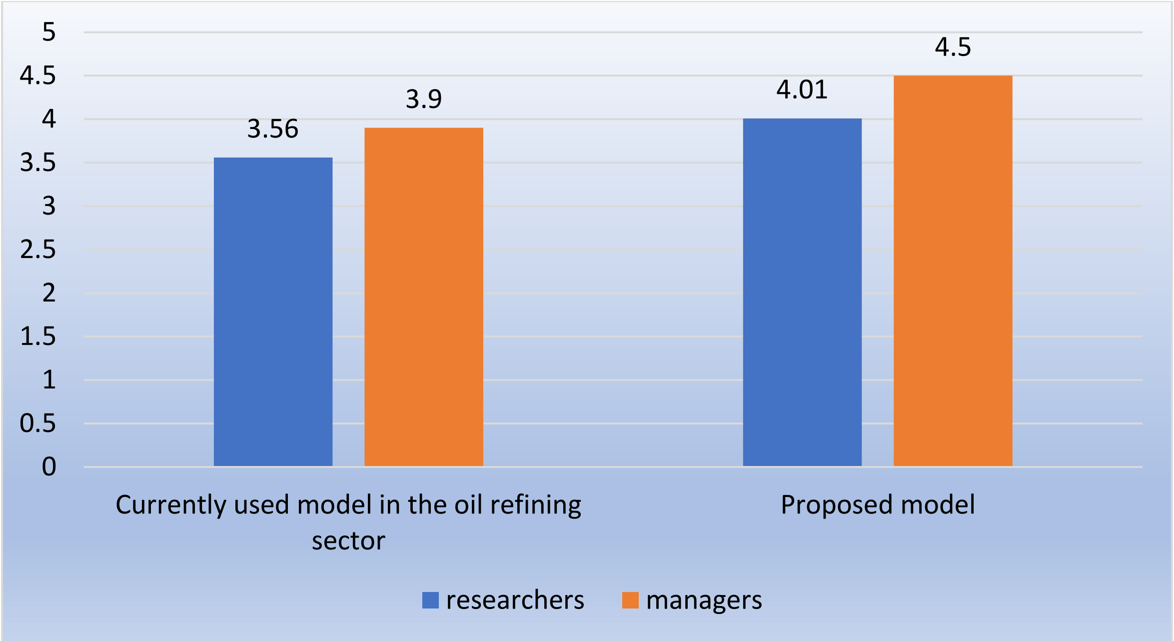

Figure 6.5 Comparison between the level of effectiveness currently used models in the oil refining and the proposed model regarding the second economic statement.

6.4.2.3 Testing H2.3

H2.3 states that there is a significant difference in social performance between the currently used models in the oil refining and the proposed model.

Table 6.37. Normality test for H2.3.

Social performance			Researchers		Managers	
			Currently used models in the oil refining sector	**Proposed Model**	**Currently used models in the oil refining sector**	**Proposed Model**
Appreciating employee rights and occupational health and safety	Kolmogorov-Smirnov test	**Static**	0.371	0.381	0.52	0.61
		Sig.	0.0001	0.0001	0.0001	0.0001
Respecting community, society and business ethics		**Static**	0.364	0.437	0.23	0.53
		Sig.	0.0001	0.0001	0.0001	0.0001

By testing the normality of the data of H2.3 using the Kolmogorov-Smirnov test of normality, as illustrated in Table 6.37, there is no normality in (social) performance according to nominal variables (the currently used models in the oil refining and the proposed model) where the values of significance are less than 0.05, which led to rejecting the null hypothesis of the test (there is normality). Therefore, the Mann-Whitney test is the appropriate test for comparison of (social performance) according to the currently used models in the oil refining sector and the proposed model for both researchers and managers.

Table 6.38. Mann-Whitney test of the H2.3 for the first social statement.

Models	Researchers				Managers			
	M	**SD**	**Z**	**Significance**	**M**	**SD**	**Z**	**Significance**
The Currently used models in the oil refining sector	2.58	0.946	-15.2	0.0001	3.1	1.1	-12.4	0.0001
The Proposed model	3.95	0.71			4.6	0.9		

M: Mean, SD: Standard Deviation, Z: Z test

The Mann-Whitney test was conducted on the first social statement (previously mentioned) for the currently used model in the oil refining sector and the proposed model. As illustrated in Table 6.38, there is a significant difference with regard to respondents' opinions in appreciating employee rights and occupational health and safety between the currently used models in the oil refining sector and the proposed model, where significance=0.0001, which is less than (α=0.05). The mean values for the proposed model for both researchers and managers respectively (3.95, 4.6) were higher than the values for the currently used model in the oil refining sector (2.58, 3.1). This is shown in Figure 6.6.

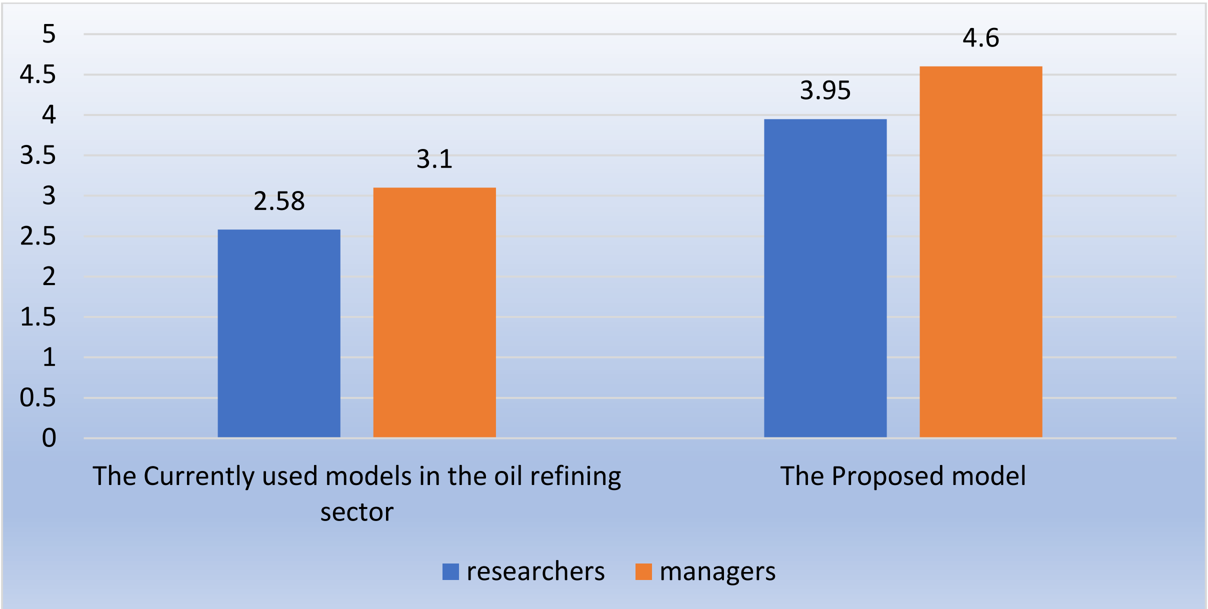

Figure 6.6 Comparison between the level of effectiveness of the currently used models in the oil refining sector and the proposed model regarding the first social statement.

Table 6.39. Mann-Whitney test H2.3 for the second social statement.

Models	Researchers				Managers			
	M	**SD**	**Z**	**Significance**	**M**	**SD**	**Z**	**Significance**
Currently used models in the oil refining sector	2.34	0.916	-16.2	0.0001	3.1	0.7	-10.3	0.0001

Proposed model	3.8	0.69 8			4. 2	0. 2		

The Mann-Whitney test was conducted on the second social statement (previously mentioned) for the currently used model in the oil refining sector and the proposed model. As illustrated in Table 6.39, there is a significant difference in respondents' opinions in respect of community, society and business ethics between the currently used model in the oil refining sector and the proposed model, where significance=0.0001, which is less than (α=0.05). The mean values for the proposed model for both researchers and managers (3.8, 4.2) were higher than the values for the currently used models in the oil refining sector (2.34, 3.1). Consequently, the researcher accepted H2.3. This is shown in Figure 6.7.

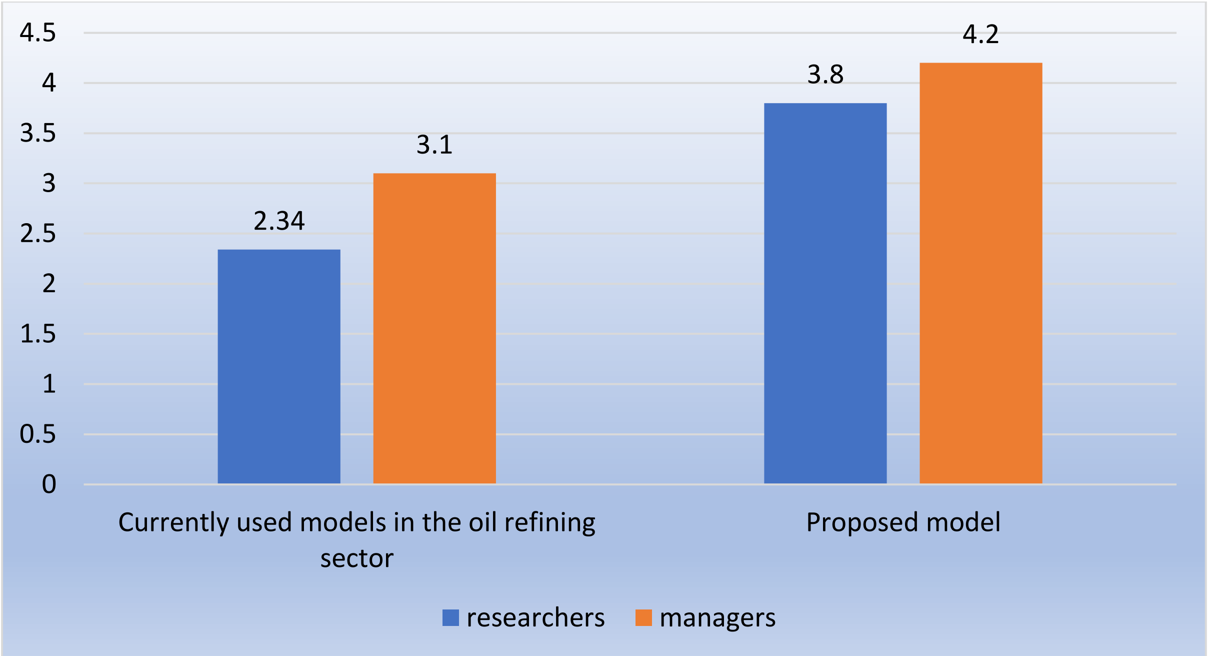

Figure 6.7. Comparison between the level of effectiveness of the currently used models in the oil refining sector and the proposed model in respect to the second social statement.

Based on the above discussion, the performance of the proposed model was primarily in the agreement zone. Respondents expected that referring to the proposed model can enhance sustainability practices. This was due to the fact that the proposed model was expected to include KPIs that reflect the main characteristics of the oil refining sector while also integrating the three pillars of sustainability. Moreover, the currently used models do not include some KPIs included in the proposed model. This contributes to respondents' expectations that the proposed model, as a result of having more KPIs than the currently used models, will more effectively assist companies in measuring their performance regarding the social, environmental economic aspects which in turn will enhance sustainability practices.

6.5 Model Modification Based on Global Perspectives

This section shows respondents'opinions with regard to the KPIs stated in the proposed model. The proposed model underwent some modifications based on the respondents' viewpoints, as the respondents were encouraged to add, modify or exclude any of the KPIs set in the proposed model. Some respondents recommended the addition of an indicator in the environmental aspect of the propsed model and therefore under the environmentally friendly practice theme, a new indicator known as environmentally friendly products was added to the proposed model. Additionally, some of the KPIs relevant to the environmnetal perspective of the proposed model were modified. For instance, a respondent suggested that under the water aspect, the term 'water withdrawal' should be changed to 'water withdrawal rate'. Additionally, the term 'quantaity of recycled/reused water' should be changed to 'waste water treatment'. For the economic perspective of the propsed model, one respondent made a recommendation to remove the 'sustainability profit' aspect. Additionally, the respondents suggested the addition of 'information system' under the innovation theme . Furthermore, under the investment theme, 'capacity utilisation' and 'return on sustanibilty investment' were both suggested. For the social perspective of the proposed model, the respondents recommended changing the phrasing of 'safety committee', under occupational health and safety aspect, to 'occupational health and safety committee'.

The following figures show the modifications. Figure 6.8 represents the comprehensive performance measurement model for the oil refining sector which will be referred to as the fourth version and is based upon the global perspective. This comprehensive model comprises the main aspects of the economic, environmental and social pillars of sustainability.

In addition to Figure 6.9, Figure 6.10 and Figure 6.11 illustrate the aspects and KPIs relevant to each pillar separately.

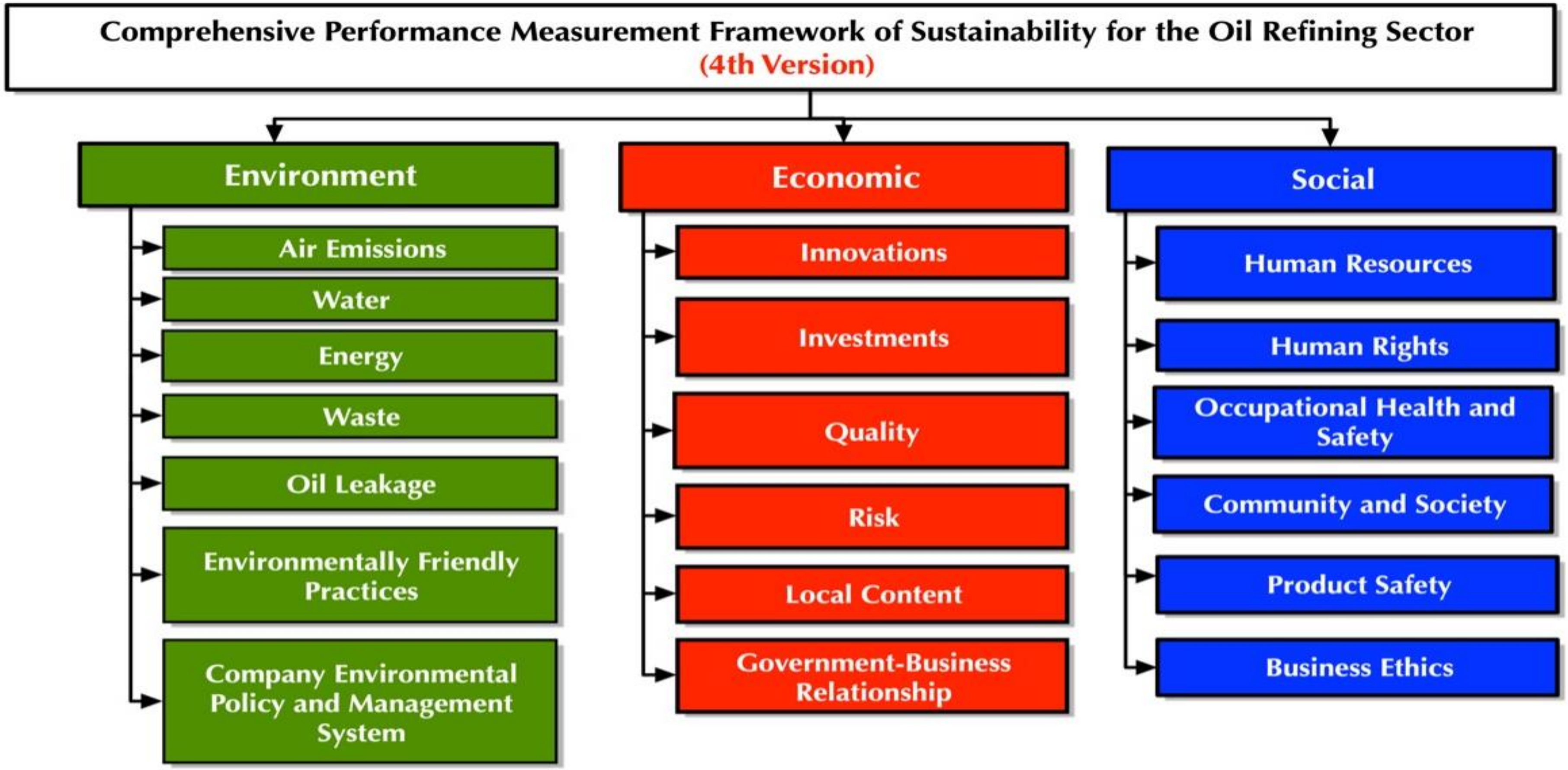

Figure 6.8 The modified comprehensive performance measurement model specific to the oil refining sector based on the global perspective.

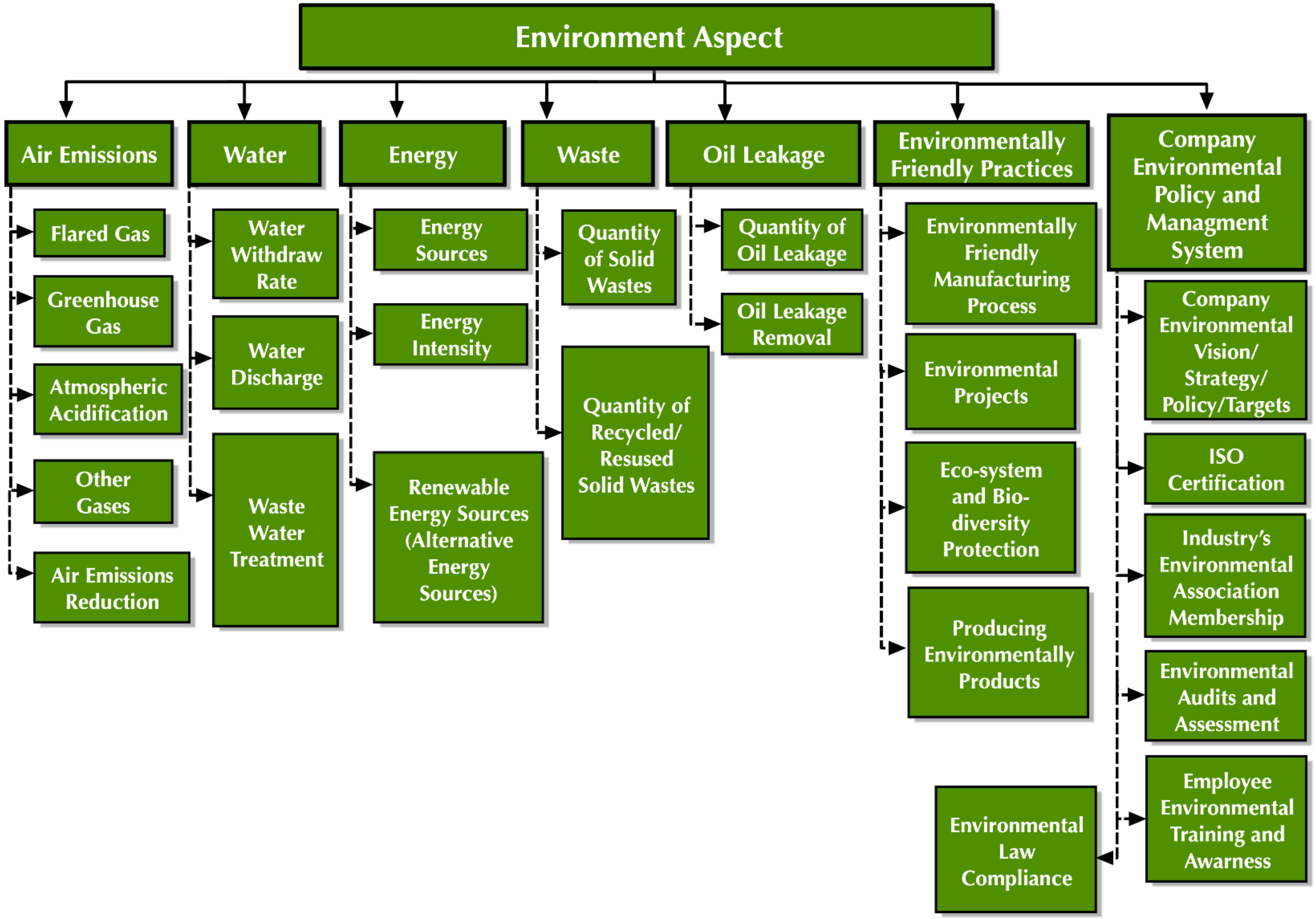

Figure 6.9 The modified developed model from the environmental perspective (4th version).

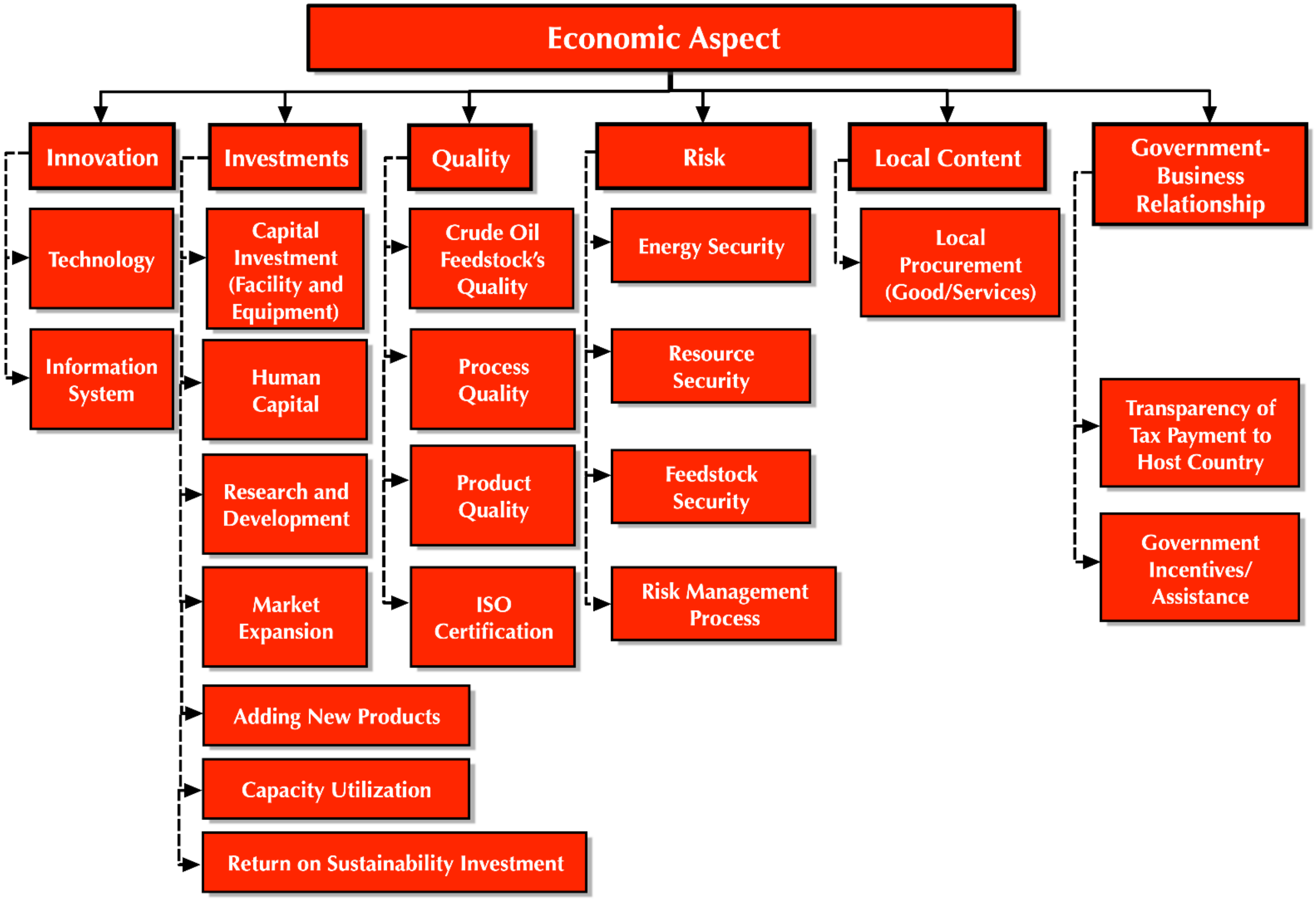

Figure 6.10 The modified developed model from the economic perspective (4th version).

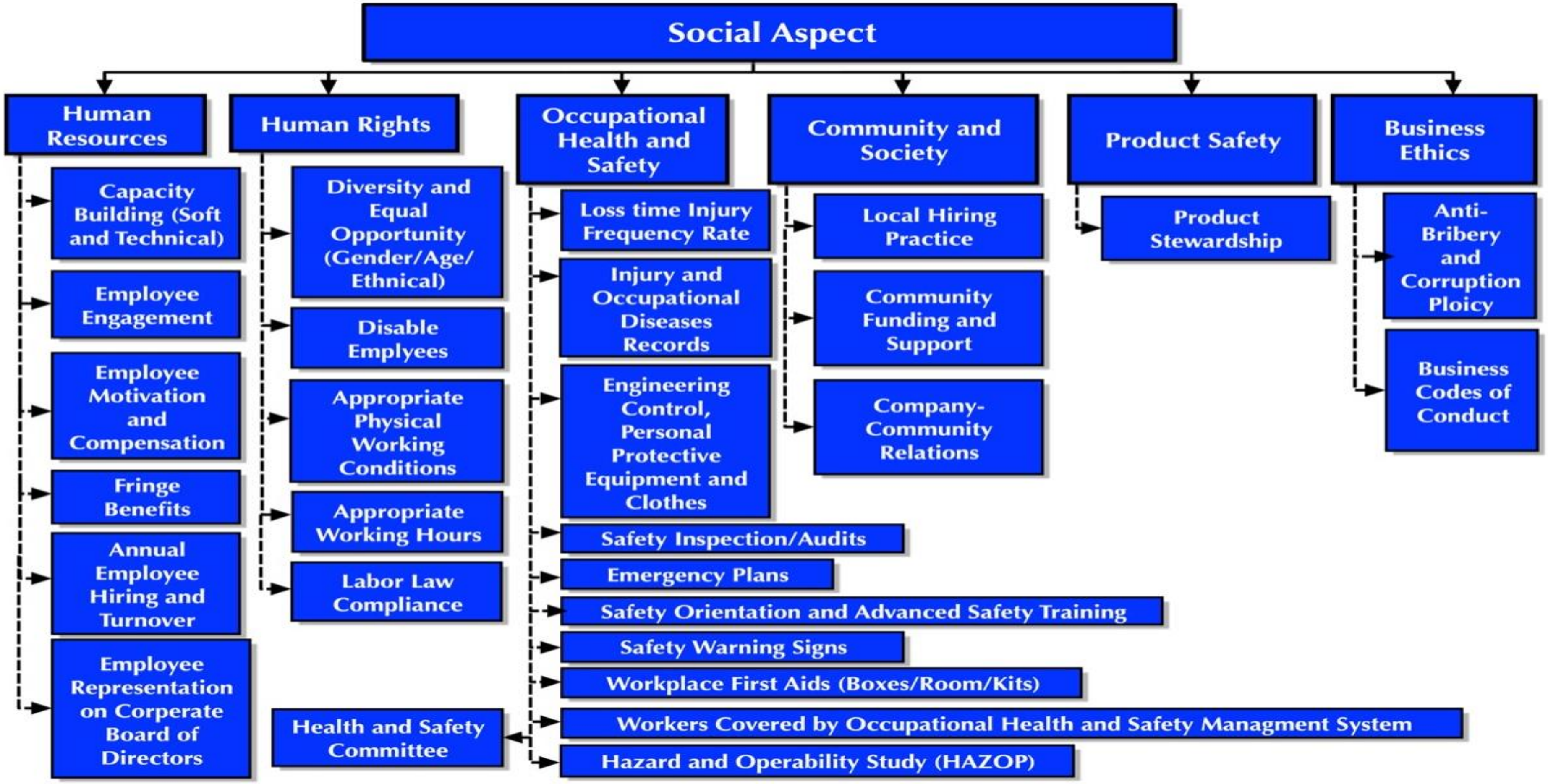

Figure 6.11 The modified developed model from the social perspective (4th version).

6.5.1 Evaluating the Effectiveness of the 4th Version of the Proposed Model for Addressing Global Challenges

This evaluation is an extension of the previous evaluation conducted in chapter 5 on the 3rd version of the proposed model. Table 6.40 shows the evaluation of the fourth version of the proposed model effectiveness in terms of addressing the current global challenges facing the oil refining sector.

Table 6.40 Evaluating the effectiveness of the 4th version of the proposed model in addressing the current global challenges facing the oil refinery sector.

No.		KPIs' of 4th version of the proposed model	
		Addressed	Not Addressed
Environmental			
1	Air emission reduction	√	
2	Recycling of wastewater	√	
3	Recycling of solid wastes	√	
5	Production of environmentally friendly products	√	
7	Energy preservation in all oil refining processes	√	
8	Implementing new projects concerning environmentally friendly practices	√	
9	Protecting ecosystem	√	
Economic			
10	Complying with International standards	√	
11	Staying up to date with the latest developments and innovation	√	
12	Data integration	√	
13	Risk management processes	√	
14	Building relationships with government	√	
15	Investing in operations, processes, facilities, equipment and employees	√	
Social			
16	Social responsibility	√	
17	HAZOP	√	

As per the table it is evident that the fourth version of the proposed model is capable of addressing all the identified current global challenges. This means that the proposed model is comprehensive since it addresses all the identified global challenges, incorporates all the unique characteristics of the oil refining industry and integrates the three pillars of sustainability.

6.6 Summary

Through this research, by examining the current status of the oil refining sector, it was clear that the level of awareness regarding sustainability issues has continued to grow and following the exploratory interviews, companies continued to progress their sustainability practices. Some oil refining companies are already working with developed performance models of sustainability; others are still in the process of adopting or developing performance measurement models of sustainability. Many respondents agreed on the fact that their companies have future plans that incorporate sustainability practices with goals to measure company's performance with regard to this. However, many managers stated that their companies continue to refer to the currently used models, such as the SCOR, BSC, the Petroleum authority model, the Environmental, the Quality model, etc. Meanwhile, other companies developed their own customised performance measurement model to measure their companies' performance from the sustainability perspective. This research has also shown that through the correlation and regression analyses there was a moderate impact of the environmental, economic and social KPIs currently used in the oil refining sector on current company's performance regarding the environmental, economic and social aspects. In other words, if oil refining companies refer to more KPIs while implementing the currently used models, it is expected that the performance of companies will increase. Based on the Mann-Whitney analysis carried out for the purposes of this research, the proposed model was more effective and expected to more significantly enhance the sustainability practices of oil refining companies as compared to the currently used models in the oil refining sector. This can be attributed to the fact that the proposed model comprises more KPIs that can assist oil refining companies to measure their performance from a sustainability perspective. In addition to the previous results, suggested modifications resulted in the development of the fourth version of the proposed model, which was assessed in terms of its effectiveness regarding addressing the identified current global challenges. This assessment revealed that the fourth version of the proposed model addresses all the identified current global challenges. To conclude, all of the hypotheses set by the researcher to be tested were accepted.

Table 6.41 illustrates whether the hypotheses tested in this research were accepted.

Table 6.41 The research hypotheses.

Item	Hypothesis	Accepted / Rejected
H1.1	The currently used key performance indicators will not yield a noticeable impact on company's performance in terms of the environmental aspects. (**H1.1**)	Accepted
H1.2	The currently used key performance indicators will not yield a noticeable impact on company's performance in terms of the economic aspects (**H1.2**).	Accepted
H1.3	The currently used key performance indicators will not yield a noticeable impact on company's performance in terms of the social aspects (**H1.3**).	Accepted
H2.1	There is a significant difference between the developed model and current models in terms of their impact on company's performance in terms of the environmental aspects. (**H2.1**).	Accepted
H2.2	There is a significant difference between the developed model and current models in terms of their impact on company's performance in terms of the economic aspects. (**H2.2**).	Accepted
H2.3	There is a significant difference between the developed model and current models in terms of their impact on company's performance in terms of the social aspects. (**H2.3**).	Accepted

Chapter 7: Findings and Discussion

7.1 Introduction

This chapter commences with a comprehensive overview of the research gap, objectives and research phases. Next, the discussion tackles the primary objective and focal point of the chapter, namely the findings of each phase and a comparative analysis that involves a thorough comparison between the theoretical insights and the practical application. Eventually, the chapter concludes with a summary of the main points and insights discussed in the chapter.

7.2 Research Findings

The research observed through reviewing the previous studies, as well as, conducting interviews with experts in oil refining sector, that the significance of oil refining persists, given its role as a major energy source and supplier of essential raw materials for other industries. However, this industry still has negative impacts on the environment and communities, thus posing some challenges for the industry. Moreover, the oil refining industry operates in a complex environment that is constantly changing and encounter multiple global challenges, this underpins the necessity for the oil refining industry to mitigate the hazards it causes to the environment and the community and to address the challenges facing the industry, through implementing sustainable practices that are considered the trend and the future in this era. That is, adopting a sustainable vision, strategy and planning, along with performance measurement system responsible for accurately tracking and monitoring the sustainability performance, has become important. Notably, there is currently a gap in the existing models due to their lack of a comprehensive model that is capable of integrating the three dimensions of sustainability, incorporating the specific characteristics of oil refining industry and addressing the current global challenges.

Accordingly, the study aimed at addressing the recognised research gap by systematically aligning its objectives and phases to bridge and tackle this research gap. The research achieved its objectives by employing a mixed method approach and tailoring each phase to address a specific goal. Initially, the research approach with conducting a comprehensive literature review and exploratory interview gained a deep understanding of the industry, its surroundings and relevant research themes. In addition, it identified the research gap from both theoretical and practical insights. Following, an extensive literature review was conducted leading to the development of performance measurement model of sustainability particular for oil refining sector in its early stages. Then, an empirical study on the Egyptian oil refining companies was carried out via a focus group questionnaire to demonstrate the practical applicability of the proposed model in the real context of the oil refining sector which led to further development of the proposed model and the development of some determinants in the form of procedures, barriers, benefits and drawbacks that can act as a road map to assist in the model implementation. Ultimately, the research plan continues with conducting an online survey questionnaire to gather the global insights, thereby ensuring the alignment to the international rules and applicability of the model on a global scale. This approach encompassed testing the research variables which formulated in the form of research hypotheses and finalising the proposed model.

According to the aforementioned discussion, there were four research phases (reflecting the sequential progression of the research). Each research phase was tailored to target a specific objective and address a particular question. Each phase resulted in outcomes that contribute to achieving the set objective and providing a clear answer to the respective research question. The upcoming section discusses the findings derived from each phase comprehensively, alongside with a thorough analysis to provide deeper insights and comprehensive understanding of the results.

Phase 1: Findings and analysis

In the initial phase, the study delved into the characteristics of the oil refining industry, analysed its structure and environmental impact. The results emphasised the continuous vital role of oil refining industry in human daily life and serving as crucial feedstock for various industries (Kalinina et al., 2019).

However, it also highlighted that oil refining is distinctive across environmental, economic and social aspects (Asmelash & Gorini, 2021). Environmentally, the industry continuous to cause pollution with emissions and spills, so this may encounter health and safety concerns among society. The findings revealed that the challenges persist without clear solution. Economically, the industry’s main and distinct features include high capital investments, market price volatility and substantial contributions to national economies (Ebrahimi et al., 2018). Socially, the industry impacts the employment community well-being and may encounter health and safety concerns to nearby residents; these aspects helped in presenting the distinct features of oil refining across different dimensions (Sojinu et al., 2019). Therefore, these findings, notably enhanced the understanding of the research context and emphasised the urgent need to address the negative impacts, calling for intensified awareness and effective resolutions.

Next, the study identified a comprehensive array of key challenges facing the industry, particularly those influencing sustainability, in order to understand the factors beneficial in reducing negative impacts. The findings indicated that the following studies Langlois et al. (2017), Raut et al. (2017), Putri et al. (2019), Taouab & Issor (2019), and Sánchez-Flores et al. (2020) had individually addressed each of the challenges facing oil refining industry separately and that they also lacked the efforts to combine such challenges within a comprehensive framework. Additionally, the findings revealed that there are challenges encompassing environmental, economic and social aspects. From the environmental perspective, aspects were identified in terms of air emission reduction, recycling of wastewater, recycling of solid wastes, production of environmentally friendly products, energy preservation in all oil refining processes, protecting the ecosystem and implementing new projects concerning environmentally friendly practices were identified.

Simultaneously, the economic challenges including the need to comply with international standards, staying up to date with the latest developments and innovation, data integration, risk management process, building relationships with governments and investigating in operations, process, facilities, equipment and employees were recognised. Then, the social challenges related to the social responsibility and HAZOP were also identified. The identified challenges significantly improved the understanding of the industry context. The results highlighted that the industry encounters various challenges from environmental, economic and social aspects and in order to be sustainable, the industry has to tackle these challenges. That is to say, these findings helped in establishing the foundation for comprehending the industry's challenges.

Consequently, the study drew insights from prior studies to examine the current status in terms of sustainability and performance measurement models in the oil refining industry. This examination revealed a notable absence of in-depth discussion on the sustainability practice in connection with performance measurement models in the oil refining industry (Rajeev et al., 2017; Nosratabadi et al., 2019; Sánchez-Flores et al., 2020). When these themes were examined in previous studies, the models frequently focused on one or two dimensions of sustainability, failing to address some of the challenges confronting the industry and to incorporate industry specifications (Kazemi, 2016; Aghelie, 2017; Mojarad et al., 2018; Kalinina et al., 2019; Barforoush et al., 2020; Nicolescu et al., 2020).

In addition, previous studies heavily relied on a single case study, thus leading to diminishing the applicability and reliability of the results. This emphasises the fact that the comprehensive models that can integrate sustainability dimensions, incorporate industry characteristics and address global challenge are still missing. That is, the analysis highlighted that there is still a gap in having sufficient performance measurement models, specifically tailored for the industry capable of helping the oil refining companies to measure their performance in a way that suits the unique needs of the oil refining sector. That is to say, these findings played a vital role in establishing the current sustainability standing and the approaches used to measure performance through sustainability lens. This highlighted the research gap from a theoretical perspective.

The initial phase concluded with an exploratory interview with the purpose of collecting insights from the industry experts, revealed that the sustainability practice and performance measurement in the context of the sustainability aspects are not universal among companies in this industry. While some companies are considering adopting it, the current models still struggle to efficiently integrate key sustainable aspects and address industry specific characteristics. For instance, measuring the environmental impact, safety, regulatory compliance, resource efficiency, social impact and sustainable practice in general poses challenges to measuring due to the complex nature of the aspects.

The findings confirmed the similarity of identified gap between theoretical and practical perspectives, emphasising the need for a comprehensive model that integrates the pillars of sustainability, addresses most of the challenges the industry faces and incorporates the key characteristics of the oil refining industry. These perspectives managed to clarify the research gap and the potential strategies were proposed to bridge this gap in the upcoming research stages. This involved the identification of some research questions need to be answered clearly, as well as, hypotheses need to be tested in the phases to follow.

The findings successfully achieved the first research objective by initially gaining a deeper understanding of the industry’s foundation and surrounding environment. Next, the study moved towards identifying the challenges facing the industry. This comprehensive approach, combining theoretical and practical perspective, enabled the researcher to clearly observe the gap and current state of sustainability application and the performance measurement models that assist in assessing companies’ performance from the sustainability perspective. Therefore, these outcomes clearly answered the first research question.

Phase 2: Findings and analysis

In accordance with the strategies outlined in the initial stage, the second phase thoroughly reviewed and extracted key performance indicators from prior studies addressing technical issues in the oil refining industry. The findings shed light on the existing limitations in these studies, with the main focus on six key aspects: technology, environmental consideration, security, transportation, health and safety and social factors. Furthermore, the extracted key performance indicators notably displayed gaps in addressing the identified challenges comprehensively. The findings brought to attention the challenges in the environmental realm, in areas like production of environmentally friendly products, energy preservation in all oil refining processes, implementing new projects concerning environmentally friendly practices and ecosystem protection, as well as the challenges on the economic perspective, such as data integration, building relationships with government and investing in operations, processes, facilities, equipment and employees. And those on the social level were aspects related to social responsibility and HAZOP studies. These findings not only underscored the persisting research gap but also emphasised the on-going need for continuous improvement to enhance the proposed model's capability in addressing the identified challenges comprehensively.

In the following stage of the study, the research identified some key performance indicators from models applied in various industries due to some limitations in previous studies as mentioned earlier. In addition, the research aimed at developing a comprehensive model capable of including most of the key performance indicators relevant to oil refining industry's features and capable to address the current challenges facing the industry. However, it was observed that not all the extracted key performance indicators (KPIs) effectively addressed every challenge, so, some challenges remained unaddressed, thus indicating a need for further development tailored to the specific characteristics of oil refining. For instance, environmental aspects should focus on energy preservation throughout the oil refining process, executing new projects concerning environmentally friendly practices and ecosystem protection. Additionally, the economic aspect should encompass data integration, building relationships with government and investing in operations, processes, facilities, equipment and employees and on the social side, more social considerations need to be addressed, as well as HAZOP studies. These outcomes emphasised the on-going need for improvements in order to comprehensively address all identified challenges.

The study later progressed into identifying the factors impacting the application of sustainability practices, in order to understand the reasons beyond the sustainability application not reaching the maturity level. The findings revealed the lack of studies on the topic. Notably, the findings highlighted a lack of comprehensive frameworks consolidating essential factors that have to be taken into account to assist in the implementation process of the sustainability practices. Existing literature tended to focus on barriers and benefits, allocating comparatively less attention to procedural aspects and drawbacks in sustainability practices. These observations not only underscored the initial gap but also emphasised the scarcity of significant research, signalling the need for additional exploration for both the addressed aspects such as benefits and barriers and those less addressed such as procedures and drawbacks within the context of sustainability practice. To clarify, a comprehensive understanding of procedures, barriers, benefits and drawbacks aspects can assist in ensuring a well informed and strategic approach to the implementation of sustainability practices, promoting successful and sustainable outcomes.

The second research question was addressed and the second research objective was achieved. As the second research phase was concerned with the initial stages of the theoretical model development, two sources were deployed to identify key performance indicators. The first stage involved reaching insights from previous studies that focused on technical issues within the industry, this step successfully identified key performance indicators related to industry features and addressing current challenges. Acknowledging the limitations and seeking a comprehensive model, the study turned to a second source. This involved identifying key performance indicators from models applied in other industries, considering indicators that could suit the distinctive features of the oil refining industry and assist in addressing the current challenges facing the industry. This comprehensive approach played a key role in developing a partially tailored model that not only incorporated industry specific features but also effectively addressed some of the challenges facing the oil refining industry, but still requires further development addressed in the next stages.

Phase 3: Findings and analysis

In the third phase, an empirical study was conducted via focus group interview on the Egyptian oil refining companies and demonstrated the applicability of the proposed model and continued the model development as outlined in previous phases. The preliminary findings extracted from this phase are the results of the SWOT analysis conducted in this research on the Egyptian oil refining market. The outcome revealed that Egyptian oil refining market has strengths like being the largest non-OPEC oil producer and has the largest oil refining capacity in Africa (Thompson, 2021; Environmental Impact Assessment, 2022). In addition, the

Egyptian market plays a vital role in international energy markets through its operation of the Suez Canal and Suez Mediterranean (Summed) pipelines (Hegazy, 2015). Furthermore, Egyptian oil refining market has a great pipelines transportation network around Egypt (Labib et al., 2010). However, these strengths are not used efficiently due to some weaknesses such as operating below full capacity due to old infrastructure and lack of new strategies and technology such as sustainability practices that can assist the companies to remain in the forefront of the industry development instead of falling behind (Thompson, 2021). The results from the conducted focus group revealed that the Egyptian market is witnessing a phase in which companies and factories are in the process of developing their oil refineries by increasing the capacity and implementing new strategies including the sustainability aspect. As of the research time, oil refining companies have not begun implementing sustainability practice, as there was a noticeable absence of a sustainability department and staff members representing this department within the oil refinery sector. The absence of the sustainability department in oil refining companies reinforces the identified research gap in previous phases whereby oil refining companies have not fully implemented sustainability practices or models to measure sustainability performance within their operations.

On the other side, the findings indicated that managers of Egyptian oil refining companies expressed their insights that the proposed model can be applied and implemented in the real-world context within the industry. Their insights identified some determinants regarding the procedures, barriers, benefits and drawbacks that can act as a road map for the application of the proposed model. More so, their viewpoints provided valuable insight, allowed the refinement and improvement of the previously proposed developed model.

Overall, the gathered perspectives suggested that the contribution of the proposed model is not confined to a theoretical level, but it rather extends to practical application. In addition, taking the practitioners' insights into account has reinforced the model's effectiveness, opened more possibilities for the proposed model to be successfully implemented in the practical context and validated its relevance and worthiness in a real-world context. Therefore, the gathered Egyptian mangers' perceptions contributed in achieving the primary goal of the third objective which is conducting the empirical study to demonstrate the applicability of the proposed model. In addition, it provided a clear answer to the third research question.

Phase 4: Findings and analysis

In the fourth and concluding phase, an online survey was conducted and assessed the applicability of the model in the international context and refined the proposed model developed in previous phases until it reached the final version. The results from the survey analysis indicated that companies were still relying on some well-know performance measurement models including SCOR, BSC, or KPIs related to the petroleum authority, or environmental or quality models; these models signified the lack of integrating of the three pillars of sustainability, as mentioned earlier. Although some companies chose to develop and use customised models for measuring sustainability, thus demonstrating an increased awareness of sustainability practice and measurement, respondents did not refer to a unified comprehensive performance measurement model capable of incorporating the oil refining characteristics, integrating the three pillars of sustainability and addressing the current challenges which face industry. These findings reinforced the research gap identified previously.

In addition, the findings emerged from the fourth phase helped in fulfilling the research hypotheses. That is, the hypotheses' variables were assessed through correlation and Man-Whitney analyses, the outcome revealed that the existing models have a moderate influence on company performance in terms of the sustainability dimensions. These results reinforced and shed light on the identified research gap in previous research phases. The insights revealed that the existing models are insufficient and incomprehensive for application in measuring the company's performance effectively from a sustainability perspective. Additionally, when comparing the effectiveness of the existing models with the proposed model in terms of the economic, environmental and social aspects, the results showed that the proposed model is more effective.

Additionally, the outcome of the survey analysis assisted in further refinement of the proposed model developed in previous research phases. To elaborate further, experts in the oil refining companies provided valuable insights and perspectives that, allowed for the refinement of the proposed model, enhancement of the model's capabilities, allowance for better integration of sustainability dimensions, incorporation of relevant characteristics and further addressing the identified challenges.

The final phase of the research involved examining the applicability of the model in the international context and refining the proposed model until it reached its final version. The results from this research phase highlighted that the model underwent several modifications, becoming comprehensive and better suited to effectively assist in measuring the performance of oil refining companies. This progression supported achieving the fourth research objective and clearly answered the fourth research question.

Table 7.1 presents a roadmap illustrating the interconnection and alignment between each research objective and its corresponding research questions, phases, methods and findings stemming from each research phase.

Table 7.1. Comprehensive overview of research questions, objectives, phases, methods and findings

Research Questions	Research Objective	Research Phase	Method	Findings from Each Research Phase
What are the key challenges facing the oil refining industry?	Assessing the ability of existing performance measurement models in relation to sustainability integration and addressing the challenges facing the refining industry.	Phase One	Conducting a literature review and exploratory interview	• The oil refining industry's distinctive characteristics across the environmental, economic and social aspect. • The challenges facing the oil refining industry. • The previous studies focused only on one or two pillars of sustainability and relied on a single case study, which did not allow comparison with current models and inhibited the ability of the studies to be more widely generalised. • Exploratory interviews revealed that there is a limited awareness of sustainability practice among oil refining companies and that oil refining companies have not fully integrated sustainability practices into their visions and strategy and so relying on more traditional performance measurement models. • The outcomes in the literature aligned with the practical insights obtained through conducting exploratory interview, which is embedded in having insufficient performance measurement models that can incorporate the sustainability theme along with the main properties of the oil refining sector and addressing the global challenges and trends.
What are the key indicators that can effectively address the challenges facing the oil refining industry and how can they be integrated into the development of performance measurement model?	Developing a theoretical performance measurement framework tailored to the unique needs and challenges of the oil refining sector.	Phase Two	• Conducting extended literature review through examining previous research exploring some technical issues for the oil refining sector. • Reviewing studies that focused on performance measurement models in other industries. • Reviewing previous studies concerned with sustainability practice in the petroleum industry or other industries.	• The initial model addressed only a small percentage of the identified challenges facing the oil refining sector. • The second version of the model addressed a higher percentage of the identified challenges compared to the initial model, but it still required further improvement to effectively address more of the challenges. • Previous studies overlooked the factors essential for sustainability practice. In addition, the papers that exist tend to disproportionately focus on certain aspects such as benefits and barriers, while allocating insufficient attention to procedures and drawbacks. In essence, there is a general lack of developed frameworks in previous studies to serve as a comprehensive roadmap for companies in their sustainability practice.

Research Questions (Cont.)	Research Objective (Cont.)	Research Phase (Cont.)	Method (Cont.)	Findings from Each Research Phase (Cont.)
What are the essential guidelines and considerations that can effectively support oil refining companies in the implementation of the proposed performance measurement model?	An empirical study will be conducted via focus group on the Egyptian oil refining companies in order to demonstrate the applicability of the developed model.	Phase Three	Conducting focus group	• The Egyptian oil refining sector possesses significant potentials and strengths for further growth. However, these strengths are not currently utilised efficiently. In addition, the results indicated that the Egyptian oil refining sector is witnessing a new stage of innovation particularly considering sustainability practices. • There are often no sustainability departments and participants that can represent such departments. This reinforced the identified research gap as this means that oil refining companies are not concerned with sustainability practice and are not measuring their performance from a sustainability perspective. • The feedback received from managers confirmed that the model can be applicable in the real-world context and that it is not only theoretical. • Some refinements to the proposed model are conducted to better tackle the challenges that were not addressed in the development of the proposed model in the previous phases.
How does the developed model compare to existing models in terms of its impact on company performance from an economic, environmental and social perspective?	A global online survey questionnaire will be conducted among researchers and managers in the oil refining sector in order to test the applicability of the developed model.	Phase Four	Conducting an online survey	• Companies continue to depend on well-known models such as SCOR, BSC and or KPIs that are related to the petroleum authority, or environmental or quality models, yet these models lack integrating the three pillars of sustainability. Additionally, the outcome revealed that some companies have developed and applied customised performance measurement models to measure their performance from the sustainability perspective, but there is still a lack of having a unified performance measurement model that integrates the three pillars of sustainability, incorporates the industry the distinctive characteristics and addresses challenges facing the industry. • The existing model is insufficient and not comprehensive for measuring company performance from a sustainability perspective. • The proposed model is more effective than existing models. • The acceptance of testing H1.1, H1.2, H1.3, H2.1, H2.2 and H2.3. • Modified proposed model (regarded as version 4).

7.3 Comparative Analysis: Theoretical Insight vs. Practical Perspective

This section includes a comparative analysis of the findings derived from literature review and the findings obtained from practical insights gathered through conducting exploratory interview, focus groups and an online survey. The comparative analysis can enrich and enhance the findings, elevating them beyond a simple discussion, as this approach presents the comparison between the theoretical insights and practical perspective, highlighting the difference and similarities in viewpoints. The comparative analysis was conducted on three key research areas derived from the four research phases; these areas encompass the illustration of the main obstacles and difficulties in the oil refining sector, the determinants in the form of procedure, barriers, benefits and drawbacks which are considered as crucial to bear in mind before implementing the model and the progression of proposed model throughout the four research phases. Thus, these three specific subjects have been selected for their significance; these subjects mirror cornerstones in the research. It was important for the researcher to identify similarities and differences between theoretical and practical insights regarding these three subjects, which in turn guided the researcher to take the right decisions concerning the strategies and procedures of the research. The subsequent section presented the comparative analysis of the three subjects.

- **The main obstacles and difficulties in the oil refining sector**

This section highlighted the main obstacles and difficulties confronting the oil refining industry, the research particularly focused on the aspects related to the sustainability application and performance measurements models used to measure the sustainability practice in the oil refining sector.

Sojinu & Ejeromedoghene (2019) pointed out that the oil refining industry faces numerous and complex challenges that need to be addressed. However, Putri et al. (2019), and Sánchez-Flores et al. (2020) mentioned that many of the challenges facing the oil refining industry remain unaddressed with no apparent solutions. Additionally, Nosratabadi et al. (2019) highlighted that there is notable lack of in-depth discussion related to sustainability practice and application in the oil refining industry.

The interviewees' responses during the exploratory interviews showed that the level of awareness regarding sustainability is not at the climax. Therefore, oil refining companies still lack a universal model. Their insights are in accordance with those of previous studies as they both emphasise the industry's struggle with difficulties in both sustainability application and measuring.

The study conducted an empirical study via focus groups on Egyptian oil refining companies to demonstrate the applicability of the proposed model; participants revealed that these companies did not fully commence implementation of the sustainability practice and performance measurement model to measure the company's performance from sustainability lens. According to the present study the Egyptian companies' structure lacked sustainability department or the personnel specifically responsible for sustainability application in the Egyptian oil refining company. These findings emphasised the difficulties previously mentioned from literature and exploratory interviews.

Also, the current study performed an online survey to test the applicability of the model on global context. The respondents pointed that the oil refining companies still rely on well-known models such, as SCOR and BSC to measure the company's performance, although these models lack the integration of the three pillars of sustainability. Therefore, this industry lacks a unified comprehensive model to rely on. Such lack was evident upon testing hypotheses for assessment through correlation and Mann-Whitney analyses and the results revealed that the existing model has a moderate influence on company performance in terms of the sustainability dimensions. The results of the comparison of the effectiveness of the existing model and the proposed model in terms of the economic, environmental and social aspects, showed that the latter was more effective. The effectiveness of the proposed model is attributable to several factors: its ability to integrate all three dimensions, to incorporate the specific characteristics of the oil refining industry and to also address the current global challenges of the industry. The results support the existing difficulties revealed by literature, exploratory interview and focus group.

- **Procedures, barriers, benefits and drawbacks are determinants to consider upon application of the proposed model.**

This research examined previous studies that considered the determinants such as procedures, barriers, benefits and drawbacks to consider before tackling the sustainability practice or implementing the proposed model. The review revealed that there are a limited number of studies that address these aspects (Costache, Dumitrascu & Maniu, 2021). Moreover, the studies greatly stressed the aspects of benefits and barriers, while giving comparatively less concern to the procedures and drawbacks.

According to the previous studies, 18 obstacles hindering the sustainability practice were identified. Ageron et al. (2012), and Costache et al. (2021) pointed out specific barriers, such as lack of awareness, lack of resources, lack of staff training and skills, as well as limited financial resources. Different obstacles such as limited human resources, high initial cost, employee resistance, lack of sustainability knowledge and lack of time, were identified by other studies such as Mahmood et al. (2019) who indicated the improper communication to support sustainability practice, lack of technical expertise to support sustainability practice and lack of government support as revealed by (George et al., 2016). Other obstacles were added by Lehner et al. (2017) such as the difficulty in defining sustainability performance matrix, limited available training course, difficulty in supply chain configuration and lack of strategy, in addition to the difficulty in changing managers and mind sets and the difficulty restricting company strategies towards sustainability practice as per (Nordin et al., 2014).

On the other hand, other studies presented the benefits of sustainability practices, identifying 13 benefits the company can gain from the application of sustainability practice. Hamzah et al. (2019) identified the benefits as preserving and conserving environment, increasing companies' competitive advantages and improving companies' reputation. According to Bello (2020) "sustainability practice can aid companies in reducing operating costs, improving company's productivity, increasing company's growth and profitability and increasing employee safety". Some other benefits of the sustainability to the company include attracting and retaining high quality employees, reducing wastes and increasing customer satisfaction as per, Niţă et al. (2014). Also, Hristov et al. (2019) highlighted that reducing greenhouse gas emission and increasing quality can be the gains achieved from sustainability practice.

According to Negro et al. (2019) the procedures and steps taken to assist in sustainability practice include creating awareness, assuring two-way communication between leaders and employees, encouraging employees' autonomy and ensuring that companies have necessary resources for sustainability practice. Also, Stewart et al. (2016) pointed out that the cost could be considered one of the drawbacks for sustainability practice application.

The research sought to prove that the proposed model is both theoretical and applicable in a real context. This was done via focus groups as an empirical case study in Egyptian oil refining companies to identify some determinants such as procedures, barriers, benefits and drawbacks, to consider before implementing the proposed model. Based on the results from this empirical study, some aspects align with those gathered from the literature (these common aspects will be highlighted in Table 7.3), indicating that the literature discussed more aspects related to procedures, barriers, benefits and drawbacks. The insights from the focus group sessions revealed that the application of the sustainability practice can depend on selecting the appropriate key performance indicator such as carrying out simulation process, setting sustainability strategy, considering the company resources, communicating with employees and convening top managers of sustainable vision. The results reveal that the barriers include lack of financial resources and efforts, lack of management support, limited resources, limited awareness of sustainability theme, internal communication deficiency, difficulty in identification of the appropriate key performance indicators and lack of transparency, in addition to the benefits from the company becoming green, thus including; enhancing the company profitability, extending the companies social awareness, promoting the company's performance, improving the company's reputation, drawing the attention of employees and investors, increasing employees safety, enhancing trust and transparency and monitoring sustainability practice. On the other hand, the drawbacks are company commitment and cost.

Then, the research conducted an online survey to test the applicability of the developed model and gather opinions on a global scale. That is, the aspects related to procedures, barriers, benefits and drawbacks were included in the questionnaire to collect the opinions of oil refining experts. As per the results, most of the aspects are within the agreement zone (Chapter 6, Tables 6 .14 to 6.23).

The following Table 7.2 lists the aspects related to procedures, barriers, benefits and drawbacks in one table. These aspects are gathered from the literature and focus group sessions, highlighting common aspects found between the results of literature review and those of the focus group.

Table 7.2 Overview of the procedures, barriers, benefits and drawback gathered from literature and focus group

Determinants	Literature review	Focus group	Common determinants from both literature review and focus group
Procedures	• Creating awareness. • Encouraging employees towards sustainability practice.	• Select the appropriate KPI. • Carry out simulation process. • Set sustainability strategy. • Convince top managers of sustainability vision	• Assisting two-way communication between leaders and employees. • Ensuring that companies have the necessary resources for sustainability practice.
Barriers	• Lack of awareness. • Lack of resources. • Lack of staff training and skills. • Limited human resources. • High initial cost. • Employee resistance. • Lack of time. • Lack of technical expertise to support sustainability practice. • Lack of government support. • Difficulty in defining the sustainability performance matrix. • Limited available training course/ consultancy provided by government. • Difficult in supply chain configuration. • Lack of sustainability strategy. • Difficulty in changing mangers mind sets. • Difficulty in restructuring company strategy towards sustainable practice.	• Lack of management support. • Difficulty in defining the appropriate key performance indicators. • Lack of transparency.	• Limited financial resources. • Lack of sustainability knowledge. • Improper communication to support sustainability practice.
Benefits	• Preserving and conserving the environment. • Increasing company's competitive advantage. • Reducing operating costs. • Improving company' productivity. • Reducing environmental incidents. • Reducing wastes. • Increasing customer satisfaction. • Increasing quality. • Reduce greenhouse gas emission.	• Support the company to be green. • Extent the company social awareness. • Promote the company's reputation. • Increase trust and transparency. • Monitor sustainability progress.	• Improving company's reputation. • Increasing company's growth and profitability. • Attracting and retaining high quality employees. • Increasing employee's safety.
Drawbacks	• Company commitment	• Cost	• Company commitment

- **The progression of proposed model throughout the four-research phase**

The proposed model passed four phases as each of the phases witnessed both modification and refinement. The upcoming section comprehensively analysed each version of the proposed model, exploring how key performance indicators are identified, defining the inclusion of key performance indicators in each version and conducting a comparison with the identified challenges to determine the need for further refinement.

In order to develop the initial proposed model, this research reviewed previous papers that tackled some technical issues of the oil refining industry. These issues addressed six key aspects: technology, environmental consideration, security, transportation, health and safety and social aspects and they assisted the research in extracting and identifying some key performance indicators (Table 7.3, 7.4 and 7.5). Particularly on the environmental side, key performance indicators include flared gas, fresh water, discharged water, oil spills, alternative energy sources, waste, fuel, greenhouse gas emission, other gas emissions and refining effluents treatment technology. On the economic side, indicators include local procurement, energy security against uncertainty risks, crude oil quality, bio-refinery technology and smart refinery. On the social side, indicators include occupational health and safety, social investment, local hiring practices, product stewardship and workforce developments.

This phase resulted in the initial model, which has been evaluated in terms of its effectiveness in addressing the identified current global challenges. This evaluation revealed that the initial version did not address most of the identified current global challenges (see Table 7.6). To clarify, from the environmental side, the initial model did not address areas such as production of environmentally friendly products, energy preservation in all oil refining processes, implementing new projects concerning environmentally friendly practices and ecosystem protection. From the economic perspective, aspects such as data integration, building relationships with government and investing in operations, processes, facilities, equipment and employees. While on the social level, aspects related to social responsibility and HAZOP studies. Thus, further modifications were required, so this research resorted to reviewing previous studies that consider performance measurement from sustainability perspective in other industries.

To develop a second version of the proposed model, the research reviewed previous studies that discussed performance measurement from sustainability in other industries (Erol et al., 2011; Boukherroub et al., 2015; Ahi et al., 2016; Rajeev et al., 2017; Simpson et al., 2018; Ramezankhani et al., 2018; Andalib et al., 2019). In this phase, forty-two new key performance indicators were identified and were incorporated into the second model version (see Table 7.3, 7.4 and 7.5). The comparison with the initial version of the proposed model revealed that the second version underwent a dramatic change. That is, the key performance indicators' addition significantly altered the framework, resulting in the division of the initial proposed model into three models, focusing on the environmental, economic and social aspects. All this is the result of the fact that it is challenging to address all the indicators in a single model. Particularly, 12 key performance indicators were introduced from the environmental side; these aspects are related to atmospheric acidification, quantity of recycled/reused/recover of water, energy consumption, quantity of solid wastes, quantity of recycle/reuse/recover of solid wastes, oil spill removal, environmental friendly products, company environmental strategy policy and targets, ISO 14001 certification, industry's association membership, environmental audits and assessment and employee environmental training and awareness. In addition, ten new key performance indicators were added from the economic side; these aspects are associated with research and developments, sustainable return on investment, facility and equipment maintenance, crude oil feedstock quality, process quality, product quality, ISO 19001 certification, transparency of tax payment to host country and subsidies. Furthermore, twenty newly added key performance indicators from social side, including soft skills development and training, employee engagement, workers motivation and compensation, fringe benefits, annual employee turnover, employee representation on corporate board of directors, diversity and equal opportunity, disable employees, appropriate physical working conditions, appropriate working hours, injury and illness incident records, engineering controls personal and protective equipment and clothes, safety inspection audit, emergency plans, safety orientation and control, safety warning signs, workplace first aids, company community relations, corruption/bribery policy and business codes of conduct.

This phase has resulted in coming up with the second version of the proposed model, which has been assessed in terms of its effectiveness towards addressing the identified current global challenges. This assessment revealed that the second version of the proposed model is capable of addressing most of the challenges, but there are still some challenges that remained unaddressed, indicating a need for further development tailored to the specific characteristics of oil refining (Table 7.6). For instance, environmental aspects should focus on energy preservation throughout the oil refining process and new projects to be implemented concerning environmentally friendly practices and ecosystem protection. Additionally, the economic side should include data integration, building relationships with government and investing in operations, process, facilities, equipment and employees and on social side, more social considerations need to be addressed and HAZOP studies. These outcomes emphasise that the 2nd version of the proposed model required additional improvements to be capable of addressing more of the identified current global challenges, so this research conducted an empirical study through focus group questionnaire on the Egyptian oil refining companies to demonstrate the applicability of the model. This phase aided the research to gather practical insights about the model, aiding in further refinements to address the challenges effectively.

The current research, in order to develop the 3rd version of the proposed model, conducted an empirical study on the Egyptian oil refining companies through a focus group questionnaire, to demonstrate the applicability of the model. According to the empirical study results, there are slight adjustments to the third version of the proposed model, but no significant changes or additions are made to the key performance indicators compared to the second version of the proposed model (see Table 7.3, 7.4 and 7.5). These results indicate that the focus group practitioners' perspectives were compatible with KPIs that were set in the 2nd version of the proposed model gathered from literature review. That is, minor key performance indicators were added to the 3rd version of the environmental model: air emission reduction, energy sources, energy intensity, renewable energy sources, environmental projects, ecosystem and biodiversity protection and environmental law compliance. Additionally, some key performance indicators were modified in the environmental model, such as changing "ISO certification" to "ISO certification 14001", changing "environmental products" to "environmentally friendly process" and changing "oil spills" to "oil leakage". On the economic side, few new key performance indicators were added, including human capital, market expansion, information system, new products, resources security and feedstock security. Some key performance indicators were modified in the economic model, such as changing "ISO certification" to "ISO certification 9001" and changing "capital employed" to "capital investment", as well as merging two fundamental aspects which are "bio-refinery" and "smart refinery" to "technology". On the social side, some key performance indicators were inserted to the 3rd version of the proposed model, including hazard and operability study (HAZOP), loss time injury frequency rate, health and safety committee, annual employee hiring and turnover, workers covered by occupational health and safety management system and labour law compliance. Moreover, some key performance indicators were modified in the social model, such as changing "occupational safety and health" to "occupational health and safety", changing "soft skills development and training" to "capacity building", changing "annual employee turnover" to "annual employee hiring and turnover" and changing "bribery and corruption policy" to "anti-bribery and corruption policy" (to support the following modifications, see Appendix 9, which includes the evidential quotes taken from the focus group participants).

This phase resulted in reaching the third version of the proposed model, which was assessed in terms of its effectiveness in terms of addressing the identified current global challenges. This assessment revealed that there are still some challenges that remained unaddressed, particularly in terms of the production of environmentally friendly products and from the economic side, the data integration. Therefore, additional modifications were still required to address more of the identified current global challenges (Table 7.6), so the research conducted an online survey to test the applicability of the proposed model and collect opinions on a global scale.

This phase resulted in reaching the fourth version of the proposed model, through a globally distributed online survey, to test its applicability in the international context, given the nature of the oil refining industry that has to adhere to the international rules and regulations. The results from the online survey revealed that survey respondents' perspectives were compatible with KPIs included in the 3rd version of the proposed model collected via empirical study through focus group sessions in the Egyptian oil refining sector and only few modifications were made to the environmental model, including the addition of new key performance indicators related to environmentally friendly products. In the economic model, capacity utilisation and return of investment were introduced. In addition, changes were made to the environmental model including shifting from "water withdrawal" to "water withdraw rate" and adjusting "quantity of recycled/reused water" to become "wastewater treatment". In the economic model, the "sustainability profit" aspect was removed (Table 7.3, 7.4 and 7.5).

Assessing the effectiveness of this version reflected that this version addressed all the identified current global challenges. This reveals that the KPIs in the proposed model were further validated on a wider scale from the industry experts. All of previous phases contributed to the development of a comprehensive model that is capable of integrating the three pillars of sustainability, incorporating the characteristics of the oil refining industry and addressing the identified current global challenges (Table 7.6).

According, to the previous discussion, Table 7.3, 7.4 and 7.5 illustrate the key performance indicators incorporated into each version. Table 7.3 focuses on the environmental KPIs, Table 7.4 focuses on the economic KPIs and Table 7.5 focuses on the social KPIs.

Table 7.3. Comprehensive overview of the environmental KPIs across proposed model versions

Environmental KPIs	Initial model	2nd version of the proposed model	3rd version of the proposed model	4th version of the proposed model	Environmental KPIs	Initial model	2nd version of the proposed model	3rd Version of the proposed model	4th version of the proposed model
Flared gas	√	√	√	√	Quantity of oil leakage	√	√	√	√
Greenhouse gas	√	√	√	√	Quantity of leakage removal		√	√	√
Atmospheric acidification		√	√	√	Environmentally friendly manufacturing processes			√	√
Other gases	√	√	√	√	Environmental projects			√	√
Air emissions reduction			√	√	Eco-system and bio-diversity protection			√	√
Water withdraws rate	√	√	√	√	Producing Environmentally products				√
Water discharge	√	√	√	√					
Wastewater treatment	√	√	√	√	Company Environmental vision/strategy/policy/targets		√	√	√
Energy sources			√	√	ISO certification		√	√	√
Energy intensity			√	√	Industry environmental association membership		√	√	√
Renewable energy sources	√	√	√	√	Environmental audits and assessment		√	√	√
Quantity of solid wastes		√	√	√	Employee environmental training and awareness		√	√	√
Quantity of recycled/ reused solid waste		√	√	√	Environmental law compliance			√	√

Table 7.4 Comprehensive overview of the economic KPIs across proposed model versions

Economic KPIs	Initial model	2nd version of the proposed model	3rd version of the proposed model	4th version of the proposed model	Economic KPIs	Initial model	2nd version of the proposed model	3rd version of the proposed model	4th version of the proposed model
Technology	√		√	√	Process quality		√	√	√
Information system			√	√	Product quality		√	√	√
Capital investment (facility and equipment)		√	√	√	ISO certification		√	√	√
Human capital			√	√	Energy security	√	√	√	√
Research and development		√	√	√	Resource security			√	√
Market expansion			√	√	Feedstock security			√	√
Adding new products			√	√	Risk management process				√
Capacity Utilisation				√	Local procurement	√	√	√	√
Return on sustainability investment		√		√	Transparency of tax payment to host country		√	√	√
Crude oil feedstock quality	√	√	√	√	Government incentives/ assistance		√	√	√

Table 7.5 Comprehensive overview of the social KPIs across proposed model versions

Social KPIs	Initial models	2nd version of the proposed model	3rd version of the proposed model	4th version of the proposed model	Social KPIs	Initial models	2nd version of the proposed model	3rd version of the proposed model	4th version of the proposed model
Capacity building (soft and technical)		√	√	√	Safety Inspection/ Audits		√	√	√
Employee engagement		√	√	√	Emergency Plans		√	√	√
Employee motivation and compensation		√	√	√	Safety Orientation and Advanced Safety Training		√	√	√
Fringe benefits		√	√	√	Safety Warning Signs		√	√	√
Annual employee hiring and turnover		√	√	√	Workplace First Aids (Boxes/Rooms/Kits)		√	√	√
Employee representation on corporate board of directors		√	√	√	Workers Covered by Occupational Health and Safety Management System			√	√
Diversity and equal opportunity (Gender/ Age/ Ethnicity)		√	√	√	Hazard and Operability Study (HAZOP)			√	√
Disabled employees		√	√	√	Health and Safety Committee			√	√
Appropriate Physical Working Conditions		√	√	√	Local Hiring Practice		√	√	√
Appropriate Working Hours		√	√	√	Community Funding and Support	√	√	√	√
Labour Law Compliance			√	√	Company-Community Relations		√	√	√
Loss time injury Frequency Rate			√	√	Product Stewardship	√	√	√	√
Injury and Occupational Diseases Records		√	√	√	Anti-bribery and Corruption Policy		√	√	√
Engineering Control, Personnel Protective Equipment and Clothes		√	√	√	Business Codes of Conduct		√	√	√

Table 7.6 illustrates a comprehensive overview of the effectiveness of the proposed model versions in addressing the current global challenges, monitoring the effectiveness of each version of the proposed model in addressing the challenges facing the oil refining industry.

Table 7.6 Comprehensive overview of the effectiveness of the proposed model versions in addressing the current global challenges

No.	KPIS	Initial Models' KPIs		2[nd] version of proposed models' KPIs		3[rd] version of the proposed models' KPIs		4th version of the proposed models' KPIs	
		Addressed	Not Addressed	Addressed	Not Addressed	Addressed	Not Addressed	Addressed	Not Addressed
Environmental									
1	Air emission reduction	√		√		√		√	
2	Recycling of wastewater	√		√		√		√	
3	Recycling of solid wastes	√		√		√		√	
5	Production of environmentally friendly products		√	√			√	√	
7	Energy preservation in all oil refining processes		√		√	√		√	
8	Implementing new projects concerning environmentally friendly practices		√		√	√		√	
9	Protecting ecosystem		√		√	√		√	
Economic									
10	Complying with International standards	√		√		√		√	
11	Staying up to date with the latest developments and innovation	√		√		√		√	
12	Data integration		√		√		√	√	
13	Risk management processes	√		√		√		√	
14	Building relationships with government		√	√		√		√	
15	Investing in operations, processes, facilities, equipment and employees		√	√		√		√	
Social									
16	Social responsibility	Not all KPIs addressed		Not all KPIs addressed		√		√	
17	HAZOP		√		√	√		√	

7.4 Summary

This chapter commenced with a brief summary of the research phases, followed by an in-depth presentation of the findings derived from each phase, ending with a table that helps in supporting the findings and linking the method such findings were extracted from each phase that addressed the respective research objectives and questions. In addition, this chapter moved to the comparative analysis; which included presenting the theoretical and practical insights outlining the obstacles impeding the oil refining industry and the determinants in the form of procedures, barriers, benefits and drawbacks. Furthermore, the section focused on providing a comprehensive overview of the various stages of the development of the proposed model. The section also illustrated how each version of the proposed model effectively tackled the challenges within the oil refining sector, presenting the rationale for undergoing multiple refinements until reaching the conclusive version of the proposed model.

Chapter 8: Conclusion and Recommendation

8.1 Introduction

The oil refining sector plays a crucial economic role in satisfying the continuously growing global energy demand by acting as a key player in international trade. It also plays a significant part in advancing global economies and enhancing their security. Yet, the oil refining sector, have detrimental effects on the environment and society. The oil refining sector operates in a complex environment governed by international laws, regulations and challenges and must adhere to worldwide rules and regulations, as well as, deal with evolving contemporary global issues in order to exist and sustain its place in the market. To maintain its market presence and remain competitive, the industry must balance economic growth, environmental responsibility and social concerns. This balance can be achieved by implementing sustainability practices. Thus, it is crucial for the oil refining sector to constantly evaluate and track its performance from a sustainability viewpoint. This can be achieved by implementing performance measurement models with indicators that can address the three pillars of sustainability (environmental, economic and social elements). In order to create such a model, it is necessary to have a thorough awareness of the traits and global issues that oil refining companies currently face.

Accordingly, this research conducted an extensive literature review to gain an in-depth understanding of the oil refining sector's characteristics, the current global challenges it is encountering and the key performance indicators set in previous models. Additionally, this research conducted an exploratory interview to understand the current status of the oil refining sector. The literature review and the exploratory interview revealed the lack of effective performance measurement models that can incorporate the sustainability theme along with including the main properties of the oil refining sector whilst also addressing the global challenges and trends facing the sector. As a result, this research attempted to bridge this identified research gap by addressing the research limitations of previous studies. Furthermore, this research sought to demonstrate the applicability of the proposed model, to ensure that the proposed model is not only theoretical but also can be applicable in a real context. This was done by conducting focus groups as an empirical case study with Egyptian oil refining companies. The proposed model was then tested to demonstarte it can be applied in an international context through distributing an online survey. This all facilitated the development of a comprehensive performance measurement model capable of integrating the three pillars of sustainability, while including specific characteristics of the oil refining sector and addressing the current global challenges facing the sector. The proposed model can, therefore assist oil refining companies in tracking and assessing their sustainability practices, identifying areas for improvement and ultimately, sustaining their presence in the market. Consequently, by encompassing sustainability practices and aligning with global challenges, the oil refining industry can continue to play a crucial role in the global economy.

This chapter explains how each research objective and question were fulfilled in order to achieve the main research objective. In addition, the academic and practical contributions are discussed and the research limitations and recommendations for further research are highlighted.

In the next section 8.2 the realisations of the objectives each objective was addressed through discussing the achievement of each objective. In section 8.3 the academic contribution, the research's potential benefit to knowledge was discussed. Whereas the practical implementations in section 8.4 tackled how the study is expected to assist the industry. As for the limitations of the study, section 8.5 mentioned the obstacles with regard to the methodology or the design that have affected the findings of the research. Finally section 8.6 of the future work this section gave recommendations to the future areas of research required in the future studies.

8.2 Realisation of the Objectives

This research developed a comprehensive performance measurement model that incorporated the key elements of the oil refining sector, integrated the sustainability aspect (economic, social and environmental pillars) and addressed the current global challenges that the oil refining industry faces, which was the main aim of the research. This model was developed to assist oil refining companies in tracking, monitoring and measuring company performance from a sustainability perspective. That is, in implementing the proposed model, companies can gain relevant insights into their sustainability practice and performance. In order to achieve the research aim, the four research objectives were developed and the next section outlined the main achievements of each objective.

Objective 1: Assessing the ability of existing performance measurement models in relation to sustainability integration and addressing the challenges facing oil refining industry

The first objective was accomplished by successfully achieving the following aspects:

1. Attaining a comprehensive understanding of the distinctive features of the oil refining industry across the environmental, economic and social aspects; this step was considered foundational before delving deeper into the complexities of the industry.
2. Identifying the current challenges facing the oil refining industry across the environmental, economic and social lens. Understanding challenges is vital since the main research aim revolves around developing a performance measurement model and ensuring effective measurements in order to confront the industry challenges.
3. Examining and identifying the current status of the sustainability application and particularly the performance measurement models that can assist in measuring companies' performance from sustainability perspective through theoretical and practical insights. Understanding the current status of the field of research is considered an informed analysis which assisted in identifying improvement areas.
4. Identifying the weaknesses and gaps established in the oil refining sector, particularly the field of performance measurement models which can assist in measuring companies' performance from sustainability perspective and accordingly establishing the roadmap for the subsequent phases to bridge the identified research gap.

Objective 2: Developing a theoretical performance measurement framework tailored to the unique needs and challenges of the oil refining sector

The second objective was fulfilled by tackling the following points:

1. Developing an initial performance measurement model of sustainability particular for of refining sector; this proposed model is capable of integrating the key features considered by the oil refining industry as incorporating such features is crucial to ensure that the proposed model is tailored to specific characteristics of the sector and this can result in more meaningful performance assessment.
2. Modifying the initial model as it still does not address all the identified challenges facing the industry and developing the 2nd version of the proposed model which aligned various indicators in the initial model and introduced additional indicators identified from performance measurement models of sustainability used in other industries to be

more comprehensive. In addition, the 2nd version of the proposed model addressed a higher percentage of the identified challenges compared to the initial model, but it still required further improvement to effectively address more of the challenges which was achieved in the third objective. Identifying the indicators that suit the unique needs of the oil refining sector from other performance measurement models used in other industries helped the model to include more indicators and to be comprehensive.

3. Identifying some determinants in the form of procedures, barriers, benefits and drawbacks that the companies have to bear in mind before sustainability application. The identification of the determinants assisted the research to provide theoretical framework or a roadmap for companies to take into account before implementing the proposed model.

Objective 3: Conducting an empirical study via focus group on the Egyptian oil refining companies in order to demonstrate the applicability of the developed model

The third objective was reached through attaining the following elements:

1. Identifying the insights and perspectives of the managers in Egyptian oil refining companies and according to their insights, the proposed model can be applied and implemented in the real-world context within the industry. The model's applicability was demonstrated by identifying some determinants in the form of procedures, barriers, benefits and drawbacks that oil refining may encounter when implementing the proposed model. These determinants served as guidelines or a roadmap that can assist oil refining companies in putting the proposed model into practice.
2. Refining the 2nd version of the proposed model and developing the 3rd version of the proposed model to better tackle the challenges that were not addressed during the development of the proposed model in the previous phases. The more refinement of the proposed model to address more the challenges faced by the oil refining sector maximises the model's effectiveness.

Objective 4: Applying a global online survey questionnaire among researchers and mangers in the oil refining sector in order to test the applicability of the model

The fourth objective was attained through undertaking the following procedures:

1. Collecting the opinions and viewpoints of oil refining experts on a global scale regarding the proposed model, taking into account the nature of the oil refining industry which necessitates adherence to international rules and regulations.

2. Testing the research hypotheses and evaluating the effectiveness and application of the proposed model in the global environment. The results revealed that the existing models are insufficient and incomprehensive for application in measuring the company's performance effectively from a sustainability perspective. Additionally, when comparing the effectiveness of the existing models with the proposed model in terms of the economic, environmental and social aspects, the results showed that the proposed model is more effective. This step assisted the study in testing the applicability of the proposed model in an international context.
3. Refining the 3rd version of the proposed model and developing the 4th version of the proposed model to better tackle the challenges that were not addressed during the development of the proposed model in the previous phases. The more refinement of the proposed model made it more comprehensive and capable of integrating the oil refining features and addressing the challenges facing the oil refining industry.

8.3Research Contributions

The next section shows how this paper contributes to both theory and practice.

8.3.1 Academic Contributions

1. This research has contributed to theory through developing a comprehensive performance measurement model from a sustainability perspective for the oil refining industry. This model is able to integrate the three pillars of sustainability, incorporate the specific characteristics of the oil refining industry and also addresses the current global challenges facing the oil refining sector. The proposed model's key academic contribution can be summed up as follows;

   - Integration of the 3 pillars of sustainability (economic, environmental and social aspects) bridges the gap in previous studies, which concentrated on only one or two dimensions of sustainability. Accordingly, developing a model that can manage and balance the multiple aspects within one single framework was a challenge, as each pillar of sustainability encompasses multiple dimensions and factors that need to be considered. Therefore, the integration of the three pillars enables a thorough and balanced assessment of sustainability performance in the oil refining industry, as it enables consideration of the three dimensions simultaneously.

- The proposed model's key indicators were carefully selected based on principles that were tailored to be aligned with the unique characteristics of the oil refining industry and the global challenges currently encountering the industry. The key indicators were selected through four research phases, including an extensive literature review, exploratory interview, focus groups and an online survey that was distributed globally. The proposed model was improved and refined at each phase to better align with the specific characteristics and global challenges of the oil refining sector.
- This research assigned each key performance indicator with a specific measurement to facilitate the assessment of the corresponding indicator. That is, selecting the right measurement for each KPI and integrating them within a single model is considered a challenge, particularly due to the large number of KPIs involved in the proposed model. Therefore, underpinning the proposed model with a measurement capacity, enhances the understanding of how to more accurately measure and assess sustainability performance in the oil refining industry.
- In this study, the proposed model was developed by combining academic and practical insights. This combination adds a significant value to the proposed model. The academic insights provide the proposed model with a solid theoretical basis. On the other hand, the practical insights gathered from experts involved in day-to-day operations helped in demonstrating and testing the applicability of the proposed model in a real-world context. Furthermore, this research expanded to investigation of the model's applicability through testing it in an international context. Testing the applicability of the model in an international environment bridges the gaps that exist in previous studies where the applicability of current models was solely tested in a specific context. As a result, combining the academic and practical insights, along with considering a broader range of contexts, can help in strengthening the proposed model's value, usefulness and relevance for academia and industries globally.

2. This study exposed the research gap and limitations of previous studies and raises awareness of the areas that require additional research and development. Identifying the research gap and developing the proposed model was a challenge due to several reasons. First of all, there were few papers that considered the general aspects of oil refining and particularly performance measurement from a sustainability perspective for the oil

refining sector. Additionally, given the industry's complex environment and requirement to adhere to strict global rules and regulations, gathering data on the environmental, economic and social aspects can be extremely challenging. Therefore, bridging this gap is an essential step as it serves as the gateway for this research to make a meaningful contribution to knowledge.

3. This research identified some determinants in the form of procedures, barriers, benefits and drawbacks. Accordingly, these determinants are regarded as a crucial resource that highlights the issues which oil refining companies may run into while putting the proposed model into practice. These determinants can serve as guidelines or a roadmap that assists in the effective practical application of the proposed model.
4. This study enhanced understanding the sustainability practices in the Egyptian oil refining sector. It remains one of the few studies that focus on sustainability practices in the Egyptian oil refining sector.
5. The study in hand attained methodology contribution, through using different methodological approach not used in previous studies, so the majority of studies relied heavily on conducting online survey (since it is considered one of the appropriate methods, considering the restricted access to oil refining companies due to practical and strategic factors related to nature of the industry). This research achieved a methodological triangulation which integrated different methods of gathering data through conducting exploratory interviews, focus groups and an online survey. Achieving methodological triangulation enhanced the validity and reliability of the research findings.

8.3.2 Practical Contributions

The following section pointed out the research contributions to practice in the oil refining field and to sustainability. These contributions were outlined as follows:

1. The developed performance measurement model is expected to assist oil refining companies to measure their companies' performance from a sustainability perspective. The proposed model is expected to aid practitioners in the oil refining sector in monitoring, tracking and managing their performance from a sustainability perspective. Additionally, the proposed model is expected to help other industries that have the same features as the oil refining industry to evaluate their companies' performance from a sustainability perspective. The study may enable managers within oil refining companies to rely on a

performance measurement framework as an important resource in gaining a competitive advantage.

2. The guidelines which this has developed serve as a foundation for either implementing the proposed model or sustainability practices in any other industry. These guidelines include the procedures, barriers, benefits and drawbacks that companies may encounter when integrating sustainability or referring to the proposed model.
3. The proposed model, along with the proposed guidelines, are predicted to be a good opportunity to assist the Egyptian oil refining sector as the Egyptian oil refining sector is witnessing a phase in which companies and factories are in the process of developing their oil refineries by increasing the capacity and implementing new strategies including the sustainability aspect. As a result, the proposed model and the guidelines can help Egyptian companies in planning integration of sustainability practices to their vision, goals and strategies. It can also assist in measuring their performance from a sustainability perspective.
4. The proposed model and the guidelines are expected to assist the oil refining companies in monitoring, tracking, measuring and managing their performance from the sustainability perspective. This may lead to the fact oil refining companies will be responsible for the environmental risks and economic and social wellbeing. It is expected that this will positively affect the oil refining sector, the petroleum industry and the community in addition to supporting the SDGs goal 2030.

8.4Limitations of the Study

The following section will identify the factors and constraints that impacted the research process.

Firstly, there were a limited number of studies that explored the oil refining sector in general and an insufficient number of papers addressing performance measurement models of sustainability for the oil refining sector. It was therefore challenging to develop a comprehensive understanding of the oil refining field. To overcome this limitation, this research considered alternative sources, such as conducting exploratory interviews, focus groups and an online survey to compensate and to enhance understanding of the oil sector and sustainable practices.

Another limitation lies in the lack of accessibility of some Egyptian oil refining companies. Focus group sessions were intended to be conducted with nine oil refining companies; however, only seven companies were ultimately involved, since two refineries were closed due to renovations at the time of data collection and one refinery was situated in Upper Egypt, which was not geographically feasible for the researcher to visit. This research, therefore could not benefit from the perspectives of these additional two organisations. Despite this limitation, perspectives were gathered from those remaining companies and this represented around 70 % of the Egyptian oil refining market segment. This research also encountered a limitation when conducting the focus group sessions. It was initially planned for each focus group session to include seven managers, preselected from seven departments; environmental, financial, human resources, health and safety, SC, quality assurance and sustainability. However, six of the Egyptian oil refining companies did not assign participants to represent the sustainability department, since there was no sustainability department, or representative, within their company who is responsible for the tasks related to sustainability practice. However, among the Egyptian oil refining companies included in the study, only one company had a sustainability department and was able to assign a participant who could represent the company's sustainability perspective. Despite this limitation, the experience of the selected participants still encompassed the three pillars of sustainability and could provide valuable insights and the necessary knowledge to assist the researcher gain a comprehensive understanding of the required data.

Furthermore, restrictions in communicating with global oil refining companies are regarded as another limitation. The restricted communication is the result of the strategic and nature of the industry whereby there it was difficult to gain access and communicate with oil refining companies in order to gather their perspectives. Despite this limitation, more than 50% of the required sampling size was able to be reached (see Chapter 4).

8.5 Future Work

The following section outlines some research topics and areas that would benefit from further investigation:

1. As previously noted, there are few resources and studies available on the research topic, so this area would benefit from additional research. In other words, more studies are required to help in broadening the knowledge base, bridging the gaps related to the research topic

and providing a thorough understanding of the oil refining field. Additionally, conducting more studies will aid to address the limitations encountered by this research and potentially lessen the likelihood of future research in encountering the same limitations and difficulties.

2. It was observed through the focus groups and online survey that relatively few oil refining companies have a sustainability department. This finding is in line with previous studies that also pointed out this issue. There would, therefore be an advantage in exploring the issues that prevent oil refining companies from setting up sustainability departments. In order to facilitate the adoption of the sustainability practice, it is crucial for all companies to have sustainability departments. Additionally, establishing a sustainable department within a company will aid in monitoring and evaluating the performance of the company through the lens of sustainability.
3. It is recommended to regularly refine, improve and update the proposed model in light of new research findings or new data from practitioners and researchers. Such updates will ensure that the suggested model remains up to date and effective in addressing the emerging sustainability challenges in the oil refining sector.
4. It is advised to perform a comparative analysis to judge the proposed model's applicability in real life circumstances. In other words, comparative analysis will include comparing the performance and results of oil refining companies that have adopted the proposed model to those that have not implemented the proposed model. This comparative analysis will help provide a better understanding of the benefits and limitations of the suggested model.
5. Expanding the sample size is recommended in future research to include a wider range of perspectives and insights regarding the proposed model. Participants from the Ministry of Petroleum, government agencies and environmental organisations are examples of stakeholders that should be included.

Appendix 1: Exploratory Interview Questions

I am Dina Tamazin and I am looking forward to hearing from you about your experience and knowledge in the performance measurement models from the sustainability perspective adopted in the oil refining sector which will assist me in collecting the needed data for my research in developing a performance measurement model to enhance the performance of oil refining companies through the lens of sustainability. I will record the interview to avoid missing any of your comments if you agree to have this interview with me. All your answers and responses to the questions will be kept confidential and it will only be shared for research purposes. Moreover, I will make sure that all the information included in the research does not identify you as a respondent. Also, you have the right to end the interview at any time and to refuse responding to any of the questions. Are there any questions regarding what I have just mentioned? Are you willing to participate in this interview?

1- During the recent years, there has been a tremendous interest about sustainability, please indicate, how much do oil refining companies' aware of the sustainability practice?

2- How do oil refining companies measure their performance?

3- To the best of your knowledge, do you think that oil refining companies refer to key performance indicators to measure their performance from the sustainability aspect?

4- Do you wish to add any further points?

Thank you for your participation.

Appendix 2: Egyptian Oil Refining Companies

No.	Oil Refining Companies
1	Nasr Petroleum Company (NPC)
2	Suez Oil Processing Company (SOPC)
3	Alexandria Petroleum Company (APC)
4	Cairo Oil Refining Company (CORC)
5	Amreya Petroleum Refining Company (ARPC)
6	Assuite Oil Refining Company (AORC)
7	Middle East Oil Refining Company (MIDOR)
8	Alexandria Minerals and Oil Company (AMOC)
9	Alexandria National Refining and petrochemicals Company (ANRPC)
10	Egyptian Refining Company (ERC)

Source: (US Energy Information Administration, 2008; Veerapandian, 2010; Egypt Oil &Gas, 2017)

Appendix 3: Global Refinery Companies' Ranking

Rank	Global	Africa	Asia	Europe	Latin America	Middle East	North America
1	Reliance Petroleum Ltd	Naftec SPA	Reliance Petroleum Ltd	Deutsche Shell AG	Paraguana Refining Center	Abu Dhabi National Oil Co.	Galveston Bay Refining
2	Galveston Bay Refining	Societe-Anonyme-Marocaine de L'Industrie-Rafflinage	GS Caltex Corp	Shell Nederland Raffinaderij BV	Petroleos Mexicanos	Saudi Arabian Oil Co. & Total (SATORP)	ExxonMobil Refining & Supply Co.
3	Paraguana Refining Center	Shell and BP PLC Petroleum Refineries Pty. Ltd	SK Innovation	Saras SPA	Petroleos Mexicanos	Saudi Arabian Oil Co. & Sinopec (YASREF)	Motiva Enterprises LLC
4	GS Caltex Corp.	Port Harcourt Refining Co. (NNPC)	S-Oil Corp	Total SA	Petroleos-Mexicanos	Saudi Arabian Oil Co.	Marathon Petroleum Co. LP
5	SK Innovation	Middle East Oil Refinery	ExxonMobil Refining and Supply Co.	Lukoil European Holding BV	Petroleos-Mexicanos	Saudi Arabian Oil Co. & ExxonMobil (SAMREF)	ExxonMobil Refining and Supply Co.
6	ExxonMobil Refining & Supply Co.	Engen Petroleum Ltd.	Formosa Petrochemical Co.	BP PLC	Petroleo-Brasileiro SA	Kuwait National Petroleum Co.	BP PLC
7	Motiva Enterprises LLC	National Petroleum Refiners of South Africa Pty Ltd.	JX Nippon Oil & Energy Corp.	PKN Orien SA	Refineria Isla Curazao SA/PdVSA	National Iranian Co.	Citgo Petroleum Corp
8	Marathon Petroleum Co. LP	Caltex Oil SA/ Chevron South Africa	Sinopec	Mineraloelraffinerie Oberrhein GMBH	Petroleo Mexicanos	Saudi Arabian Oil Co. & Sumitomo	Chevron Corp.
9	Exxon-Mobile Refining & Supply Co.	El Nasr Petroleum Co.	Essar Oil	BP PLC	Patroleo Brasilerio SA	Kuwait National Petroleum Co.	ExxonMobil Refining & Supply Co.
10	S-Oil Corp	Ras-Lanuf Oil & Gas Processing Co.	Sinopec	Phillis 66	Petroleos Mexicanos	National Iranian Oil Co.	Valero Energy Corp.
11	Abu Dhabi National Oil Co.	Warri Refinery & Petrochemical Co. (NNPC)	CNOOC	Neste Oil Corporation	EmpresaColombiana de Petroleos	Saudi Aramco Shell Refinery Co. (SASREF)	Valero Energy Corp.
12	Saudi Arabian Oil Co. & Total (SATORP)	Concorp (Sudapet & CNPC)	China National Petroleum Corp	ExxonMobil Refining & Supply Co.	EmpresaColombiana de Petroleos	Bahrain Petroleum Co.	WRB Refining LLC
13	Exxon-Mobil Refining & Supply Co.	Kaduna Refinery & Petrochemical Co. (NNPC)	Indian Oil Co. Ltd.	Exxon-Mobile Refining & Supply Co.	Petroleum Co. of Trinidad & Tobago Ltd.	National Iranian Oil Co.	Chevron Corp.
14	BP PLC	Societe Ivoirienne de Raffinage	Sinopec	Bayernoil Raffineriegesellschaft GMBH	Petroleo Brasileiro SA	National Iranian Oil Co.	Shell Deer Park Refining Co.

Source: (Straras Advisors, 2018).

Appendix 4: Environmental KPIs Matrix

Air Emissions					
No.	**Key performance indicator (KPI)**	**KPI's Definition**	**Measurement**	**Tool**	**Reference**
1	Flared Gas	These gases are released from the flare stack to the atmosphere, produced from the company's operations.	It is measured through the total quantity of hydrocarbon released to the atmosphere.	It can be indicated through: • Gas chromatography analysis. • Flow meter (cubic meter)	Zadakbar et al. (2008); Duck (2011); Johnson & Coderre (2012); Emam (2015); Comodi, et al. (2016); Rajović et al. (2016); Tahouni et al. (2016)
2	Greenhouse Gas	These types of gases emission are produced during the oil refining operations. These gases cause air pollution, affect the global warming and make climate changes.	It is measured through measuring: Carbon dioxide (CO_2), Nitrous oxide (N_2O), Perfluorocarbons (PFCs), Hydrofluorocarbons (HFCs), Methane (CH_4) and Nitrogen trifluoride (NF_3) Sulphur hexafluoride (SF_6).	It can be identified through: CO_2 (infrared gas emission & chemical gas sensors), N_2O (GC electron capture detector, FTIR spectroscopy, Quantum cascade laser, laser absorption spectroscopy, Amperometric Micro sensor), PFCs & HFCs(GC fused-silica capillary column), CH_4 (GC), NF_3 (Medusa pre-concentration GC-MS system) and SF_6 (GC- Electron Capture Detector).	Bluestein et al. (2010); Johnson & Coderre (2012)
3	Atmospheric Acidification	• Atmospheric acidification refers to the gases which cause acid rain resulting in increasing soil and water acidity. • That is, SO_2 and NO_x are emitted into the atmosphere and transported by wind and air currents, the SO_2 and NO_x react with water, oxygen and other chemicals to form sulfuric and nitric acid.	• Sulphur dioxide (SO_2). • Ammonia hydrochloric acid (HCI). • Nitrogen dioxide (NO_2). • Sulphuric acid (H_2SO_4).	• The gases emitted to the atmosphere are assessed by the total amount of a selected group of emission expressed in CO_2 equivalent (tons) divided by the total production (tons). • The water acidity and soil are measured by PH Scale.	Ahi et al. (2016)

Air Emissions (Cont.)					
No.	**KPI**	**KPI's Definition**	**Measurement**	**Tool**	**Reference**
4	Other Gases	• These types of gases emission are produced during the oil refining operations. • These gases released in the air cause air pollution, but they do not affect the global warming.	Other gases can be measured through: Volatile organic compounds (VOCs), Oxides of Sulphur (SOx), Particulate matter (PM), Ozone depleting substances (ODS), Other regulated air emissions. And Oxides of Nitrogen (NOx) excluding N2O.	Other gases can be identified through: VOCs (by the proton transfer reaction mass spectrometry technique (PTR-MS)), Sox (is monitored by Ultraviolet Fluorescence instrument) and NOx (measured by using Nitric Oxide, Ozone Chemilumescence analyser).	Frynas (2009)
5	Air Emission Reduction	• There are actions that should be taken to reduce air emissions. • Reduction initiatives can include: o Process redesign. o Conversion and retrofitting of equipment. o Fuel switching o Change behavior.	Air emissions are reduced as a direct result of reduction initiatives measured in metric tons of (CO2 equivalent). These gases are: CO2, N2O, PFCs, HFCs, CH4, NF3, SF6, VOCs, Sox, PM, ODS and NOx.	Air emission reduction can be verified through technical reports, techniques sand technologies which companies can rely on to follow up, remove or treat air emission.	Frynas (2009)
Water					
No.	**KPI**	**KPI's Definition**	**Measurement**	**Tool**	**Reference**
1	Water Withdraw rate.	It includes freshwater withdrawal in cubic meter (m3) by the company either directly from fresh water sources (lakes, pounds, streams, rivers or ground water) or taken from municipals freshwater suppliers; These fresh waters withdrawn used in cooling operations or used in the oil refining manufacturing process.	Water withdraw can be measured by means of: Dividing water withdrawal (m3) by available water sources (m3) and Water usage efficiency can be measured by dividing water withdrawal (m3) by tons production.	Flow meter (cubic meter)	Delai & Takahashi (2011)

Water (Cont.)					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
2	Water Discharge	It refers to oil refining company's residue discharges in waterways (like seas, rivers, lakes) after being treated from salts, bine, oil, sludge or other contaminants.	It is measured through the average concentration of hydrocarbons (mg/1 or ppm).	Water discharge can be verified through: • Infrared adsorption ASTM 7066-04. • Gravimetric methods. • GC, FID, ISO 9377-2 (2000). GC-MS.	Gossen & Velichkina (2006); Hu et al. (2013); Yusuf et al. (2013); Hasani & Nabhani, (2016)
3	Wastewater treatment	It refers to the wastewater treatment which can produce the reuse of water for other beneficial purposes.	It assesses the extent to which wastewater is capable of being reused/recovered/recycled. The proportion of the company's wastewater which can successfully be converted into useful water that can be reused for other purposes.	Techniques used in this process are: • Adsorption. • Coagulation. • Chemical oxidation. • Biological techniques. • Membranes. • Microwave assisted catalytic wet air oxidation. Advanced oxidation process (AOP).	Hasani & Nabhani, (2016)
Energy					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
1	Energy Sources	• Energy sources can include renewable, non-renewable sources and self-generated by the company.	• Energy sources are measured through the total energy consumed within the company. • Energy efficiency is calculated by dividing Kcal energy used by tons of production.	• Energy sources can be identified through: • Fuel consumption (is measured by cubic meter or ton). Heat of combustion in BTU or kilocalories (Kcal).	Azzuni & Breyer (2017); Guivarch & Monjon (2017)

Energy (Cont.)					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
2	Energy Intensity	• It refers to the quantity of energy required per unit output or activity, so that using less energy to produce a product reduces the intensity. • Energy intensity ratios define energy consumption in the context of an organisation specific metric.	It calculates the energy intensity ratio by dividing the absolute energy consumption by the organisation specific metric. *Organisation-specific metrics can include: ○ Units of product ○ Production volume (such as metric tons, liters or MWh) ○ Size (such as m2 floor space) ○ Number of full-time employees ○ Monetary unites (such as revenue or sales)	It is manifested through reports which show energy consumption and organisation specific metric.	Ahi et al. (2016)
3	Renewable energy sources (Alternative energy sources)	Companies use renewable energy sources that will result in using clean sources of energy and using resources efficiently.	Sources of renewable energy are measured by calculating the percentage of applicability of renewable sources in the industrial scale (Ex: the oil refining company).	Sources of renewable energy can be found in: • Solar energy, wind energy, bio-gas, bio-diesel, bio- fuels, natural gas and hydrogen as a fuel which is more common now days.	Erol et al. (2011)
Waste					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
1	Quantity of Solid Wastes	Waste is generated from different types of oil refining operations. Solid wastes result from clean up or replacement or upgrading of existing facility).	Waste quantity is calculated at the site or by waste disposal contractor or process knowledge or engineering estimates.	Refinery solid wastes (ton): Wax bottoms, Separator coke, Asphalt drips, Coke fines, Wax tailings, Acid sludge, Adsorbents, Slops, Soups, Sand, Rust, Silt, Slop oil, Emulsion and Spent catalyst.	Gossen & Velichkina (2006); Hu et al. (2013); Yusuf et al. (2013); Hasani & Nabhani (2016)

Waste (Cont.)					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
2	Quantity of recycled/ reused/ recover of solid wastes	• It refers to the process of converting waste materials into new materials that can be reused again in other purposes. • The frequent recycling re-usage of materials results in efficient use of natural resources in production and consumption. Additionally, it will cause lower wastes and save the company's resources.	• It assesses the extent to which products are capable of being recycled/reused. It also assesses the proportion of a company's products/materials that are collected and successfully converted into useful materials for new production process. • Quantity of recycled/reused/recovered is calculated by dividing tons of recycled materials used in production by ton produced.	• It is indicated by advanced treatments and disposing technologies to recycle or reuse solid waste. • These technologies have to turn solid waste into useful materials. • Examples of these technologies that recycle/recover solid wastes are: o Thermal conversion: this technology uses heat and pressure to turn useless materials into useful products. o Plasma Arc Recycling.	Gong et al. (2018)
Oil Leakage					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
1	Quantity of oil leakage	It is the release of liquid petroleum hydrocarbons into the environment. The oil leakage can be due to the release of crude oil from tankers, offshore platforms, drilling well or leakage from refined petroleum production or accidents.	It is calculated through the total volume of hydrocarbon represented in the total amount leaked in the environment.	Oil leakage quantity can be indicated in: • Ultra violet fluorescence (UVF). • Gas chromatography - flame ionisation detector (GC, FID). • Gas chromatography, Mass spectrometry (GC-MS).	Gossen & Velichkina (2006); Hu et al.(2013); Yusuf et al. (2013); Hasani & Nabhani (2016)

Oil Leakage (Cont.)					
No.	(KPI)	KPI's Definition	Measurement	Tool	Reference
1	Oil leakage removal	• Oil leakage is a very dangerous occurrence, as it affects the marine ecosystem and land. As a result, it becomes important to employ various oil leakage removal methods.	Oil leakage removal can be measured by a number of procedures undertaken by companies to clean up oil leakage in ocean and land.	• Examples of techniques used to clean up oil leakage on ocean can be: ○ Booms and skimmers. ○ Chemical dispersants. ○ In situ burning. ○ Hot water and high pressure washing. ○ Bioremediation. ○ Natural recovery • Examples of techniques used to clean up land leakage on ocean include: ○ Land booms. ○ Hydrocarbon pads. Environmental solution floor sweep.	Delai & Takahashi (2011)
Environmentally Friendly Practices					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
1	Environmentally friendly process	This process considers environmental issues during the design of the processing scheme. These are processes/ operations which attempt not to harm the environment during the whole production lifecycle beginning from the extraction of raw material until the final disposal.	• It is calculated by dividing tons of environmentally friendly materials used by ton of production. • Quantity of recycled/reused/ recovered is calculated by dividing tons of recycled materials used in production by ton produced.	Investments made by companies to incorporate/ use/produce environmentally friendly products/ green products are: • Energy efficiency. • Often made of recycled/renewable materials or content. • Biodegradable and easily reused. • Free ozone depleting. • Less carbon footprints.	Gong et al. (2018)

Environmentally Friendly Practices (Cont.)					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
2	Environmental projects	When managing a company's project, the project's manger must consider more than just the project itself. In other words, managing a project involves an understanding of the environment in which the project must function. • Examples of environmental based projects are: ○ Hydrocarbon pollution restoration (HYPREP) project. ○ Green projects ○ Environmental remediation project	They are measured by the number of environmental projects that the companies can participate in.	• They are indicated through internal audits which will indicate that the company's projects consider the environmental aspects. • They are also indicated through the company's reports which will include that company participates in environmental based projects.	Panwar et al. (2011)
3	Eco-system and Bio-diversity protection	The company has to set strategies and plans to prevent, mitigate and manage the direct and indirect impacts on ecosystem and biodiversity system to ensure the protection of the ecosystem and biodiversity.	They are measured through the significant direct and indirect positive and negative impacts with reference to the following: ○ Species affected ○ Extent to areas impacted ○ Duration of impacts ○ Reversibility or irreversibility of the impacts.	• They are indicated through policy statement by which the company describes its strategy and plans which ensure that the ecosystem and biodiversity aspects are integrated into operations through the company's lifecycle. • They are indicated through reports which identify how the company addresses biodiversity and ecosystem aspect • They are indicated through Internal and external professionals audit reports which address the extent of the company's prevention and remediation activities with respect to the company's impact on the ecosystem and bio-diversity system.	Guivarch & Monjon (2017)

Company Environmental Policy and Management System					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
1	Company environmental vision/strategy/policy and targets	It is a written statement which outlines the business's vision, aims, targets and principles in relation to managing and monitoring the environmental impacts relevant to the company's SC and operations, to prevent environmental pollution.	It is measured through: • Written environmental strategy/policy statements which is regularly reviewed and continuously upgraded. • Regular review of the company's environmental reports to check that the company's activities still comply with the company's environmental strategy/policy.	Internal audits report which determines the conformance of the company's practice in terms of the company's environmental vision/strategy/policy/targets which are: • Recycling/reusing water and solid waste. • Minimising waste, emissions, oil leaks and noise disturbance generated by the company's operations. • Using water and energy effectively. • Complying with environmental legislation and requirements (approved codes of practices importance of environmental issues to your business). • Raising awareness and encouraging participants and training employees in environmental matters. • Buying materials and resources that comes from renewable source.	Ramezankhani et al. (2018)
2	ISO certification	• This certificate is an internationally accepted standard for environmental management system. • This certificate sets out the criteria for an environmental management system and maps out a framework that a company can follow.	It is measured through the number of times the company has been granted the re-certification (renewable every 3 years).	It is indicated through: • Internal audits reports which determine the conformance of companies to the environment management system of the organisation in terms of ISO certification. • There should be constant internal audits to re-evaluate the company's environmental management system, based on the ISO requirements.	Erol et al. (2011)

Environmental Policy and Management System (Cont.)					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
3	Industry's environmental association membership	The industry's association establishes the industry's global standards, which provide people and organisations with a basis of mutual understanding and are used as tools to facilitate communication, measurements, commerce and manufacturing.	It is measured by: • The number of years the company attempts to have membership or participating in the industry's association. • The number of industry's association companies follow or have membership.	• It is indicated through Industry's association application. • Membership agreement which includes that the company will: ○ Respect or adhere to the industry's association standards and best practices. ○ Participate in association activities.	Elhuni & Ahmad (2017)
4	Environmental audits and assessment	• Environmental internal audits and assessments can be done on regular basis to gather information how the company is working, to ensure that policies and procedures being applied correctly according to what the company has planned. Environmental audits or assessment can be done through observation, reviewing documents, interviewing employees.	Environmental audit or assessment rate	They can be manifested in the environmental audit and assessment reports.	Ahi & Searcy (2015)
5	Employee environmental training and awareness	Environmental training is provided to newly assigned workers, temporary workers and contract workers.	It can be calculated through estimating the average hours of training per year per employee.	Several training methods are: classroom based training program, interactive training, on job training, modern learning, group discussions and tutorials and case study.	Ahi & Searcy (2015)
6	Environmental law compliance	It refers to the company's compliance with the international/local environmental laws, regulation, standards.	It is measured through: • Company's total monetary value of significant fines. • Company's cases	It can be verified through the Companies' reports and statements which encompass the significant fines and non-monetary sanctions that companies have to pay for their non-compliance with environmental laws and	Rajeev, Pati, Padhi & Govindan (2017)

Appendix 5: Economic KPIs Matrix

Innovation					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
1	Technology	There are various types of technologies applied to oil refining sector. Examples of these technologies are: • Bio-refinery technology • Smart Refinery • Technology usage used in treating oil refining effluents.	It is measured through calculating return on investment for technology: the net returns from technology investment by the cost of the investment, then express this as percentage (* 100).	• The bio-refinery technology application. • Applying smart refinery in companies depends on implementing new technologies such as: ○ Process automation. ○ Process control. ○ Data integration ○ Modern control technology. ○ Wireless communications solutions. ○ Maintains technology ○ Remote operator technology.	Moro (2003); Borgne & Quintero (2003); Emerson Electric Co. (2010); ABB (2011); Diya'uddeen et al. (2011)
2	Information System	• Information systems make it simple to store operational data and revise histories. • Information systems simplify the process of delivering the required information, increase coordination and interoperability across the company.	It is measured through: • The number of information system applications used by the company. • The number of reports extracted, based on the use of information systems.	It is indicated by types of information system applications used by the company.	Elhuni & Ahmad (2017)

Investments					
No.	KPI I	KPI's Definition	Measurement	Tool	Reference
1	Capital Investment (facility and equipment)	• Capital investment is the money used by company to purchase fixed asset such as land, machinery and building.	It is measured through calculating: • Company's total investments costs. • Return on invested capital (is calculated when companies want to measure the percentage of return on the money that the company invested) =original value of the invested capital – present value of the invested capital/ original value of the invested capital *100	• To calculate total investment done by the company, the company should have some data: ○ Total investments done by a company • To calculate return on invested capital, companies should have some data as: ○ original value of the invested capital (How much cash went in to the project and the time spent by the employees working on it). ○ Present value of the invested capital.	Elhuni & Ahmad (2017)
2	Human capital	• The company's employees are the most valued asset, so mangers invest money and time in the company's employees to provide healthy work, place and opportunities for education advancement and training sessions to build productive and healthy team. • The true asset is the quality of skills and knowledge held by the company's employees and how to utilise these skills and knowledge.	It is calculated through: • Total Employment costs (i.e., salaries, health insurance premiums, retirement plan contributions and training, educations assistance and fringe benefits costs).	To calculate human capital, the company should have some data as: ○ Salaries ○ Health insurance premiums ○ Retirement plan contributions ○ Training ○ Education's assistance ○ Fringe benefits costs	Ramezankhani et al. (2018)

Investments (Cont.)					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
3	Return on Sustainability Investment	It is a performance measurement used to evaluate the gains produced as a result of company's sustainability initiatives relative to the amount of money invested in those initiatives projects.	It can be assessed through calculating the sustainable return on investment: by dividing the net returns from sustainable investment projects by the cost of the investment, then express this as percentage.	It is manifested in the company's financial statements like income statements and balance sheets.	Boukherroub et al. (2015)
2	Research and Developments	These activities companies undertake to innovate and introduce new product or service.	• Assessing the extent to which a company is concerned with innovation and new products development. • Investment in R&D: dividing investment in R&D ($) by turnover ($).	There are some criteria which are needed to be determined by the company to know how much to invest. These criteria are: • The size of the business. • The sector. • The commercial potential of a project. • The importance of the project to the future success of the business. • The expected duration. • What companies' competitors are doing. • New innovation or improvement is needed.	Ramezankhani et al. (2018)
5	Market Expansion	It is a plan of action to increase a company's market share. • There are variety of ways for market expansion: ○ Market penetration: ○ Market development ○ Market expansion	Company market share (%) = company's sales over the period/total sales of the industry over the same period.	There are some criteria which are needed to measure the company market share which are: • Company's growth strategy • Market analysis • The market growth rate measures how far the in which companies operate is growing. This provides an insight into the size of the opportunity a company might have.	Elhuni & Ahmad (2017)

Investments (Cont.)					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
6		• It is a plan to add new products to the company's product line. • There are a variety of ways adding new products: ○ Adding new product to the company's portfolio through product development or diversification. ○ Adding new versions of existing product. ○ Providing upgrades to existing products.	It is calculated through Companies market share (%) = company's sales over the period/total sales of the industry over the same period.	It can be indicated in: • Company's growth strategies. • Market analysis. • Customer reviews.	Elhuni & Ahmad (2017)
7	Capacity utilisation	It represents the use of the capacity of a refinery or process unit which measured through its maximum throughput. It is great way to understand the efficiency and productivity of a project.	It is calculated through: • Dividing the gross input of these unites by the operable refinery capacity of the unites. • Actual capacity being used/total capacity *100	It can be included in company's utilisation reports, this report shows the efficiency of a person, department or the company within a defined time framework.	Elhuni & Ahmad (2017)
Quality					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
1	Crude oil feedstock's quality	Crude oil has different quality characteristics, based on the physical characteristics (API gravity) and chemical components (Sulphur content). Crude oil is classified in terms of: ○ Light crude oil ○ Heavy crude oil	It is measured through evaluating the following elements to determine the crude oil grade: ○ API gravity. ○ Molecular weight (g/ml). ○ Sulphur content (%). ○ Water content (%) ○ SARA analysis	It is indicated through: • API gravity • Crude oil grades: ○ Light crude oil (API>38) ○ Medium crude oil (38>API>29) ○ Heavy crude oil (29>API>8.5) ○ Very heavy crude oil (<8.5) • The total Sulphur content. • Water content can be determined by Karl Fischer titration.	Hasan, Ghannam, & Esmail (2010); Martínez-Palou et al. (2011)

Quality (Cont.)					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
2	Process quality	Process quality is the degree or extent of conformance of the process based on process quality targets set by the company to have final output.	It is assessed through conducting regular internal process audits, which is an on-site verification activity such as monitoring, analysing, inspecting, examining and assessing of a process to ensure that the company's process quality targets are fulfilled. These internal audits end up with a written assessment report which includes the opinion of the auditors about the actual process quality.	Process quality audit committee evaluates the process quality conformance to the company's product quality targets by focusing on how the company's team prepares and produces the final output based on the company's process quality targets.	Boukherroub et al. (2015)
3	Product quality	Product quality is the degree or extent of conformance of the product (items and services) to the internal requirements, design and technical specifications (i.e. shape, size, color strength, appearance, height, weight, thickness, diameter, volume and other product characteristics).	It is assessed through conducting a regular internal product audit, which takes place after manufacturing and before the product reaches the customer to verify the total goodness of the finished product and to ensure that finished output fits the purpose and it is up to the product quality targets set by the company. The internal audits end up with a written assessment report which includes the opinion of the auditors about the actual product quality.	• Company set product quality targets as: ○ Quality of design: product is designed as per customer needs. ○ Quality conformance: the level which assures that the finished output matches the product design specification. ○ Reliability: The product remains operating for a satisfactory time. ○ Safety: The product must not harm consumers in any way. ○ Proper storage procedures: the product packed and stored properly until its expiry date. • The product quality audit committee evaluates the product quality conformance to the company's product quality targets.	Boukherroub et al. (2015)

Quality (Cont.)					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
4	ISO Certification	• This certificate is an internationally accepted standard for quality management system. • This certificate sets out the criteria for a quality management system and maps out a framework that a company can follow to set up an effective quality management system.	It is assessed through the number of times the company has been granted the re-certification (renewable every 3 years).	• It is indicated through internal audits reports. The audit reports determine the conformance of the quality management system of the organisation in terms of ISO certification. • There should be constant internal audits to re-evaluate the company's quality management system, based on the ISO requirements.	Ramezankhani et al. (2018)
Risk					
No.	KPI	KPI's Definition	Measurement	Tools	Reference
1	Energy security	• It refers to the company's accessibility to clean, reliable and affordable energy for productive use. • Energy security means long term energy security which mainly deals with timely investments to supply energy. • Energy security comprises the ability of the energy system to react promptly to the uncertain events. Examples of uncertain events are like war, natural hazardous, conflicts, terrorism and population growth.	It is measured by: • the number of legal agreements between the company and energy suppliers/providers. • The timeframe of legal agreements between the company and energy suppliers/providers. • The probability of the energy system ability/adaption to react properly to sudden changes or uncertainty risks.	• It is revealed through: ○ Legal agreement/contracts between the company and energy suppliers/providers. ○ Historical records ensure that the energy security system comprises the ability to react promptly to uncertain events (is the unexpected and unpredictable events.	Kiriyama & Kajikawa (2014)

Local Content					
No.	KPI (KPI)	KPI's Definition	Measurement	Tool	Reference
1	Local procurement (Goods/ Services)	It describes to what extent companies depend on local suppliers and contractors to carry out companies' needs and requirements (local goods or services).	It is calculated by: • The number/ percentage of local entities that the company depends on to procure their supplies and services locally. • The number of legal agreements/contracts between the company and local suppliers.	It is reflected through: • The company's approaches and plans for sourcing goods and services from the host country at different stages of operations. • Local suppliers contracts which are legal agreements between local supplier/contractors and international companies which describe the item purchased or services provided, the total value of the item purchased/ service provided and the terms of the contract between them	British Petroleum Company (2015)
Government-Business Relationship					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
1	Transparency of tax payment to host country	It describes the company's effort, practices and policy for admitting payment and revenue information to host governments. In other words, it includes the company's payment and revenue report disclosure in response to the government policy.	Tax payment is calculated through: dividing taxes ($) paid by profit ($) before taxes.	It is manifested in : • Records of the annual business tax receipts. • Tax payment recorded in the company's financial statements. • Tax payment report disclosure on the company's web sites. • All the supporting documents that report the business earnings and expenses occurred during the year.	Elhuni & Ahmad (2017)
2	Government incentives/Assistance	• Government incentive/support is provided by the government to companies with the aim of promoting policies. • Incentives can be in terms of cash subsidies or tax concessions.	Calculating incentives received: Dividing incentives received ($) by profit ($) before taxes.	It can be manifested in financial statements that report incentives received from the government.	Ahi & Searcy (2015)

Appendix 6: Social KPIs Matrix

Human Resources					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
1	Capacity Building (Technical and Soft) Skills	These are activities that aim at improving the employees' performance and productivity, however there is a difference between soft and technical skills. • Technical skills are a training program organised by the organisation to develop the technical knowledge and key skills required for the current job. • Soft skills are an organised training to enhance the conceptual and general knowledge to develop the maturity of the employees, like leadership.	Workforce training is calculated by: • Dividing the total hours of training activities by the number of employees. • Total number of technical training hours given to each employee per year.	• Training records are evidence that certain employees attend. • Trainings can be given to the employees in the form of: ○ E-learning. ○ Simulators. ○ On job training. ○ Coaching/mentoring. ○ Lectures. ○ Group discussion and tutorials. ○ Management games. ○ Role playing ○ Outdoor training. ○ Case-studies ○ Films and videos.	Elhuni & Ahmad (2017)
2	Employee engagement	• It refers to company's approach to engage the company's workers, to determine their satisfaction with the company's employment practices, general working conditions, company's culture and compliance.	It is calculated by the % of engaged employees in free dialog/ speech with the management.	Workforce survey can be used as: ○ An indication that the employees are engaged /included to have dialog /speech with the management. ○ An approach used to gather data from the company's workers, to determine their satisfaction with the company's employment practices, general working conditions, company's culture and compliance.	Ramezankhani et al. (2018)
Human Resources (Cont.)					
No.	KPI (KPI)	KPI's Definition	Measurement	Tool	Reference

3	Employee motivation, promotion and compensation	Employee motivation is how the company acknowledges employees' achievements through rewards/ compensation/ promotion.	• Benefits are calculated by dividing benefits ($) by salary ($) • Bonuses are calculated by dividing bonuses ($)by salary ($) • Promotion rate is calculated by dividing number of employees promoted by the total number of employees.	Compensation management software is an integrated platform that covers all the areas of performance, used by human resources (HR) department. The Compensation management software can: ○ Simplify calculation. ○ Create better visibility and compliance. ○ Offer better decision support for managers.	Erol et al. (2011)
4	Fringe Benefits	Employee fringe benefits are forms of benefits by which the company compensates employees besides the stated salary/ wages.	Fringe benefit rate is calculated by dividing the annual cost of all benefits ($) by annual wage paid ($).	Hiring contracts which will include employee's fringe benefits, are like: ○ Medical and dental insurance. ○ Use of company's car ○ Housing allowance. ○ Vacation pays. ○ Sick pay. ○ Meals. ○ Employee discount. ○ Family medical and dental insurance. ○ Children schooling fees.	Elhuni & Ahmad (2017)
5	Annual Employee Hiring and Turnover	• Employee hiring is the process of finding, selecting and hiring new employees to a company. • Employee turnover is the percentage of employees who leave an organisation during a certain time period.	• External hire rate is estimated by: external hires/average headcount*100 • percentage of annual turnover is calculated by dividing the total number of employees who left by average number of employees in a year, then the result is multiplied by 100	Personnel records are kept at the human resource department which gathers all the profiles and personnel files for each employee.	Erol et al. (2011)

Human Resources (Cont.)					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
6	Employee Representation on Corporate Board of Directors	Employee representation on corporate board of directors refers to the workers' right to vote to represent on board of directors.	The percentage of employee represented on corporate board of directors is calculated by dividing the number of employees represented on corporate board of directors by total number of employees and the result multiplied by 100.	Personnel records are kept at the human resource department's records.	Ahi & Searcy (2015)
Human Rights					
No.	KPI	KPI's Definition	Measurement	Tools	Reference
1	Diversity and equal opportunity (gender/age/ethics)	Diversity means that the workplace is composed of employees with different genders, age and ethnical.	• Gender equity is measured by dividing women average salary ($) by men average salary ($) • Ethnical equity is calculated by dividing white women/men average salary ($) by not white women/men average salary ($)	Personnel records are kept at the human resource department's records.	Andalib, Ardakani & Soltanmohammadi (2019)
2	Disable employees	The disabled employee has the right to have job, enjoy befits offered to employees and receive equal treatment.	Percentage of disabled employees is measured by dividing the number of disabled employees by total number of employees and the result will be multiplied by 100.	Personnel records are kept at the human resource department's records.	Ajbakhsh & Hassini (2015)

Human Rights (Cont.)					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
3	Appropriate Physical working condition	Physical working conditions refer to the context, outlook, surroundings of the workplace within which a worker is expected to perform his/her job.	It is evaluated by conducting regular internal audits and assessments to evaluate the physical working conditions, to check whether or not any action for improvement is needed.	Audit reports show whether or not the company complies with the Occupational Safety and Health regulations and recommendations. In addition, these reports ensure whether the audit committee verifies that the workplace meets the following conditions: space, cleanliness, lighting, ventilation, adequate toilet, washing and changing facilities, emergency lightning, suitable floor, windows, appropriate temperature, safe traffic routes, doors, escalators, water and restrooms	Ramezankhani et al. (2018)
4	Appropriate working hours	Appropriate working time refers to the appropriate time the employee spent at the workplace carrying out the working duties based on the International Labour Organization (ILO) regulation.	Average working hours are measured by dividing the average number of hours worked by a set period.	• Company's schedules show the number of hours each employee spent in the workplace. • Audit reports show how far the company complies with the International Labour Organisation's standards and regulations. • The International Labour Organisation (ILO) set the framework for working hours. • The International Labour Organissation set the hours worked daily, weekly, rest periods and annual holidays.	Ramezankhani et al. (2018)
5	Labour Law Compliance	• Labour laws are set of mandatory rules and regulations set for the employment. • Labour law's prime objective is to provide protection and benefits for workers while they are in the employment.	It can be measured through labour audits which are detailed checks of the policies, procedures and standards of the company in respect to labour, compliance and noncompliance of labour laws and regulations.	It can be indicated through: • Audit reports and checklists. • Company's employee records.	Elhuni & Ahmad (2017)

Occupational Health and Safety					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
1	Loss time Injury Frequency Rate	Loss time injury refers to incidents that result in a disability or an employee missing work due to an injury or inability to perform the job for at least one day/shift.	It is calculated by the number of lost time injuries in the reporting period * 1000000/ total hours worked in the reporting period.	It is indicated by the occupational injuries, illness and statistical records. These records provide the company with information about the injured employees.	Ramezankhani et al. (2018)
2	Occupational Diseases/illness	It refers to any diseases or types of illness that are developed or aggravated by type or the environment of the work.	It is measured through the rate of employees who suffered from occupational disease/ illness annually.	It is indicated through occupational injury and illness statistical records which provide information to the company about the employees' cases who were ill as a result of work hazards.	Bhuvaneswari & Nandhini (2017)
3	Engineering control, personnel protective equipment and clothes	• Engineering control is a mechanical device/equipment or a method built in the design of a plant designed to minimise the harm associated with chemical/ physical hazard. • Personnel protective equipment and cloths refer to the equipment/cloths designed to protect the wear's body from injury or exposure to hazards. That is, this equipment and cloths impose a barrier between the wearer and the working environment.	It is calculated through the return on investment in engineering control, personnel protective equipment and cloths: dividing the return/benefit from investment ($) by cost of investment ($).	• It is shown through the financial records. • The company should grantee that the workplace/ employees are supplied with: o Engineering controls as ventilation system, fume hoods, centrifuges, heating devices, pressure and vacuum system, refrigerators and freezers, stirring and mixing devices. o Personnel protective equipment and cloths as safety helmets, goggles, gloves, eye protection, high visibility cloths, safety footwear, respiratory protective equipment.	Bhuvaneswari & Nandhini (2017)
4	Safety inspection and audits	Safety inspection refers to work practices to identify unsafe action, hazards, risks or other tactics.	It is evaluated through safety inspection and audit rate.	It is revealed through safety inspection, audit reports and checklists.	Delai & Takahashi (2011)

Occupational Health and Safety (Cont.)					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
5	Emergency plans	Emergency plan is a written set of instructions that outlines what workers and others at workplace should do in an emergency.	It can be assessed through the rate of workplace emergency drill to execute/verify the emergency plans.	It is indicated through: • Emergency drill checklist. • Emergency plan elements including o Written procedures and resources available (i.e., medical supplies, auxiliary communication equipment, power generators, respirators, chemical and radiation detection equipment). o Detailed list of personnel including their home telephone number, their duties and responsibilities. o Floor plans. o Large scale maps showing evacuation, routes and service conduits (such as gas and water tiers)	Gong et al. (2018)
6	Safety orientation and advanced safety training	Safety orientation training provides employees with necessary safety information about their jobs and tasks. In addition, it informs the employees about specific details about workplace hazards.	Safety orientation training is calculated by dividing the total hours of training activities by the number of employees.	It is shown through trainings records which are evidence that certain employees attend safety orientation and advanced safety trainings.	Gong et al. (2018)
7	Safety warning signs	Safety warning signs contain symbols, colors and written instructions, which indicate a potential hazard, obstacle or a condition requiring special attention.	It can be verified through the total number of the right warning signs located in the right place.	It is revealed through safety audits and inspection reports, which will include data about the work practice and the compliance of the company with the company's safety rules in setting the right warning signs in the right place.	Rajeev, Pati, Padhi, & Govindan (2017)

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Occupational Health and Safety (Cont.)					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
8	Workplace first aids (boxes/rooms/ kits)	Workplace first aids are used to provide immediate and effective first aid to workers or others who have been injured or become ill at work.	They are checked out through the total number of availabilities of first aids based on the workplace nature/size.	They are indicated through safety audits which check whether the workplace first aid is appropriate and adequate for the immediate treatment of injuries that could arise at the workplace. In addition, they can be verified through checking whether the first aids and kit are appropriate for the number of employees on each site and work number.	Rajeev, Pati, Padhi, & Govindan (2017)
9	Occupational Health and Safety Management	This is the system which encompasses health and safety activities and programs for the company's process, which includes health and safety policies, systems, standards and records.	It is assessed through the internal and external audits to review key aspects of the company's occupational health and safety management system from the perspective of quality and effectiveness of the system.	It is indicated through: o Internal and external audit's inspection reports. o Records for occupational health and safety management system.	American Petroleum Institute (2017)
10	Health and Safety Committee	The committee is formed to address work health and safety issues that affect employees. This may include addressing hazards in the workplace.	It is calculated through the number of times the health and safety committee meet.	It is indicated through the agenda of the health and safety committee's meetings.	Eyayo (2014)
11	Hazard and Operability study (HAZOP)	HAZOP is a hazard analysis method which can be used in identifying problems at early stages of the project development, as well as identifying potential hazards in existing system. HAZOP is a systematic way to review process or operation to determine any deviations.	It can be assessed through the number of studies and analysis produced by the HAZOP's team.	It can be shown through the reports or records or studies required by HAZOP's team to assist in conducting the HAZOP analysis.	Elhuni & Ahmad (2017)

Community and Society					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
1	Local hiring practice	It describes the company's attempts, practices and policies to provide employment opportunities to residents or nationals in host community.	The percent of hiring opportunities granted to resident is calculated by dividing the total number of employees who are locally hired by average number of employees in a year, then the result multiply by 100.	It is indicated through complying with host government rules and legislation which set the percentage of local hiring practice.	Esteves et al. (2013); Olawuyi (2017)
2	Community Funding and Support	• It describes the company's approaches and policies to support community needs and developments. • Social investments can be in the form of financial (donations) and non-financial (training programs) investments to support community needs and development.	• It assesses what companies do for society through the analysis of social investments. • Social investment is calculated by dividing investment in social action ($) by turnover ($). • Donations are calculated by dividing donation of any kind ($) by turnover ($).	It is shown through the financial records which include data for social investment actions and donations which companies use to support community development.	Rajeev, Pati, Padhi, & Govindan (2017)
3	Company-Community relationship	It refers to the open channel of communication between the community and the company where it operates.	• Meeting with community can be measured with number of meetings with community. • Handling communities complains can be measured by dividing number of complains solved by the number of complaints received.	It is indicated through: • Regular meetings record with the community surrounded the company. • Handling complains received from the community surrounded the company.	Andalib, Ardakani & Soltanmohammadi (2019)

Product Safety					
No.	KPI	KPI's Definition	Measurement	Tool	Reference
1	Product stewardship	It is Identified by the health, safety and environmental risk (toxicology hazards, accident hazards information) to make customers aware of the hazards of the products.	It is assessed through auditors who check and inspect the availability of safety data sheet (SDS) which provides information on chemical products which describe the hazards the chemical products present. It also gives information on handling and storage in case of accident.	It is indicated through: • Audit's checklist. • Company's regulations and codes concerning products and service information and labelling.	Kumar et al. (2017)
Business Ethics					
No.	KPI	KPI's Definition	Measurement	Tools	Reference
1	Anti-Bribery and Corruption Policy	It refers to the company's effort to manage reputational risks arising from corruption/bribery practices by employees.	It is measured through: • Total number of confirmed incidents of bribery and corruption. • Company's actions/responses taken against corruption and bribery cases.	It is shown through: • Legal records which include the bribery and corruption cases. • Company's ethics policy and statements which outline all the ethics codes, procedures and practices set by the company.	Ahi & Searcy (2015)
2	Business Codes of Conduct	• Codes of conduct is a set of rules outlining the social norms, rules, responsibilities, proper practices for the organisation and the employees.	Business codes of conduct can be measured by number of code of conduct trainings issued for employees, which are calculated by: dividing the number of employees trained in the codes of conducts by the total number of employees.	It is manifested through: • Company's ethics policy and statements which outline all the ethics codes, procedures and practices set by the company. • Code of conduct training courses. • Audits reports which describe employees act towards business codes of conduct	Delai & Takahashi (2011)

Appendix 7: Focus Group Questions

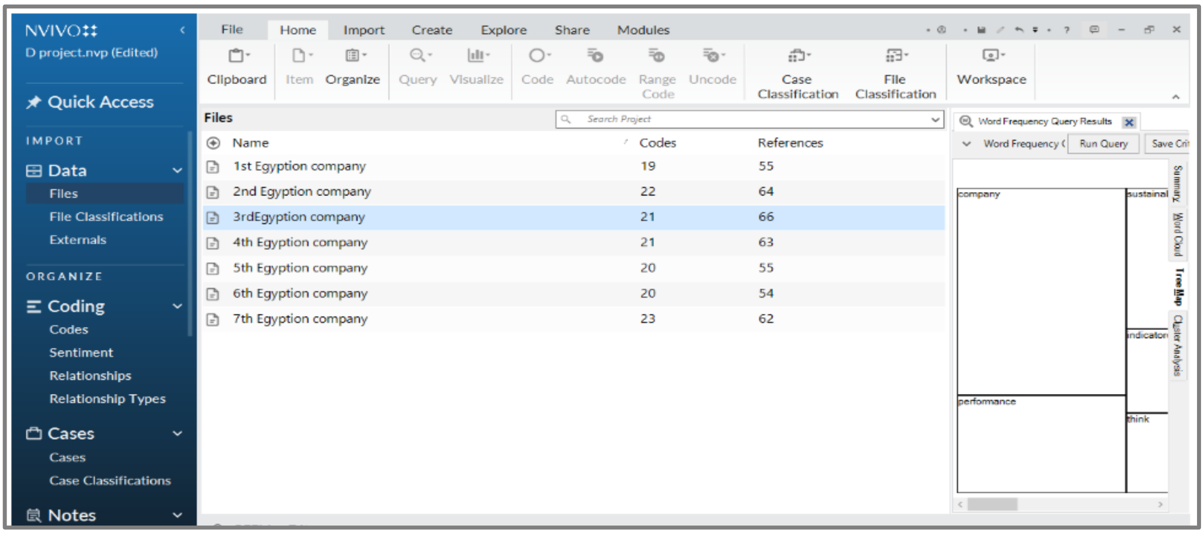
First of all, I would like to welcome you all. I am grateful for your consideration of my research. I would like to thank you for your time and your consent to participate in the focus group session. I am looking forward to learning more about your professional experience, opinions and knowledge.
Your participation in this research is voluntary and your responses to these questions will be kept confidential as these results will be used for academic purposes only. Also, you have the right to end up the interview at any time and to refuse responding to any of the asked questions. The interview will take approximately an hour. I would like to take your permission to audio record the focus group discussion in order to accurattely capture what is said in the session. The recordings will be transcripted, but neither your identity nor the identity of the your company will be disclosed.
Kindly feel free to share your point of view even if it differs from what others have said. There are no wrong answers but different point of views, perspectives and opinions.
This research aims at developing a performance measurement model particular for the oil refining sector that seeks to assist oil refining companies in measuring their performance from the sustainability perspective. Implementing sustainability is a complex process: that is why the researcher attempts to provide companies with some guidelines that are expected to serve as preliminary foundations to assist companies in their future plans of sustainability practice and its evaluation.
Please express your opinion in case your company is motivated to refer to the developed oil refining supply chain performance model from the sustainability perspective through answering the following questions.

1. What are the procedures that oil refining companies expected to take when refereeing to the comprehensive performance measurement model of sustainability particular for oil refining sector?

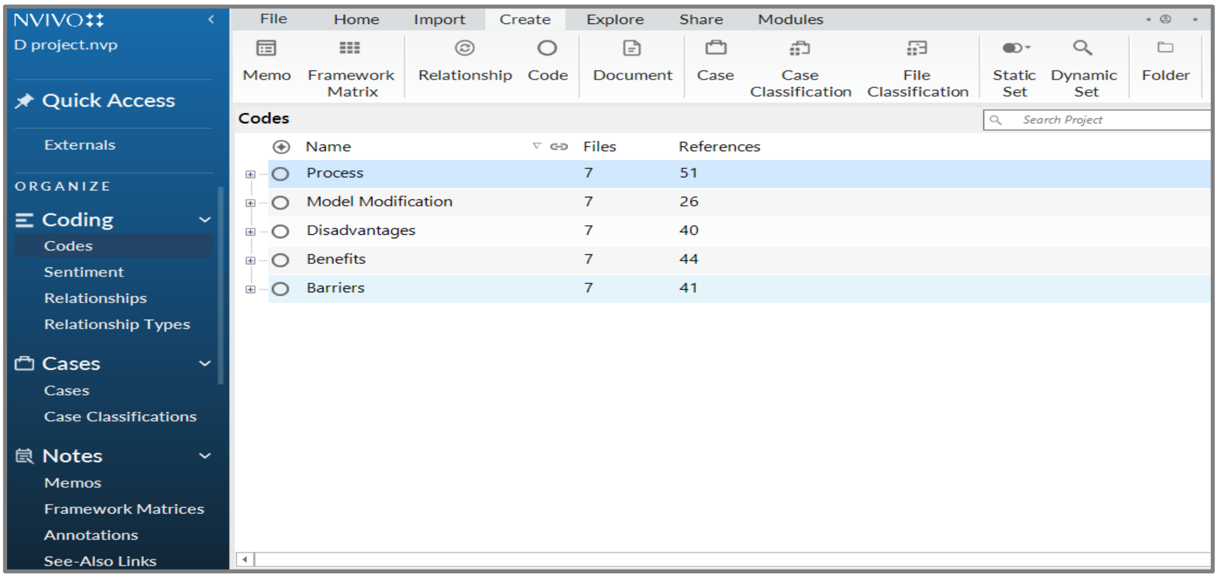
2. Will be there any barriers that oil refining companies might encounter while referring to the comprehensive performance measurement model of sustainability particular for oil refining sector? If so, what are these barriers?
3. What are the benefits oil refining companies are expected to achieve while referring to the comprehensive performance measurement model of sustainability particular for the oil refining sector?
4. What are the drawbacks expected to be facing the oil refining companies upon referring to the comprehensive performance measurement model of sustainability particular for the oil refining sector?
5. Are there any recommendations/suggestions you wish to add?

Thank you for taking the time to participate in this focus group discussion. I really appreciate your participation.

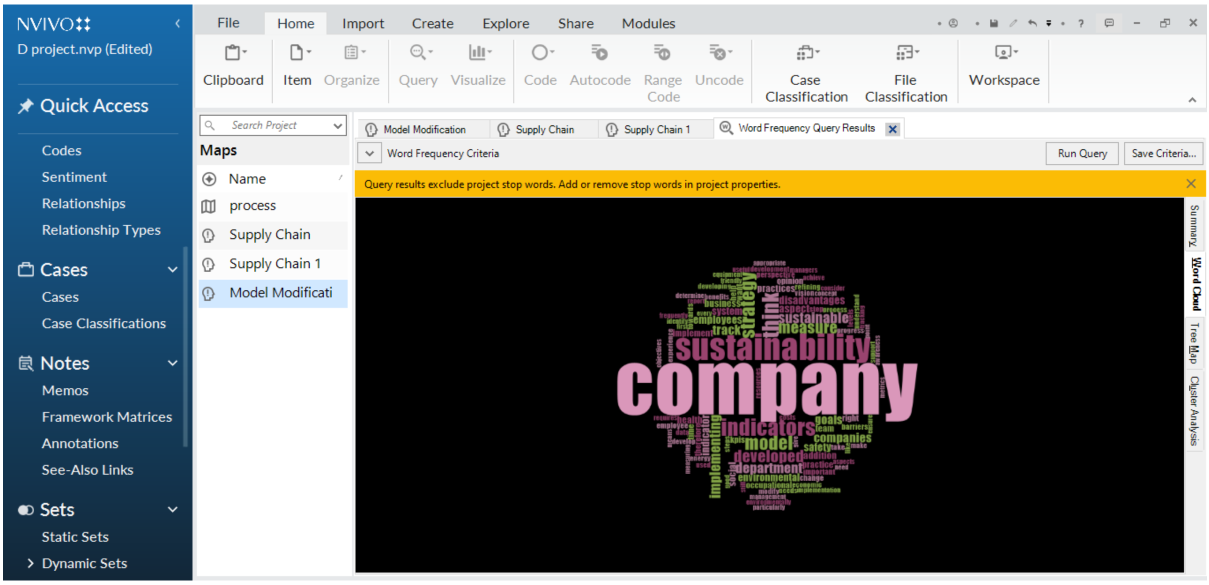
Appendix 8: Snapshots Extracted from NVivo Software



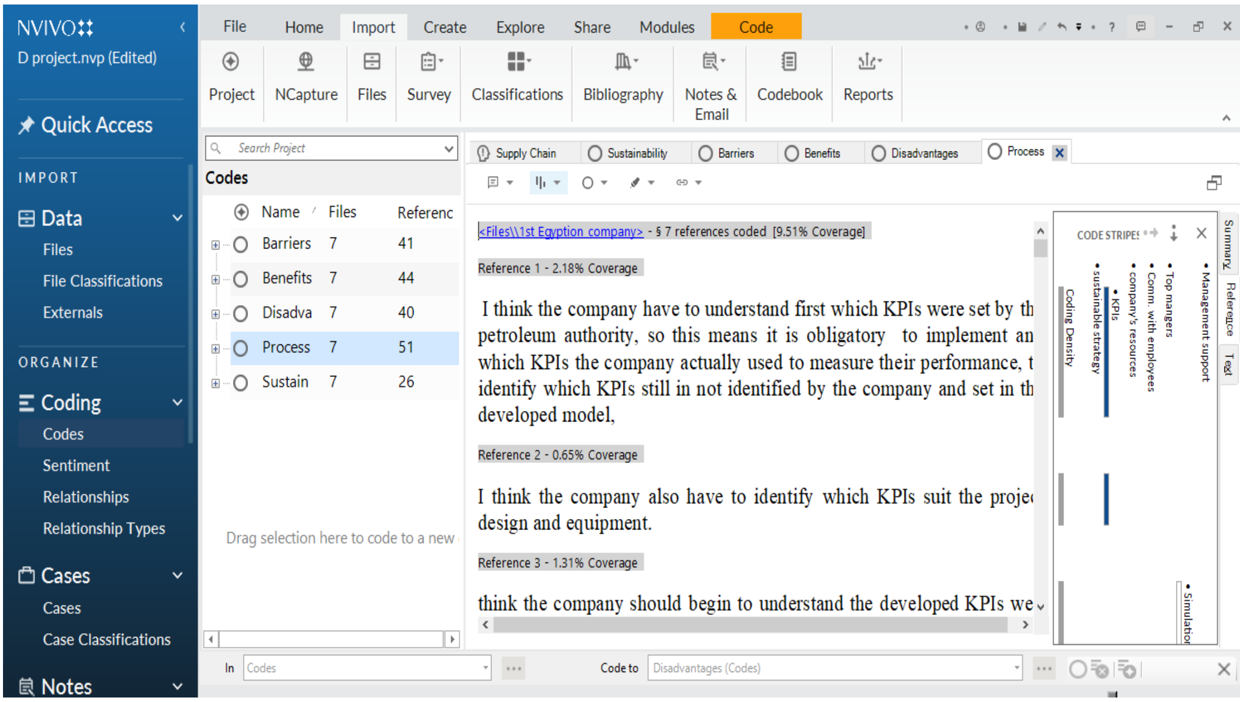
Imported file into NVIVO-12.



Extracted responses from NVIVO-12.



Word cloud extracted from NVIVO-12.



Quotes extracted from NVIVO-12.

Appendix 9: Evidential Quotes Taken from Focus Groups' Participants

Procedures	
Sub-themes	**Statements**
Select the appropriate key performance indicators	**<u>Select the appropriate KPIs.</u>** *-I think the company has to understand first which KPIs are set by the Petroleum Authority, as they are obligatory to implement, which KPIs the company actually uses to measure their performance and which KPIs are still unidentified by the company but are set in the developed model".* **<u>Categorise the KPIs</u>** *-I think that the company has to categorise the KPIs, so that it gives priority to the KPIs set by the Petroleum Authority. Secondly, it should identify the KPIs which match the company's vision, objectives and strategy".* **<u>The company has to pinpoint which developed KPIs suit the project design and equipment</u>**. *-I also want to add that I think that the company also has to identify which KPIs suit the project design and equipment".* **<u>The company should define and understand well the research developed KPIs.</u>** *-I think the companies have to start with knowing what they need to measure by identifying potential problems and how the current KPIs are used in each department to solve and measure these potential problems. This step will make the company determine the missing KPIs which the departments need to measure their progress. Then, the companies, along with the department, should work out to find the right measurement by studying the developed model to decide the most appropriate key performance measurement which matches the company's goal and strategy to be used in measuring a department progress and solving any potential problems".* **<u>Assessing the developed KPIs advantages and drawback before implementing the developed KPI</u>** **-** *I think understanding and assessing the measurements, benefits and drawbacks for each KPI is the first stage".* **<u>The company has to regularly manage and track the current KPIs</u>**. *-Evaluating a company's KPIs is an important step and managers need to constantly review the company's KPIs at all levels to make sure these indicators are useful to measure and to indicate the required data needed by the company to make better business decisions at the right time.* *-Evaluating a company's KPIs constantly helps such company to take the appropriate action in case any of the KPIs is inconvenient, unsuitable or incapable of matching with the company's strategy and objectives".* *-Each department has to determine, in the modifying or developing phase of the KPI, how frequently the department will measure each KPI to monitor the KPI's status so as to make sure that the developed KPI is still useful and track the information the department intends it to measure".* **<u>The company has to refer to successful stories or models that can assist the company in measuring its performance from the sustainability aspect but choose the KPIs which will help it to meets its sustainability strategy and goals.</u>** *-In my opinion, these success stories, frameworks, guidelines or initiatives made by other companies could support any company looking to orient itself and trying to determine the potential aspects to develop a sustainability strategy and KPIs".* *-I agree that there is no single path, but there is a need for frameworks or successful stories to assist companies that are taking the step of transferring their entire business strategy into another business strategy by relying on some guidelines to support them to form their own vision, goals and plans. I think that our company can be locally committed to provide leadership and guidance in the Egyptian oil refining sector as it developed its own customised sustainability KPI and the company issues a sustainability report every 2 years. That is, our company is the first Egyptian oil refining company which has a balanced approach towards the three pillars of sustainable developments. I think our company can be a good example of leadership due to company's experience in optimising resource utilisation, security process, product health and safety and putting people's health and safety high on the company's priority list".*
Carry out simulation phase	**<u>Carry out simulation phases.</u>** - *"I think the company should begin by understanding the developed KPIs well, then start to make a simulation for each KPI to assess and define how each KPI can be implemented in the company".* - *"A company can make a simulation of the implementation plan so that it can have practical feedback before implementing the KPIs".* - *"From my perspective, companies have to begin with a simulation for the vision, goal, plan and implementation phase of this sustainability strategy and KPIs to stimulate the relevant and irrelevant aspects before the actual start. Transferring the company's entire business strategy into a sustainable business strategy is time-consuming, as it can take from 6 months up to 1 year to implement. Costs and efforts are needed before the company begins to change its entire business strategy into a sustainable business strategy. Therefore, the company needs to be assured and convinced of every particular step that will be taken".*

Procedures (Cont.)	
Sub-themes	**Statements**
Set sustainable strategy.	**<u>Set sustainable strategy.</u>** - *"I expect that the first stage in implementing the model is starting with the company's strategy. I mean, before implementing or modifying any KPI, the department or the company, at all levels, has to realise first what its business is seeking to achieve so that a strategy will be the starting point for modifying or designing the appropriate KPIs"*. - "*I can add that it is essential that all the company's departments ensure that their used KPIs are aligned with the company's strategy, or else each department would be working towards specific objectives that do not have an impact on the company's progress in achieving its strategic plan"*. -"*I think KPIs are only really useful if they are aligned to the company's strategy. When the company's KPIs are not linked to the company's strategy, the company is wasting huge amounts of time and money for measuring and collecting information that is not going to benefit the department or the company overall"*. - "*I think that before implementing the developed model, companies have to start building a corporate sustainability strategy by setting goals and establishing a system"*. - "*I can add that the company has to ensure that all the departments', at all levels, key metrics are matched and aligned with the company's sustainability goals. Subsequently, the company will ensure that it has developed a real sustainability strategy because the company's strategy and all the company's department metrics at all levels are attempting to fulfil the company's sustainability goals"*. - "*I agree that the first step is that the top managers are convinced of developing a company's sustainability strategy. Secondly, the company has to develop a clear sustainability vision. Thirdly, effective communication should be made at all levels concerning the sustainability goals and their importance to the company's performance success and completion. Lastly, the sustainability strategy should be connected with the overall business strategy"*. - *"I think that the general rule should be that the companies have to develop a clear vision about the steps which will be taken to transform their entire business strategy into a sustainable business strategy"*. - "*If the company is attempting to orient its visions and strategy to be sustainable, it needs to start at a very small scale and, from time to time, modifies and develops, so that as time goes by, this company becomes more and more sustainable"* and "*It is important to set the company's sustainability vision and goals. Next, the system is set that includes the detailed process which is needed to guide and measure the performance towards each goal. In addition, KPIs are defined to meet the identified goals to allow the company to detect areas for improvements. These KPIs will gather relevant data to track progress, as metrics and indicators are central for reporting and communicating the activity of the company"*. **<u>The company has to choose the appropriate KPI from the developed model which will align with the company's sustainable strategy</u>**. - *"Therefore, the assigned team can identify the right KPIs which can help the company's managers to evaluate their progress and performance overtime and track whether each department is hitting the company's objectives. In case of non- compliance, the team can guide the department to take the appropriate steps to get there"*. - *"I think the first step would be that each department has to define their responsibilities, functions and problems. The second step is to evaluate the current KPIs used in the department. The third step would be that the department defines the KPIs in the developed model in order to identify the KPIs concerned with the department. The fourth step is comparing the department's current KPI with the identified indicators extracted from the developed model. The fifth step is that each department has to determine what KPI needs to be changed, modified or developed. The sixth step is that the department starts to link its KPIs to the company's strategy"*. - *"determining the right KPIs and ensuring that these KPIs match with the company's strategy"*. - *"The companies should find out the right measurement by studying the developed model to decide the most appropriate key performance measurement which matches their goal and strategy to use in measuring their departments progress and solve any potential problems"*. - "*In addition, a company has to determine which KPIs set in the developed model will help it to meet its goals so as to integrate these KPIs throughout the company's department"*. **<u>The company should ensure that the company's sustainable strategy covers the three pillars of sustainability.</u>** - "*I mean, as we realise from the developed model that sustainability is the integration between three pillars which are environmental, social and economic, I can observe that some companies' strategy is to focus on the environmental aspect. I can give an example concerning the fact that some companies in the oil refining sector report their green houses or carbon dioxide gases. By taking this step, they think that they have a company's sustainable strategy"*.

Procedures (Cont.)	
Sub-themes	**Statements**
Set sustainable strategy (Cont.)	**<u>There is no single path to develop and implement a sustainability strategy</u>** - "*I think that there are no ideal steps or a starting point for the development of sustainable KPIs"* and - *"I understand that "every company has a unique case". However, I want to add that observing a success story of developing sustainability and KPIs would be a good example to follow as it can give the company a good insight and some guidelines that it can benefit from".* - "*I want to add that there is no single path to use to adopt sustainability practices, so each company has to develop its own road map of the development and implementation phases".* - "*I agree that there is no single path, but there is a need for frameworks or successful stories to assist companies taking the step of transferring their entire business strategy into a business strategy using some guidelines to support them to form their vision, goals and plans. I think that our company can be locally-committed to provide leadership and guidance in the Egyptian oil refining sector as it developed its own customised sustainability KPI and the company issues a sustainability report every 2 years. That is, our company is the first Egyptian oil refining company to have a balanced approach towards the three pillars of sustainable developments. I think our company can be a good example of leadership due to its experience through optimising resources utilisation, security process, product health and safety and putting people's health and safety high on the company's priority list".* - "*I want to add that, as I was one of the company's sustainability team, when companies have to implement the sustainability practice, the company has to begin step by step and not aim that, in a short time, its process and practices will be fully transferred to be sustainable. Therefore, small improvements are probably the easiest way to start and to keep on focusing on the projects which have been completed and what next that needs to be changed. However, there is no single path to use to adopt and successfully integrate sustainability practices into the business strategy, as every company represents a unique case and requires a comprehensive review of its strategy, operation and goals. Therefore, the company needs to search for a framework or a successful story to follow as guidelines. The lessons that the company's sustainability team and I have learned from our experience is that fully transferring a company's entire business strategy into a sustainable business strategy is a journey, rather than a destination, so the company has to always focus on and track the KPIs set".*
Consider the company's resources.	**<u>A company has to calculate the cost of the activities carried out to implement the developed KPIs which match with the company's sustainable strategy.</u>** - "*I think the important step is to calculate the cost of these activities to develop a KPI"* and "*I think yes, it is important to identify the right KPI to evaluate and monitor the current performance at all levels, but it is an important step to calculate the cost of the activities carried out to develop such KPI".* *- it is an important step for the Financial Department to set a financial plan to achieve these KPIs to attain the company's sustainability strategy".* **<u>A company has to be in charge of the sustainability team who will be in charge of looking at the company's KPIs through defining, monitoring, evaluating and implementing the appropriate KPI which will correspond to the company's sustainable strategy.</u>** **<u>-</u>** *"The company should form a team to be in charge of looking at the company's KPIs. That is, each department will assign one key person to represent the department. Therefore, each key person in the team will be responsible for defining, monitoring, evaluating, implementing and interpreting the KPIs particular for this department".* - "*I think that, to have a successful team who is in charge of looking at the company's KPIs, it is essential that each department should appoint a key person that has good experience and is aware of the department responsibilities, operations, plan, problems, system and KPIs used in the department. Besides, each key person in the team should be aware of the strategy and objectives set by the company. Also, it is significant that all team members are transparent when representing the concerned department's performance, problems and KPIs used during the discussion and evaluating session to identify which business areas need to be improved. Therefore, the assigned team can identify the right KPIs which can help the company's managers to evaluate their progress and performance overtime and track whether each department is hitting the company's objectives. In case of non- compliance, the team can guide the department to take the appropriate steps to get there".*
Communication with employees	**<u>The company has to communicate its own sustainable vision, strategy and plan efficiently to its employees to understand the reason and the benefits from implementing the developed KPIs.</u>** - "*I believe that KPIs are considered part of the decision-making process for every employee in the company. That is, every employee should understand what metrics the department and company need to gather and how these measurements are linked to the company's strategy.* - *"I would like to say that when the vision and strategy are not communicated at all levels within the organisation overtime, the transition phase will take a longer time, or else they can fail because the employees are behind and do not understand the reason or the benefits of this transfer.*

Procedures (Cont.)	
Sub-themes	**Statements**
Communication with employees (Cont.)	**<u>The continuous modification and evaluation of key performance should be done by a company through increasing employers' and employees' communication.</u>** - "*I can also add that each department has to communicate with employees, during the modifying or developing phase of the KPI, how frequently the department will measure each KPI to monitor the KPIs status to make sure the developed KPI is still useful and track the information the department intends it to measure*". - "*it is not enough to just report a company's real sustainability strategy, but the company needs to manage, track and communicate with employees these KPIs continually to ensure that these are the right KPIs used and that they answer what the company or the department is trying to measure*".
Convince top managers of sustainable vison.	**<u>Top managers themselves are convinced of a sustainable vision</u>** - "*I can add that management support is very important, since if the top managers have sustainability awareness and understand the benefits of each KPI, they will give all the needed support by providing awareness and trainings and allocating money to the departments and employees to implement these KPIs*". - "*I want to add that developing a company's sustainability strategy has stem from the CEO's and top manager's visions, since they take the lead of the company to have a sustainable strategy. From my experience, if the middle managers have this vision, it will be very hard and take a lot of effort to convince the CEO and top managers to develop a sustainability strategy. I think it has to begin from the CEO and top manager's vision to lead the rest of the company to be sustainable*". - "*I think implementing the developed model begins with the CEO vision of developing a sustainability strategy and implementing sustainable KPIs to track the company's progress towards sustainability. So the CEO's vision is important as he/she is the main leader of the company*". - "*I want to add that when the CEO is convinced and has sustainability visions, it makes all the phases, from planning until implementation, much easier*" and "*In addition, our CEO is excited about the idea and this supports in the implementation phases a lot because our CEO is convinced of transferring the company's entire business strategy into a sustainable business strategy*".
Barriers	
Sub-themes	**Statements**
Lack of financial resources and efforts	**<u>Financial resources and time</u>**. - "*I think the main barrier is the costs and time required to implement the KPIs. Oil refining companies have a complex design and process, so to introduce new measurements in this complex design, the company is required to spare time, cost and efforts, at all scales, to re-engineer its processes and design to adopt these new KPIs*". - "*I assume that shifting the company's view and treating the environment, economic and social aspects in a balanced procedure is one of the barriers making complications in the company's structure to attain the sustainability's goals. That is, there is a need to change in the structure of strategies for pursuing sustainable development*". - "*I think that the costs, time and efforts to develop a sustainable strategy and goals can be the obstacles preventing the company from implementing the sustainability developed model*". -"*I think changing the management system requires financial investment, time and human resources, meaning that one of the obstacles which can hinder a company is the financial resources*". -"*I think changing the management system requires financial investment, time and human resources, meaning that one of the obstacles which can hinder a company is the financial resources*". - "*I think one of the barriers that a company can face is the company's team training. Implementing the sustainability theme in a company and using the developed model to track and measure its performance from the sustainability perspective is complex. Therefore, integrating this new system requires re-structuring and team-member training. Consequently, this process requires financial resources, detailed planning and regular tracking and communication with the company's team, or else it could result in costly mistakes*". **<u>lack of financial resources which are considered as essential when a company aims at implementing the developed model</u>**. - "*I think some companies lack the financial resources to develop the sustainability concept. That is to say, sustainability development requires changes in the company structure, strategies and goals, so a company will bear high costs that demand considerable financial resources*". - "*In my opinion, financial resources will hamper a company from developing the sustainability concept in the company. This is due to the fact that sustainability development requires revolutionary change in the ways, approaches and methods of the company's operation. Consequently, when the company is developing sustainability, there will be some forms of development in the environmental and social aspects to achieve the company's set sustainability strategy.*

Barrier (Cont.)	
Sub-themes	**Statements**
Lack of financial resources and efforts (Cont.)	**Face a trade-off between implementing the developed model and the company's financial resources.** - "*From my point of view, sustainability development makes the company face a trade-off when dealing with the transition to sustainable practices. In other words, the company will be facing a trade-off in case of taking the best course of actions it should take in terms of the company's financial resources, social well-being and environmental practices. I think a trade-off is one of the barriers that the company can experience when developing a sustainable concept*". - "*From my point of view, sustainability development needs to be incorporated in to polices, process and control system of the company, this makes the company to face trade off when dealing with the transition to sustainable practices. In other words, the company will be facing trade off in case of taking what is the best course of actions the company should take in terms of the company's financial resources and sustainability practices*".
Lack of management support	**Top managers are not aware of the benefits of implementing the developed model, so there will be no support given to implement the developed model**. - "*I can add that management support is very important. That is, if top managers have sustainability awareness and understand the benefits of each KPI, they will give support by raising awareness, providing trainings and allocating money to the departments and employees to implement these KPIs*" and "*I think that the barriers, which will face a company to implement the KPIs, are limited understanding and awareness of the sustainability concept and of the benefits of each KPI*". - "*In my opinion, one of the barriers for developing the sustainability concept is that the company's CEO and top managers are still unaware of the concept of sustainability*" and "*one of the barriers is that the CEO and top managers are still unaware of the sustainability concept and consider their focus on the environmental aspect alone as a sustainability practice*". - "*In my opinion, one of the barriers for implementing the developed model is still that sustainability development is not interesting for companies' CEO and top managers, as sustainability development is costly, time-consuming and requires a team behind its implementation. In addition, they are still unaware of the numerous benefits which will be achievable from the sustainable practice*". **Top managers do have the vision to implement the developed model, but do not have enough experience to implement it** - "*Regarding the top manager's perspectives and vision, for example, a company can have a certain strategy and all his employees can be adopting this strategy, then the next manager comes in and he/she either supports the same strategy or changes it altogether*". - "*I remember that, at the beginning, the CEO had the vision, but did not have the experience to take a step forward and develop the company's sustainability strategy*".
Limited awareness of the sustainability theme	**Employees lack the awareness** - "*I think that the attitude and behaviour of people towards understanding the concept of sustainability and the benefits of implementing these KPIs will be a barrier. Therefore, I think that raising awareness, having like simulations sessions to visualise the benefits of implementing these KPIs and comparing the performance and the results before implementing these KPIs will make employees fully aware and convinced of implementing these KPIs, even if it will take time and effort*". - "*I think one of the barriers is the employees' lack of awareness regarding the sustainability concept*". - "*I think one of the barriers which can hamper the company is that the employees can lack awareness and this causes them to resist change or ignore it*". **Lack of sustainability experts, skills and knowledge** *-I think one of the obstacles which can hamper a company for implementing the developed model is the lack of the sustainability skills and knowledge, which are needed by employees at all levels. That is, effective sustainability performance requires employees with a range of sustainability skills and knowledge to ensure the effective delivery of the company's sustainability policies and objectives*". **Confusion and conflicts regarding understanding and identifying the appropriate KPIs which match the company's sustainable strategy.** - "*In my opinion, one of the barriers which can face a company when developing the sustainability theme is defining the sustainability company's measurable goals clearly and determining departments and individuals' responsibilities. That is, if the goals and the tasks are not identified clearly, employees will be unclear regarding the sustainability company's goals and cannot work effectively to be achieved*". - "*I want to add that, at this phase, the CEO and the sustainability's team have recognised that the transition will take a longer time or that it can fail because the employees are not behind it and do not understand the company's sustainability goals or do not understand why sustainability is being pushed in the company. Therefore, the quality and outcome of the planned actions by the sustainability's team will always be poorer. Subsequently, the company has made sustainability awareness sessions so as to define the company's sustainability goals.*

Barrier (Cont.)	
Sub-themes	**Statements**
Limited awareness of the sustainability theme (Cont.)	**The Petroleum Authority's level of awareness towards the sustainability theme should be revisited, so the Petroleum Authority can act as a support or barrier to encourage/discourage oil refining companies to implement the developed model.** - "*I like to add that the Petroleum Authority can be a barrier or a supporter*".
Internal communication deficiency	**There is a lack of communication between a company's decision-makers and the employees responsible for measuring, tracking, analysing and eventually submitting a report to the company's decision-makers.** - "*I think one of the obstacles that can face a company is the disconnect between the decision-makers and those who are measuring, tracking and analysing the data collected to submit their report back to the decision-makers to take the appropriate decisions. The person who is responsible for measuring and analysing the data can have a lack of awareness about the sustainability concept or the company's sustainability goals. In addition, the person reporting and analysing the data might not understand the relevance of the collected data and hence reports irrelevant data*". - "*I remember that one of the barriers mentioned in one of the meetings is that some departments inside the business are really not extracting business-relevant insights. That is, no one is working out how the data relates to the company or the industry benchmark, how the metric changed over time and what this collected data means, or how it will affect the company. Unfortunately, there is a disconnection between whether something can be measured and whether it should be measured. The company's sustainability team realises that some departments are measuring the KPIs which are easy or required by the government, regardless of their relevance to the company*". **There is a lack of communication between employees and top managers while defining a company's new sustainable strategy and the new set KPIs to measure the company's sustainable performance** - "*I expect that one of the barriers is the lack of communication between employees and management and this can lead to the employees ignoring the set KPIs completely, so I suspect that implementing the sustainability concept requires that managers have an open communication channel with the employees*".
Difficulty in identification of the appropriate KPIs	**Difficulty in selecting the appropriate KPIs aligning with the company's sustainability strategy from the developed model.** - "*I think that the first barrier which a company faces is linking the KPIs with the company's sustainable strategy. From my experience, knowing first the company's strategy is a perquisite for choosing the right KPIs which will assess the company's performance towards achieving its strategy*" and "*the company can struggle in identifying, defining, measuring and tracking the right KPIs which suit its sustainable goals and strategy*". - "*a company has to choose the right and efficient KPIs which will demonstrate how effectively a company is in achieving its sustainable goals and strategy. Defining and identifying the right KPIs which are appropriate for the company's sustainable goals and strategy can constitute difficulty to the company*" and "*One of the problems that companies can face is not updating the KPIs from time to time. In other words, once the right KPIs have been identified or designed, the company can forget making sure that the chosen KPIs are still relevant, linked to the company's sustainable strategy, or continue to help the company to answer critical questions. Therefore, the company has to make sure that each department is collecting the right data to be analysed and taking the right decisions*". - "*I think one of complications of developing a sustainability perception is to identify, measure and track the KPIs which will have a direct impact on the company. In my opinion, it is necessary to identify the KPIs which will be useful and effective to achieve a company's sustainability goals and objectives*" and "*As for developing the sustainability strategy, it determines the future direction of the company. In addition, the plan and the procedures which will be done on the short, medium and long term for all levels of the company should be determined to achieve the set sustainability's strategy and goals*". - "*One of the barriers which can hamper the company when developing sustainability practices is translating the strategic objectives into more detailed short-term plans that contain actions for each department and functions designated for some employees. In addition, KPIs should be defined to measure and track each assigned action and function*". -"*In my opinion, one of the barriers which can delay a company while implementing the developed model is that the company can still have some confusion and conflict to understand what sustainability means for their business, what to do and the benefits which will be gained by such company when implementing the developed model*" and "*I believe that there is no awareness about how a company should incorporate the sustainability theme into the company's strategies and goals. Therefore, there is still a lack of clarity and there is contradiction regarding the integration of the sustainability theme into the company's strategies and goals*".

Barriers (Cont.)	
Sub-themes	**Statements**
Lack of transparency	**Transparency** - "*I think one of the barriers facing our company when shifting towards sustainability is transparency".*

Benefits	
Sub-themes	**Evidential Quotes**
Support the company to be green.	**Oil refining company should be assisted to develop environmental foot prints** - *I think companies will notice a reduction in their energy demand, less wastes generated, material reuse and recycling, which can lead to less pollution, less cost and more profit. Therefor, these positive practices can indicate that a company should have the vision to implement sustainability practices and implement the developed KPIs in order to track and measure its performance towards sustainability as they will be of great benefit for the company"* and *"Helping a company to measure its carbon foot prints and manage its emissions will result in fewer government fines and more environmentally-friendly practices will make the company save money and improve productivity".* - *"I think that being more sustainable will develop the environmental footprint, create less waste and distinguish the company's position"* and *"Sustainability development which plays a significant role in developing more environmental footprints and minimising energy usage and wastes costs".* **Helps an oil refining company in reducing environmental incidents.** -*I think that implementing KPIs reduces environmental incidents and improves employees' safety".* **Assist oil refining company to have more environmentally-friendly practices (less waste, less carbon emissions and recycling and reusing generated wastes) leading to less pollution and less costs**. - *In my opinion, sustainability practices can enhance a company to be green, so that the company seeks to cut carbon emissions and reduce its wastes. In addition, sustainability practices support the company to increase eco-efficiency by conserving resources and attempting to find ways to recycle its equipment and materials' wastes".*
Enhancing company profitability	**Helps in minimising energy usage, resulting in less energy demands, so enhancement in company's profitability** - "*it is realised that an oil refining company that starts implementing sustainability practices can use energy more efficiently".* - "*there are a lot of examples on how a company can be energy-efficient by inspecting the company's machines and equipment frequently. For example, heaters leakage can be a waste of energy and increase the company's expenses. Therefore, regular inspection reduces the machines and equipment leakages and waste of energy".* - "*I think that sustainability practices reduce a company's costs, improve its reputation and save money".*
Extending the company social awareness	**Help the company to have social awareness through thinking and supporting the community** - "*I think that when the company has a sustainability vision and implement KPIs to measure and track its performance from the sustainability perspective, it considers the surrounding community. Therefore, the company will be welcomed and appreciated. In addition, the company will become a vital part of its local community".*
Promoting company's performance	**The company should be supported to have a different position in the market.** - "*In my opinion, the company will have a better image in the industry and the market".* - "*In my opinion, one of the benefits gained when a company implements the developed model is that it will position the company as an industry/market leader by embracing sustainability practices".* **Assisting the company to track and measure its current performance** - "*I think it easily makes the managers of each department and of the organisation as whole to follow up the performance of each unit, employee, piece of equipment and to easily determine the defences or problems to resolve".* -"*I think that when a company has a sustainability vision and implements KPIs to measure and track its performance from the sustainability perspective, this means the company is thinking about the community from the economic, environmental and social aspects"* and "*I think implementing KPIs to track and measure the company's performance from the sustainability practice can help it to improve its process and the whole system by analysing issues like the material used, waste produced and energy consumption. In addition, by monitoring the internal management and the decision-making process, the costs of the company can be reduced".* - "*I think implementing KPIs to track and measure the company's performance from the sustainability practice can help it to reduce its costs through some sustainable practices".* - "*I believe that a company that has a sustainability strategy and implements KPIs can have the ability to manage, measure, monitor and report the company's sustainability performance frequently to take the right and timely decisions. In addition, publishing a sustainability report regularly will maintain transparency, trust, better* company image and reputation in the industry and the market".

Benefits (Cont.)	
Sub-themes	**Statements**
Promoting company's performance (Cont.)	**<u>Encouraging it to comply with the domestic and international rules and regulations.</u>** - "*In my opinion, a company that has a sustainability strategy helps itself to comply with regulations and avoid any non-compliance costs*". : "*I think that carrying out the developed KPIs will help a company to comply with the internal or external regulations*"
Improving company's reputation	**<u>Company reputation</u>** - "*In my opinion, good company reputation is one of the benefits gained when a company implements the developed model to track and measure its performance from the sustainability perspective*". - "*I think the developed model can make a company achieve a good reputation regarding its social and environmental responsibility, which will positively affect the company by retaining high quality employees, reducing environmental incidents and improving employees' safety*".
Draw the attention of employees and investors.	**<u>Draw the attention of employees and investors.</u>** - "*I believe that a company that has sustainable practices can attract a greater, more talented and qualified pool of employees. That is, employees would want to work with companies that ensure that they will have a healthy and motivating workplace*". - "*I think when a company implements the developed model, it will have a great opportunity to attract investors and retain employees. Employees like to be associated with a company that cares about environmental issues and social welfare*".
Increasing employees' safety	**<u>Employees' safety</u>** - "*A company is enhanced to create decent and safe jobs for employees including diversity, equity and empowerment. Moreover, the company seeks to contribute to and support the community through investment and relationships*". - "*I think applying new sustainable KPIs will change the workers' concepts. There are some examples of companies that apply the recognised the HAZOP system, in which the OHS Department imagines a problem and starts to put scenarios to realise the disaster which can occur based on this problem. This leads employees to change their concepts concerning safety which is not all about wearing protective equipment and clothes and is considered a process safety management*".
Increasing trust and transparency	**<u>Retaining the credibility and confidence of the shareholders and employees,</u>** - "*A company's sustainability practices build the credibility and confidence of both future and present employees, investors and suppliers. These parties expect that the company is concerned with the social and environmental responsibility*". - "*I think there will be trust and transparency built and maintained between the company and its stakeholders*". - "*I think a company that has a sustainable approach can lead to increasing the company's shareholders trust in the company. Therefore, sustainability practices will improve a company's reputation. Good reputation retains the credibility and confidence of its employees, investors and suppliers. These parties consider dealing with a company that is proactive with its environmental and social aspects*". - "*I think increasing a company's trust and transparency will increase investors and employees*". **<u>Developing credibility and transparency between the company and the government resulting in fewer complaints, less inspection and fewer fines.</u>** - "*I think when a company has a sustainable system and KPIs to track and measure its performance from the sustainability practice. Therefore, there will credibility and transparency in the relation between the company and the government. Consequently, this company will have fewer inspections, less fines and fewer complaints from its neighbours and the community*".
Monitoring sustainability progress	**<u>Guide the company to take the right steps in achieving the company's sustainability goals and objectives</u>.** - "*I think the integration between measures will help a company to know where it is in relation to where it wants to be, so the developed KPIs are navigation tools to achieve the company's strategy*". - "*I think implementing the developed model can help a company to demonstrate how effective the company is in attaining its sustainable goals and objectives*" and "*In my opinion, the developed model can help the company to measure its sustainable progress overtime*". - "*I perceive that implementing the developed KPIs will reveal the company's positive impacts regarding its environmental, economic and social responsibility*". -"*A well-designed set of KPIs provides a clear identification of the company's sustainable current level of performance and helps the company to make better decisions that bring the business closer to achieving its sustainability strategic objectives*" and "*From my experience, I want to say that, at the beginning, when the CEO was demonstrating his idea to develop the company's sustainability vision and strategy, it seemed to be complicated, but I can say that it is less complicated than we thought at the outset.*

Drawbacks	
Sub-themes	**Statements**
Company Commitments	**<u>Company has to regularly consider the economic, social and environmental aspects</u>**. - "*I think one of the drawbacks of implementing the developed model is that it commits the company to frequently measure its performance from the sustainability context*". - "*I think that sustainability development will increase a company's responsibility, so the company has to keep making progress towards achieving its sustainability goals*".
Cost	**<u>The company will bear initial costs.</u>** - *At this stage, our company is making progress towards achieving the sustainability goals, so I think one of the drawbacks is the initial costs which the company bears to transfer its entire business strategy into a sustainable business strategy*". - "*Although from my perspective, all the high initial cost which the company bears at the beginning, the company will save on the long run because sustainability development plays an important role in minimising energy usages and wastes costs. The fewer resources the company uses, the more money the company can save. Consequently, most of the company savings will come from the sustainability practices, which encourages the company to find ways to reduce energy usage, such as ways to reduce water usage and energy usage (like electricity, gas and fuel) and this means the company will cut carbon dioxide and greenhouse gas emissions. In addition, reduction in waste means recycling and using less material. Therefore, all the initial costs borne by the company at the beginning will be transferred on the long run into company savings*". - "*By achieving the sustainability goals, the statistics show that annual costs have been lower compared with those of previous years*".
Model Modification	
Sub-themes	**Statements**
Environmental	**-** "*I think you can add* ***"air emission reduction*** *" in the model because, as I have explained above, there are methods and systems to* ***reduce air emissions*** *".* *- Please change "ISO 14001 certification" in the environment aspect model to "ISO certification"."* - "*I want you to change* ***resource consumption*** *to* ***energy*** *as you have mentioned in the model* ***water*** *as an aspect. I think you have to mention* ***energy*** *as another aspect and under the* ***water*** *indicate* ***water withdrawal****,* ***water discharge*** *and* ***quantity*** *of* ***recycled*** *and* ***reused*** *water. Please remove the* ***recovery of water*** *as it gives the same meaning as* ***recycled*** *and* ***reused****. In addition, you should add* ***energy sources, energy intensity*** *and* ***renewable energy sources*** *under the* ***energy aspect****, which I think you have placed under* ***environmentally-friendly practices*** *".* - "*I want you to modify some things in the* ***environmental model****. At the* ***environmentally friendly practices aspect****, I want you to change* ***environmentally-friendly*** *manufacturing products to* ***environmentally-friendly process*** *as the* ***environmentally-friendly*** *practices are related to the company's whole process. In addition, I want you to include* ***environmental projects*** *as a KPI, as the company has to track and measure its performance in developing and implementing new environmental projects. In addition, the company has to track and measure its impact on the eco-system and bio-diversity protection. Therefore, I think you have to add* ***eco-system and bio-diversity protection*** *as a KPI under* ***environmentally-friendly practices****."* - "*I think you have to add* ***eco-system and biodiversity protection*** *in the* ***environmental model*** *under the* ***environmentally-friendly practices aspect****, as the company has to track and measure its performance towards this aspect and since the company should have no negative impact or damage the eco-system and biodiversity. On the other hand, the company's role is to protect bio-diversity and the eco-system*". - "*Yes, I want to give you some pointers in the* ***environmental model****. In my opinion, you have to add* ***environmental law compliance*** *under the* ***company environmental policy and management system aspect****, as the company has to track, measure and validate the data conforming to the environmental laws, "I suggest doing some modifications in the* ***environmental model****. In my opinion, you should change* ***oil spills*** *to* ***oil leakage****. In the oil refining industry, it is difficult to have oil spills as the oil refining companies start their role when crude oil is transferred to the company through pipelines and stored in tankers. Therefore, there can only be oil leakage due to bad connections or leaking valves. Accordingly, I recommend changing the* ***oil spills aspect*** *as a KPI to* ***oil leakage****. In addition, I think you have to add a KPI called* ***"eco-system and biodiversity protection"*** *under* ***environmentally-friendly practices.*** *Thus, it is important that the company tracks and measures its impact on the eco-system and bio-diversity protection"* and "*I suggest that you modify the* ***ISO certification*** *KPI in the* ***environmental model*** *and the* ***economic model****, as there are many ISO certifications. In my opinion, writing ISO certification only in the model should be done without determining the certificate which can limit KPI.* - "*I think that, in the* ***environment model,*** *you can add* ***air emission reduction*** *under the* ***air emission aspect****. Particularly now, there are measurement devices and automation solutions to reduce air emissions.*

Model Modification (Cont.)	
Sub-themes	**Statements**
Environmental (Cont.)	- "*I can suggest some modifications and additions to the KPIs in the* ***environmental model****. I recommend adding* ***air emission reduction*** *under* ***air emission*** *as a KPI because now most companies seek reducing air emission by using measurement devices. In addition,* ***bio-diversity protection and eco-system*** *should be added under* ***environmentally-friendly practices*** *as a KPI. A company has to track and measure its performance towards this aspect and see that it has no negative impact or causes damage to the eco-system and biodiversity. Furthermore, I think you have to add* ***environmental law compliance*** *as a KPI under the* ***company environmental policy*** *and* ***management system****. Thus, the company has to track, measure and validate the data conforming to environmental laws, regulations, standards and other governmental requirements*".
Economic	- "*I would like to thank you first for this session. Also, I advise you to modify the KPI which is "****ISO 9001 certification****" to "****ISO certification****" because there are many quality* ***ISO certificates****. I think stating* ***ISO certificates*** *in you model will be more comprehensive than determining one* ***certificate*** *in particular"*. - "*I want to offer some advice regarding the modification and addition in the* ***economic model****. In my opinion, you have to modify and add certain KPIs under the* ***investment aspect****, like change the* ***capital employed*** *to the* ***capital investment*** *in* ***facility and equipment****, as the company needs to invest and allocate money for facility and equipment. In addition, you need to add* ***human capital aspect*** *as the cost the company bears to improve the employee's skills and knowledge. In addition, I think you can add* ***market expansion*** *as a KPI, so that the company measures its performance towards adding a new demographic market. Furthermore, I expect you to include adding the* ***new products*** *aspect, as the company has to invest in developing and brining new products to the market. Besides, I want to advise you to remove* ***facility and equipment maintenance*** *as these costs will be included in the* ***capital investment (facility and equipment)*** *aspect which will be added to the model"*. - "*I suggest some modifications in the* ***economic model*** *under the* ***innovation's aspect****. In my opinion, you have to include* ***bio- refinery technology*** *and* ***smart refinery*** *under one aspect which is the* ***technology aspect,*** *because I expect that these elements are related to technology. Moreover, you should add the* ***information system KPI*** *under* ***innovations****, since the information system is one of the important elements in the company to store operation data, documents and measurement devices connected to the system. Therefore, the information system eases the operation by delivering the required information and hence eases the decision-making process. Therefore, it is important for the company to measure the performance of the information system and to check that the system is good and reliable and that backups exist for the system"*. - "*In my opinion, I suggest adding* ***resources security*** *and* ***feedstock security*** *in* ***the economic model*** *under the* ***risk aspect*** *as KPIs. The resources needed by the company are like the electricity and water required in the production process. Besides, the feedstock includes crude oil with specific qualifications. The company has to ensure that it has resources security and feedstock security"*.
Social	-"*Also, I advise you to change the name of the KPI which is "****occupational safety and health****" to "****occupational health and safety****""* and "*I recommend that you add* ***Hazard and Operability study (HAZOP)*** *in the* ***social model*** *under the* ***occupational health and safety aspect,*** *as it is a tool currently used in some oil refining companies and this tool contributes to risk control within the company"*. - "*I like to advise you to modify some aspects and KPIs in the* ***social model****. I think you need to change the* ***employee recognition*** *aspect to* ***the human resources aspect****. In addition, I think it will be more professional if you change the KPI of* ***soft skills development and training*** *to* ***capacity building (soft and technical)****, as capacity building is the process by which a company retains and improves the employee's skills and knowledge"* and "*I like to give you some points to modify in the* ***social model****, you need to change the* ***occupational safety and health aspect*** *into* ***the occupational health and safety****. All oil refining companies have an Occupational Health and Safety (OHS) Department, so this is the proper expression"*. - *"I want to advise you to modify the* ***annual employee turnover*** *to the* ***annual employee hiring and turnover*** *in the* ***social model****, as the company has to measure the annual employee hiring and annual employee turnover"* and "*I like to give you a point to modify in the* ***social model****, you need to change the* ***occupational safety and health aspect*** *to the* ***occupational health and safety****. In addition, I want you to add* ***lost time injury frequency rate*** *under the* ***occupational health and safety aspect****. It is important for a company to assess its safety performance so one of the most important KPIs to track its lost time injury frequency rate. The lost time injury frequency rate is the number of lost time injuries that occur during a reporting period"*. - "*I want you to change the* ***occupational safety and health aspect*** *as it is called* ***the "occupational health and safety"*** *in the* ***social model****. In addition, I recommend that you add two KPIs in the* ***social model*** *under the* ***occupational health and safety*** *aspect. I want you to add* ***'workers covered by occupational health and safety management system'*** and ***'Safety Committee'****.*"

Model Modification (Cont.)	
Sub-themes	**Statements**
Social (Cont.)	- "*I think that, in the* ***social model****, under the* ***employee recognition*** *in the* ***annual employee turnover****, you can add* ***annual employee hiring and turnover*** *as a company has to measure annual employee hiring and annual employee turnover"* and "*Thank you for this session and I have some recommendations regarding the* ***social model****. Firstly, I want you to change the* ***occupational safety and health*** *to the* ***occupational health and safety*** *because there is a department in any oil refining company called "Occupational Health and Safety" (OHS). This department's role is to create and implement health and safety in the workplace and is responsible for preventing accidents, injuries and work-related illnesses in the workplace. Thus, occupational health and safety aspects will cover the KPIs which can assist a company to track and measure its occupational health and safety performance. In addition, I suggest that the company adds* ***labour law compliance*** *under the* ***human right aspect****. That is due to the fact that a company has to track, measure and validate the data conforming to the labour laws, regulations, standards and other governmental requirements"*. - "*I recommend changing the* ***occupational safety and health*** *to* ***occupational health and safety****. In addition, you have to add* ***labour law compliance****. However, I am thinking about the aspect you can include it in. I think it should be under* ***the employee rights*** *because the law will set specific regulations for employees"*. - *"I recommend adding* ***labour law compliance*** *in the* ***social model*** *under the* ***human rights*** *as a KPI. In addition, I want you to change the* ***bribery and corruption policy*** *to* ***anti-bribery and corruption policy*** *in the* ***business ethics aspect****, because I think it is written wrong"* and "*I advise you to change the* ***occupational safety and health aspect*** *to* ***the occupational health and safety*** *in the* ***social model****. I also recommend adding* ***workers covered by occupational health and safety*** *in the* ***social model*** *under the* ***occupational health and safety aspect*** *as a KPI. In addition,* ***Hazard and Operability study (HAZOP)*** *is a tool currently used by some oil refining companies. This tool contributes to risk control within a company or a project. The department imagines a problem and starts to put scenarios to realise the disaster which can occur based on this problem until finding the appropriate result for this problem. I consider it useful to be included as a KPI in the model, so as to encourage companies to measure how frequently the company imagines a problem and starts to put scenarios to realise the disaster which can occur"*.

Appendix 10: Survey Questionnaire

PhD Research Survey

Please choose the language

- ○ English
- ○ عربي

Thank you very much for considering my study. You are invited to participate in this online survey questionnaire, so my research can benefit from your professional experience and knowledge in the oil refining field. This research is about developing a supply chain performance measurement model from the sustainability perspective. I am looking forward to learning more from your professional perspective to investigate the level of sustainability implementation in the oil refining sector through knowing more about the models applied in the oil refining sector that are capable of measuring oil refining companies' performance from the sustainability perspective. Kindly give your viewpoints with regard to the currently used models and your opinions concerning how far these models can improve companies' performance through the sustainability perspective. I also seek to know your perspectives about the proposed KPIs set in this research along with some guidelines which the researcher came up with; these guidelines are expected to assist oil refining companies if they are willing to refer to the proposed model.

This survey consisted of 5 sections; the coverage of each part is as follows:

Section I. General information.
Section II. Information regarding the oil refining sector.
Section III Respondents' assessment for the proposed key performance indicators indexed in the subsequent section.
Section IV. Respondents' perspectives about recognising the effect of adopting/following the sustainable key performance indicators towards the procedure's fulfilment, barriers, benefits and drawbacks that can face companies.
Section V. Respondents' comments

It is estimated that it will take from 15 to 20 minutes to complete the survey. Your contribution to this research is entirely voluntary and you are not obliged in any way to participate. If you require any further details, please contact the researcher. Kindly note, it is important that you read and understand the following and sign, in case you agree to participate in this online survey.

1- I have been informed of the nature and aims of this study as outlined in the previous section	○
2- I understand that I have the right to withdraw from the research	○
3- I understand that the information collected will be kept secure conditions for a period of years at the University of Huddersfield	○
4- I understand that no other person rather than the researcher/s and facilitators/s will have access to the information provided	○
5- I understand that my identity will be protected by the use of pseudonym in the report and that no written information that could lead to my being identified will be included in any report.	○

If you feel satisfied that you understand the information and happy to take part in the project, please put a tick in the box aligned to this sentence.

- Agree
- Disagree

Section (I)

Q1.1 Respondent profession

- Researcher
- Manager in an oil refining company

Q1.2 During the recent years, there has been a tremendous interest about sustainability, please indicate, how much do you know about sustainability?

- Not at all
- Little
- Moderate
- Great

Q1.3 Which department do you work in?

- Environmental
- Financial
- Human Resources
- Health and Safety
- Supply Chain
- Quality assurance
- Sustainability
- Other

Section (II)

Q2.1 Based on your professional experience, is there a sustainability department identified in oil refining companies' organisational charts?

- Yes, all oil refining companies have identified a sustainability department in their organisational chart.
- Yes, some of oil refining companies have identified a sustainability department in their organisational chart.
- No sustainability department identified in oil refining companies' organisational chart
- Not aware

Q2.2 To the best of your knowledge, do you think that oil refining companies follow key performance indicators to measure their performance from the sustainability aspect?

- Yes, all oil refining companies follow key performance indicators to measure their performance from the sustainability aspect.
- Yes, some of oil refining companies follow key performance indicators to measure their performance from sustainability aspect.
- No sustainable key performance indicators followed by oil refining companies.
- Not aware

Q2.3 If your answer to the previous question (# 2.2) was "yes" so, are the preceding indicated key performance indicators inspired from

- General applied model
- Specific applied model (i.e., Developed for certain oil refining company)

2.4 From your professional opinion to what extent the previous specified model can improve the company's performance through the following aspects?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1- Reducing air emissions, oil leakage, water withdrawal, water discharge and solid wastes	○	○	○	○	○
2- Considering energy efficiency, environmentally friendly practices and environmental policy and management system	○	○	○	○	○
3- Supporting innovations, investments, quality, less risks, local content and government-business relationship	○	○	○	○	○
4- Appreciating employee rights and occupational health and safety	○	○	○	○	○
5- Respecting community, society and business ethics	○	○	○	○	○
6- Achieving growth, better performance and profitability	○	○	○	○	○

Section (III)

Q3.1 Based on your professional experience, to what extent are the following environmental KPIs applied in the oil refining sector?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Disagree
Flared Gas	○	○	○	○	○
Greenhouse Gas	○	○	○	○	○
Atmospheric Acidification	○	○	○	○	○
Other Gases	○	○	○	○	○
Air Emissions Reduction	○	○	○	○	○
Water Withdrawal	○	○	○	○	○
Water Discharge	○	○	○	○	○
Quantity of Recycled/ Reused Water	○	○	○	○	○
Energy Sources	○	○	○	○	○
Energy Intensity	○	○	○	○	○
Renewable Energy Sources	○	○	○	○	○
Quantity of Solid Wastes	○	○	○	○	○
Quantity of Recycled/ Reused Solid Wastes	○	○	○	○	○
Quantity of Oil Leakage	○	○	○	○	○
Quantity of Leakage Removal	○	○	○	○	○

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Disagree
Environmentally Friendly Manufacturing Process	○	○	○	○	○
Environmental Projects	○	○	○	○	○
Eco-system and Bio-diversity Protection	○	○	○	○	○
Company Environmental vision/strategy/policy/Targets	○	○	○	○	○
ISO Certification	○	○	○	○	○
Industry's Environmental Association Membership	○	○	○	○	○
Environmental Audits and Assessment	○	○	○	○	○
Employees Environmental Training and Awareness	○	○	○	○	○
Environmental Law Compliance	○	○	○	○	○

Q3.2 Do you have any suggestions to add/exclude/modify any of the environmental key performance indicators from the above list?

Q3.3 Based on your professional experience, to what extent are the following economic KPIs applied in the oil refining sector.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Technology	○	○	○	○	○
Information System	○	○	○	○	○
Capital Investment	○	○	○	○	○
Human Capital	○	○	○	○	○
Research and Development	○	○	○	○	○
Market Expansion	○	○	○	○	○
Adding New Products	○	○	○	○	○
Crude Oil Feedstock's Quality	○	○	○	○	○
Process Quality	○	○	○	○	○
Product Quality	○	○	○	○	○
ISO Certification	○	○	○	○	○
Energy Security	○	○	○	○	○
Resource Security	○	○	○	○	○
Feedstock Security	○	○	○	○	○
Local Procurement	○	○	○	○	○
Transparency of Tax Payment to Host Country	○	○	○	○	○
Government Incentives/ Assistance	○	○	○	○	○
Sustainable Profit	○	○	○	○	○

Q3.4 Do you have any suggestions to add/exclude/modify any of the economic key performance indicators from the above list?

Q3.5 Based on your professional experience, to what extent the following are the social KPIs applied in the oil refining sector?

	Strongly Disagree	Disagree	Neutral	Agree	Disagree
Capacity Building (Soft and Technical)	○	○	○	○	○
Employees' Engagement	○	○	○	○	○
Employees' Motivation and Compensation	○	○	○	○	○
Fringe Benefits	○	○	○	○	○
Annual Employee Hiring and Turnover	○	○	○	○	○
Employees' Representation on Corporate Board of Directors	○	○	○	○	○
Diversity and Equal Opportunity (Gender/ Age/ Ethnicity)	○	○	○	○	○
Disabled Employees	○	○	○	○	○
Appropriate Physical Working Conditions	○	○	○	○	○
Appropriate Working Hours	○	○	○	○	○
Labour Law Compliance	○	○	○	○	○
Loss time injury Frequency Rate	○	○	○	○	○
Injury and Occupational Diseases Records	○	○	○	○	○

Engineering Control, Personnel Protective Equipment and Clothes	○	○	○	○	○
Safety Inspection/ Audits	○	○	○	○	○
Emergency Plans	○	○	○	○	○
Safety Orientation and Advanced Safety Training	○	○	○	○	○
Safety Warning Signs	○	○	○	○	○
Workplace First Aids (Boxes/Rooms/Kits)	○	○	○	○	○
Workers Covered by Occupational Health and Safety Management System	○	○	○	○	○
Hazard and Operability Study (HAZOP)	○	○	○	○	○
Safety Committee	○	○	○	○	○
Local Hiring Practice	○	○	○	○	○
Community Funding and Support	○	○	○	○	○
Company-Community Relations	○	○	○	○	○
Product Stewardship	○	○	○	○	○

Anti-bribery and Corruption Policy	○	○	○	○	○
Business Codes of Conduct	○	○	○	○	○

Q3.6 Do you have any suggestions to add/exclude/modify any of the social key performance indicators from the above list?

Q3.7 From your professional point of view to what extent can the key performance indicators which are listed above improve companies' performance through the following aspects?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1- Reducing air emissions, oil leakage, water withdraw, water discharge and solid wastes	○	○	○	○	○
2- Considering energy efficiency, environmentally friendly practices and environmental policy and management system	○	○	○	○	○
3- Supporting innovations, investments, quality, less risks, local content and government-business relationship	○	○	○	○	○
4- Appreciating employees' rights and occupational health and safety	○	○	○	○	○
5-Respecting community, society and business ethics	○	○	○	○	○
6-Achieving growth, better performance and profitability	○	○	○	○	○

Section (IV)

Q4.1 From your professional perspective to what extent can following the developed model lead companies to follow the consecutive procedures?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Selecting the appropriate key performance indicators.	○	○	○	○	○
2. Carrying out simulation phases.	○	○	○	○	○
3. Setting sustainable strategy.	○	○	○	○	○
4. Considering the company's resources.	○	○	○	○	○
5. Communicating with employees.	○	○	○	○	○
6. Convincing top managers with sustainable vision.	○	○	○	○	○

Q4.2 Do you have any suggestions to add/exclude/modify any of the previous procedures, steps and process?

Q4.3 From your professional opinion to what extent can following developed model minimise the following barriers that companies are expected to encounter?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	○	○	○	○	○
1. Insufficient Financial resources and efforts.	○	○	○	○	○
2. Absence of management support.	○	○	○	○	○
3. Limited awareness of the sustainability theme.	○	○	○	○	○
4. Internal communication deficiency.	○	○	○	○	○
5. Inappropriate identifying the of the key performance indicators.	○	○	○	○	○
6. Lake of transparency.	○	○	○	○	○

Q4.4 Do you have any suggestions to add/exclude/modify to any of the preceding barriers?

Q4.5 Based on your professional experience, please indicate to what extent can following developed model lead to the subsequent benefits that the company can achieve?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.Supporting the company to be green.	○	○	○	○	○
2.Extending the company’s social awareness.	○	○	○	○	○
3.Enhancing the company’s profitability.	○	○	○	○	○
4. Promoting the company’s performance.	○	○	○	○	○
5. Monitoring the sustainability progress.	○	○	○	○	○
6. Increasing trust and transparency.	○	○	○	○	○
7. Increasing employee’s safety.	○	○	○	○	○
8. Drawing attention of employees and investors.	○	○	○	○	○
9. Improving Company’s reputation.	○	○	○	○	○

Q4.6 Do you have any suggestions to add/exclude/modify any of the previously mentioned benefits?

Q4.7 From your professional point of view to what extent can following developed model lead to these drawbacks which companies can face?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.Commitment on the company	○	○	○	○	○
2. Cost	○	○	○	○	○

Q4.8 Do you have any suggestions to add/exclude/modify any of the above-listed drawbacks?

Q4.9 Based on your professional point of view, to what extent is there a relationship between the previous procedure's fulfilment, barriers avoidances, benefits achievements in addition to drawbacks minimisation and companies' performance?

- ○ Strongly Disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree.

<u>Section (V)</u>

Q5.1 Do you wish to add any further points?

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Appendix 11: Ethics Forms Approval

The University of Huddersfield
Business School Research Ethics Committee

Reviewer Proforma

Project Title:	Developing a comprehensive performance measurement model of sustainability for oil refining sector
Name of researcher (s):	Dina Essam Hassan Roshdy Tamazin
Supervisor (where appropriate):	Nicoleta Tipi Sahar Valadi
Reviewer name	Joanna Szulc
Date sent to reviewer	25/11/19
Target date for review	09/12/19

Issue	**Advice / Comments to applicant**
Aim / objectives of the study	Clear
Research methodology	Suitable
Permissions for study?	Satisfactory
Participants	Satisfactory
Access to participants	Satisfactory
How will your data be recorded and stored?	Satisfactory
Confidentiality	Satisfactory
Anonymity	Satisfactory
Could the research induce psychological stress or anxiety, cause harm or negative consequences for the participants (beyond the risks encountered in normal life).	Not to my knowledge
Retrospective applications	N/A
Supporting documents (e.g., questionnaire, interview schedule, letters etc.)	Satisfactory
Other comments	I am happy to approve.

References

American Petroleum Institute , A. P. I. (2017). *Workplace Injuries and Illnesses Safety (WIIS) Report*. Retrieved from: https://www.api.org/-/media/files/publications/ api_workplacesafetyreport_2017.pdf. Accessed on: 2/8/2018.

Council of Supply Chain Management Professionals, (2022). Retrieved from https://cscmp.org. Accessed on: 15/1/2022.

ABB. (2011). *Enhancing Productivity and Energy Efficiency of Oil Refineries, Terminals and Downstream Complexes*. Retrieved from: https://library.e.abb.com/public/5db14a2de51a36efc1257a7000336958/Refinin g%20and%20PetroChem_lo.pdf. Accessed on: 5/8/2016.

Abubakr, M., Abbas, A. T., Tomaz, I., Soliman, M. S., Luqman, M., & Hegab, H. (2020). Sustainable and Smart Manufacturing: An Integrated Approach. *Sustainability, 12*(6). doi:10.3390/su12062280.

Ageron, B., Gunasekaran, A., & Spalanzani, A. (2012). Sustainable Supply Management: An Empirical Study. *International Journal of Production Economics, 140*(1), 168-182. doi:10.1016/j.ijpe.2011.04.007.

Aghelie, A. (2017). Exploring Drivers and Barriers to Sustainability Green Business Practices within Small Medium Sized Enterprises: Primary Findings. *International Journal of Business and Economic Development, 5*(1), 41-48.

Ahi, P., Jaber, M. Y., & Searcy, C. (2016). A Comprehensive Multidimensional Framework for Assessing The Performance of Sustainable Supply Chains. *Applied Mathematical Modelling, 40*(23-24), 10153-10166. doi:10.1016/j.apm.2016.07.001.

Ahi, P., & Searcy, C. (2015). An Analysis of Metrics Used to Measure Performance in Green and Sustainable Supply Chains. *Journal of Cleaner Production, 86*(8), 360-377. doi:10.1016/j.jclepro.2014.08.005.

Ahmad, N. K. W., de Brito, M. P., Rezaei, J., & Tavasszy, L. A. (2016). An Integrative Framework for Sustainable Supply Chain Management Practices in the Oil and Gas Industry. *Journal of Environmental Planning and Management, 60*(4), 577-601. doi:10.1080/09640568.2016.1178105.

Al-tarawneh, R. T., & Al-Shourah, A. A. (2018). The Impact of Supply Chain Management and Manufacturing Flow Management Practices on Competitive Advantage of Jordanian Industry. *European Journal of Scientific Research, 148*(3), 394-407.

Alyavina, E., Nikitas, A., & Tchouamou Njoya, E. (2020). Mobility as a Service and Sustainable Travel Behaviour: A Thematic Analysis Study. *Transportation Research Part F: Traffic Psychology and Behaviour, 73*(2000), 362-381. doi:10.1016/j.trf.2020.07.004.

Andalib Ardakani, D., & Soltanmohammadi, A. (2019). Investigating and Analysing the Factors Affecting the Development of Sustainable Supply Chain Model in the Industrial Sectors. *Corporate Social Responsibility and Environmental Management, 26*(1), 199-212. doi:10.1002/csr.1671.

Anderson, C. L., & Bieniaszewska, R. L. (2005). The Role of Corporate Social Responsibility in an Oil Company's Expansion into New Territories. *Corporate Social Responsibility and Environmental Management, 12*(1), 1-9. doi:10.1002/csr.71.

Ashby, A., Wilding, R., Leat, M., & Hudson-Smith, M. (2012). Making Connections: A Review of Supply Chain Management and Sustainability Literature. *Supply Chain Management: An International Journal, 17*(5), 497-516. doi:10.1108/13598541211258573.

Asmelash, E., & Gorini, R. (2021). *InternatIonal Oil Companies and the Energy TranstIon*. Retrieved from: https://www.irena.org/-/media/Irena/Files/Technical-papers/IRENA_Oil_Companies_Energy_Transition_2021.pdf?rev=4288dbec90dc4acdbc8cb4ac009b8331. Accessed on: 20/6/2022.

Ayers, J. B. (2000). *Handbook of Supply Chain Management* (1st Ed.), CRC Press.

Azzuni, A., & Breyer, C. (2017). Definitions and Dimensions of Energy Security: A Literature Review. *Wiley Interdisciplinary Reviews: Energy and Environment, 7*(1), 2041-8396. doi:10.1002/wene.268.

Barata, J., Quelhas, O., Costa, H., Gutierrez, R., de Jesus Lameira, V., & Meiriño, M. (2014). Multi-Criteria Indicator for Sustainability Rating in Suppliers of the Oil and Gas Industries in Brazil. *Sustainability, 6*(3), 1107-1128. doi:10.3390/su6031107.

Barforoush, N., Etebarian, A., Naghsh, A. R., & Shahin, A. (2020). A Dynamic Modeling for Green Business Development in Oil Refining Industry. *Global Journal of Environmental Science and Management, 6*(2), 233-244. doi:10.22034/gjesm.2020.02.08.

Beamon, B. M. (1999). Measuring Supply Chain Performance. *International Journal of Operations & Production Management, 19*(3), 275-292. doi:10.1108/01443579910249714.

Balfaqih, H., Nopiah, Z. M., Saibani, N., & Al-Nory, M. T. (2016). Review of Supply Chain Performance Measurement Systems: 1998–2015. *Computers in Industry*, 82(16), 135-150.

Bello, D. (2020). Cost Reduction and Sustainable Business Practices; A Conceptual Approach. *Journal of Economics and Administrative Sciences, 26*(118), 78-87.

Beske-Janssen, P., Johnson, M. P., & Schaltegger, S. (2015). 20 Years of Performance Measurement in Sustainable Supply Chain Management – What has Been Achieved? *Supply Chain Management: An International Journal, 20*(6), 664-680. doi:10.1108/scm-06-2015-0216.

Borgne, S. L., & Quintero, R. (2003). Biotechnological Processes for the Refining of Petroleum. *Fuel Processing Technology, 81*(2), 155-169. doi:10.1016/s0378-3820(03)00007-9.

Boukherroub, T., Ruiz, A., Guinet, A., & Fondrevelle, J. (2015). An Integrated Approach for Sustainable Supply Chain Planning. *Computers & Operations Research, 54*(7), 180-194. doi:10.1016/j.cor.2014.09.002.

Brockhaus, S., Fawcett, S., Kersten, W., & Knemeyer, M. (2016). A Framework for Benchmarking Product Sustainability Efforts. *Benchmarking: An International Journal, 23*(1), 127-164. doi:10.1108/bij-09-2014-0093.

Carew, D., Ogletree, C., Gonzalez, G., & Bozick, R. (2017). *Developing a Skilled Workforce for the Oil and Natural Gas Industry: An Analysis of Employers and Colleges in Ohio, Pennsylvania and West Virginia*. Retrieved from: https://www.rand.org/content/dam/rand/pubs/research_reports/RR2100/RR2199/RAND_RR2199.pdf. Accessed on: 3/4/2018.

Chan, F. T. S., & Qi, H. J. (2003). An Innovative Performance Measurement Method for Supply Chain Management. *Supply Chain Management: An International Journal, 8*(3), 209-223. doi:10.1108/13598540310484618.

Chan, F. T. S., Qi, H. J., Chan, H. K., Lau, H. C. W., & Ip, R. W. L. (2003). A Conceptual Model of Performance Measurement for Supply Chains. *Management Decision, 41*(7), 635-642. doi:10.1108/00251740310495568.

Costache, C., Dumitrascu, D.-D., & Maniu, I. (2021). Facilitators of and Barriers to Sustainable Development in Small and Medium-Sized Enterprises: A Descriptive Exploratory Study in Romania. *Sustainability, 13*(6), 3213-3232. doi:10.3390/su13063213.

de Waal, A., & Kourtit, K. (2013). Performance Measurement and Management in Practice. *International Journal of Productivity and Performance Management, 62*(5), 446-473. doi:10.1108/ijppm-10-2012-0118.

Delai, I., & Takahashi, S. (2011). Sustainability Measurement System: A Reference Model Proposal. *Social Responsibility Journal, 7*(3), 438-471. doi:10.1108/17471111111154563.

Diya'uddeen, B. H., Daud, W. M. A. W., & Abdul Aziz, A. R. (2011). Treatment Technologies for Petroleum Refinery Effluents: A review. *Process Safety and Environmental Protection, 89*(2), 95-105. doi:10.1016/j.psep.2010.11.003.

Ebrahimi, S. M., Koh, S. C. L., Genovese, A., & Kumar, N. (2018). Structure-Integration Relationships in Oil and Gas Supply Chains. *International Journal of Operations & Production Management, 38*(2), 424-445. doi:10.1108/ijopm-02-2016-0089.

US Energy Information Administration, (2022). Retrieved from: https://www.eia.gov/outlooks/aeo/IIF_carbonfee/pdf/carbon_fee_analysis.pdf. Accessed on: 3/7/2022.

Elhuni, R. M., & Ahmad, M. M. (2017). Key Performance Indicators for Sustainable Production Evaluation in Oil and Gas Sector. *Procedia Manufacturing, 11*(2), 718-724. doi:10.1016/j.promfg.2017.07.172.

Emam, E. A. (2015). Gas Flaring in Industry: An Overview. *Petroleum & Coal, 57*(5), 532-555.

Emerson Electric Co. (2010). *Smart Refinery Process Managment*. Retrieved from https://www.emerson.com/documents/automation/article-smart-refinery-en-37750.pdf. Accessed on: 4/8/2016.

Energy, Office of Oil and Natural Gas. (2020). *Providing Energy Security and Supporting Our Quality of Life*. Retrieved from: https://www.energy.gov/sites/prod/files/2020/10/f79/Natural%20Gas%20Benefits%20Report.pdf. Accessed on:5/2/2021.

Erol, I., Sencer, S., & Sari, R. (2011). A New Fuzzy Multi-criteria Framework for Measuring Sustainability Performance of a Supply Chain. *Ecological Economics, 70*(6), 1088-1100. doi:10.1016/j.ecolecon.2011.01.001.

Estampe, D., Lamouri, S., Paris, J.-L., & Brahim-Djelloul, S. (2013). A Framework for Analysing Supply Chain Performance Evaluation Models. *International Journal of Production Economics, 142*(2), 247-258. doi:10.1016/j.ijpe.2010.11.024.

ExxonMobil. (2017). *2017 Sustainability Report Highlights*. Retrieved from: https://corporate.exxonmobil.com/-/media/global/files/sustainability-report/publication/2017-sustainability-report.pdf. Accessed on: 11/9/2019.

Eyayo, F. (2014). Evaluation of Occupational Health Hazards among Oil Industry Workers: A Case Study of Refinery Workers. *IOSR Journal of Environmental Science, Toxicology and Food Technology, 8*(12), 22-53. doi:10.9790/2402-081212253.

Fisher, N. I. (2021). Performance Measurement: Issues, Approaches and Opportunities. *Harvard Data Science Review, 3*(4), 2644-2353. doi:10.1162/99608f92.c28d2a68.

George, R. A., Siti-Nabiha, A. K., Jalaludin, D., & Abdalla, Y. A. (2016). Barriers to and Enablers of Sustainability Integration in the Performance Management Systems of an Oil and Gas Company. *Journal of Cleaner Production, 136*(7), 197-212. doi:10.1016/j.jclepro.2016.01.097.

GLAS, D. (2017). *Oil and Gas Forecast to 2050*. Retrieved from: https://www.ourenergypolicy.org/wp-content/uploads/2017/09/DNV-GL_Energy-Transistion-Outlook-2017_oil-gas_lowres-single_3108_3.pdf. Accessed on: 2/3/2018.

Gong, M., Simpson, A., Koh, L., & Tan, K. H. (2018). Inside Out: The Interrelationships of Sustainable Performance Metrics and its Effect on Business Decision Making: Theory and Practice. *Resources, Conservation and Recycling, 128*(13), 155-166. doi:10.1016/j.resconrec.2016.11.001.

Gossen, L. P., & Velichkina, L. M. (2006). Environmental Problems of the Oil-and-Gas Industry (Review). *Petroleum Chemistry, 46*(2), 67–72.

Guivarch, C., & Monjon, S. (2017). Identifying the Main Uncertainty Drivers of Energy Security in a Low-carbon World: The Case of Europe. *Energy Economics, 64*(11), 530-541. doi:10.1016/j.eneco.2016.04.007.

Gunasekaran, A., & Spalanzani, A. (2012). Sustainability of Manufacturing and Services: Investigations for Research and Applications. *International Journal of Production Economics, 140*(1), 35-47. doi:10.1016/j.ijpe.2011.05.011.

Güney, T. (2019). Renewable Energy, Non-renewable Energy and Sustainable Development. *International Journal of Sustainable Development & World Ecology, 26*(5), 389-397. doi:10.1080/13504509.2019.1595214.

Hamzah, N. F., & Hasim, M. S. (2019). The Benefits of Sustainable Practices to Existing Buildings: Perception of Local Authorities in Malaysia. *International Journal of Academic Research in Business and Social Sciences, 9*(2), 1100-1107. doi:10.6007/IJARBSS/v9-i2/5667.

Hasan, S. W., Ghannam, M. T., & Esmail, N. (2010). Heavy Crude Oil Viscosity Reduction and Rheology for Pipeline Transportation. *Fuel, 89*(5), 1095-1100. doi:10.1016/j.fuel.2009.12.021

Hasani, F., & Nabhani, N. (2016). Waste Management System in Petroleum Refinery. *International Journal of Advanced Biotechnology and Research (IJBR), 7*(3), 1446-1452.

Hegazy, K. (2015). *Egypt's Energy Sector: Regional Cooperation Outlook and Prospects of Furthering Engagement with the Energy Charter*. Retrieved from: https://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/Egypt_and_the_Charter.pdf. Accessed on: 28/9/2016.

Heini, O. (2007). *Designing a Generic Measure and Performance Indicator Model.* (M.Sc.). Universite De Geneve, Geneva. https://www.qualityoflifetechnologies.com/app/uploads/2017/06/Heini2007.pdf.

Hoggett, R., Bolton, R., Candelise, C., Kern, F., Mitchell, C., & Yan, J. (2014). Supply Chains and Energy Security in a Low Carbon Transition. *Applied Energy, 123*(8), 292-295. doi:10.1016/j.apenergy.2014.02.008.

Hristov, I., & Chirico, A. (2019). The Role of Sustainability Key Performance Indicators (KPIs) in Implementing Sustainable Strategies. *Sustainability, 11*(20), 5742-5761. doi:10.3390/su11205742.

Hu, G., Li, J., & Zeng, G. (2013). Recent development in the Treatment of Oily Sludge from Petroleum Industry: A Review. *J Hazard Mater, 261*(6), 470-490. doi:10.1016/j.jhazmat.2013.07.069.

Ibeawuchi, I. V. (2016). *Environmental Impact Assessment of Oil and Gas Industry in Niger Delta, Nigeria: A Critical Environmental and Legal Framework Assessment.* (M.Sc.). Dalhousie University, Halifax, Nova Scotia. https://dalspace.library.dal.ca/bitstream/handle/10222/72070/Iheriohanma-Valerian-MASC-Enve-August-2016.pdf?sequence=1&isAllowed=y.

International Petroleum Industry Environment Conservation Association, (2008). *Guide to Successful, Sustainability Social Investment for Oil and Gas Industry.* Retrieved from: https://www.cdacollaborative.org/wp-content/uploads/2016/02/ Guide-to-Successful-Sustainable-Social-Investment-for-the-Oil-and-Gas-Industry.pdf. Accessed on: 26/5/2015.

International Petroleum Industry Environmental Conservation. (2014). *Petroleum refinery waste management and minimization: An IPIECA Good Practice Guide*. Retrieved from: https://www.ipieca.org/resources/petroleum-refinery-waste-management-and-minimization. Accessed on: 24/8/2016.

International Petroleum Industry Environment Conservation Association, (2017). *Mapping the Oil and Gas Industry to the Sustainable Development Goals: An Atlas Executive*. Retrieved from: https://www.ipieca.org/resources/mapping-the-oil-and-gas-industry-to-the-sustainable-development-goals-an-atlas. Accessed on: 8/3/2018.

Irhoma, A. (2017). *Development of a Sustainability Management System for Petroleum Companies.* (PhD). Nottingham Trent University. https://irep.ntu.ac.uk/id/eprint/31872/1/PhD%20Thesis%20Ammar%20Irhoma.pdf.

Kalinina, O., Lisitsa, S., Levina, A., & Lepekhin, A. (2019). Supply-chain Management in the Oil Industry. *E3S Web of Conferences, 110*(4)*, 2061-2071*. doi:10.1051/e3sconf/201911002061.

Karimi, E., & Rafiee, M. (2014). Analysing the Impact of Supply Chain Management Practices on Organisational Performance through Competitive Priorities (Case Study: Iran Pumps Company). *International Journal of Academic Research in Accounting, Finance and Management Sciences, 4*(1),1-21. doi:10.6007/IJARAFMS/v4-i1/503.

Kazemi, Y. (2016). *Modeling the Petroleum Supply Chain: Mulimodal Transportation, Disruptions and Mitlgation Strategies.* (PhD). North Dakota State University of Agriculture and Applied Science, USA. https://core.ac.uk/download/pdf/211306141.pdf.

Kliestik, T., & Vidrova, Z. (2020). Supply Chain Management in the Aspect of Globalization. *SHS Web of Conferences, 74*(3)*, 4031-4041*. doi:10.1051/shsconf/20207404031.

Kumar, R. M. M., Karthick, R. B., Bhuvaneswari, V., & Nandhini, N. (2017). Study on Occupational Health and Diseases in Oil Industry. *International Research Journal of Engineering and Technology (IRJET), 4*(12), 954-958.

Kweku, D., Bismark, O., Maxwell, A., Desmond, K., Danso, K., Oti-Mensah, E., . . . Adormaa, B. (2018). Greenhouse Effect: Greenhouse Gases and Their Impact on Global Warming. *Journal of Scientific Research and Reports, 17*(6), 1-9. doi:10.9734/jsrr/2017/39630.

Labib, S., & Hun, G. (2010). *Oil & Gas Opportunities in Egypt*. Retrieved from: google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjcvKev_IaEAxVT1QIHHWX2CjcQFnoECBoQAQ&url=https%3A%2F%2Fs3.amazonaws.com%2FStagingContentBucket%2Fpdf%2F20100921112705.pdf&usg=AOvVaw3oTRf0Hbf7ZxgGHV6eKAvA&opi=89978449 Accessed on: 6/7/2016.

Langlois, A., & Chauvel, B. (2017). The Impact of Supply Chain Management on Business Intelligence. *Journal of Intelligence Studies in Business, 7*(2), 51-61.

Lehner, S., & Eyssen, S. H. v. (2017). *Overcoming of Barriers to Environmental Sustainability for SMEs: What Makes Ecopreneurs Different?* (MSc.). Uppsala University. https://www.diva-portal.org/smash/get/diva2:1114268/FULLTEXT01.pdf.

Li, H., Dong, K., Sun, R., Yu, J., & Xu, J. (2017). Sustainability Assessment of Refining Enterprises Using a DEA-Based Model. *Sustainability, 9*(4), 620-635. doi:10.3390/su9040620.

Lima, C., Relvas, S., & Barbosa-Póvoa, A. P. F. D. (2016). Downstream Oil Supply Chain Management: A Critical Review and Future Directions. *Computers & Chemical Engineering, 92*(6), 78-92. doi:10.1016/j.compchemeng.2016.05.002.

Liu, Y., Lu, S., Yan, X., Gao, S., Cui, X., & Cui, Z. (2020). Life Cycle Assessment of Petroleum Refining Process: A Case Study in China. *Journal of Cleaner Production, 256*(5)*, 120422-120432*. doi:10.1016/j.jclepro.2020.120422.

Lu, L. X., & Swaminathan, J. M. (2015). Supply Chain Management. *International Encyclopedia of Social and Behavioral Sciences, 23*(8), 709-713. doi:10.1016/B978-0-08-097086-8.73032-7.

Mahmood, Z., Ali, W., Iqbal, J., & Fatima, S. (2019). Drivers and Barriers of Sustainability Practices in Emerging and Developing Economies. *Journal of Business and Social Review in Emerging Economies, 5*(1), 213-222. doi:10.26710/jbsee.v5i1.683

Manzano, F. S. (2005). *Supply Chain Practices in the Petroleum Downstream.* (Master of Engineering in Logistics). Massachusetts Institute of Technology. https://dspace.mit.edu/bitstream/handle/1721.1/33345/62395452-MIT.pdf;sequence2.

Martínez-Palou, R., Mosqueira, M. d. L., Zapata-Rendón, B., Mar-Juárez, E., Bernal-Huicochea, C., de la Cruz Clavel-López, J., & Aburto, J. (2011). Transportation of Heavy and Extra-heavy Crude Oil by Pipeline: A Review. *Journal of Petroleum Science and Engineering, 75*(3-4), 274-282. doi:10.1016/j.petrol.2010.11.020.

MathPro. (2011). *An Introduction to Pettroleum Refining and the Production of Ultra Low Sulfur Gasoline and Diesel Fuel*. Retrieved from: https://theicct.org/sites/default/files/publications/ICCT05_Refining_Tutorial_FINAL_R1.pdf. Accessed on: 4/6/2015.

McDougall, N., Wagner, B., & MacBryde, J. (2021). Leveraging Competitiveness from Sustainable Operations: Frameworks to Understand the Dynamic Capabilities Needed to Realise NRBV Supply Chain Strategies. *Supply Chain Management: An International Journal, 27*(1), 12-29. doi:10.1108/scm-11-2018-0393.

Menhat, M. N. S. (2017). *Performance Measurement Framework for the Oil and Gas Supply Chain.* (PhD). University of Central Lancashire. https://core.ac.uk/download/pdf/161125133.pdf.

Al-Thukair, A. A. (2009). Environmental Assessments in the Oil and Gas Industry. *Water, Air, & Soil Pollution: Focus*, 9(1), 99-105. doi:10.1007/s11267-008-9190-x.

Mojarad, A. A. S., Atashbari, V., & Tantau, A. (2018). Challenges for Sustainable Development Strategies in Oil and Gas Industries. *Proceedings of the International Conference on Business Excellence, 12*(1), 626-638. doi:10.2478/picbe-2018-0056.

Moro, L. F. L. (2003). Process Technology in the Petroleum Refining Industry—Current Situation and Future Trends. *Computers & Chemical Engineering, 27*(8-9), 1303-1305. doi:10.1016/s0098-1354(3)00054-1.

Moullin, M. (2007). Performance Measurement Definitions: Linking Performance Measurement and Organisational Excellence. *Int J Health Care Qual Assur, 20*(2-3), 181-183. doi:10.1108/09526860710743327.

Negro, P. A., & Vargas, A. (2019). *Driving Organisational Culture Change for Sustainability.* (Master of Arts). MALMO University. https://www.diva-portal.org/smash/get/diva2:1481637/FULLTEXT01.pdf.

Nicolescu, A. C., & Burta, F. S. (2020). Corporate Decision-making: The Increasing Importance of Supply Chain in Strategic Decision-making. *Journal of Economic and Social Development*, 7(1), 17-24.

Niţă, C. G., & Ştefea, P. (2014). Cost Control for Business Sustainability. *Procedia - Social and Behavioral Sciences, 124*(6), 307-311. doi:10.1016/j.sbspro.2014.02.490.

Nordin, N., Ashari, H., & Hassan, M. G. (2014). *Drivers and Barriers in Sustainable Manufacturing Implementation in Malaysian Manufacturing Firms*. https://www.researchgate.net/publication/283124161_Drivers_and_barriers_in_sustainable_manufacturing_implementation_in_Malaysian_ manufacturing_firms.

Nosratabadi, S., Mosavi, A., Shamshirband, S., Kazimieras Zavadskas, E., Rakotonirainy, A., & Chau, K. W. (2019). Sustainable Business Models: A Review. *Sustainability, 11*(6), 1663-1694. doi:10.3390/su11061663.

Organization of Arab Petroleum Exporting Countries. (2020). *Annual Statistical Report*. Retrieved from: https://www.oapecorg.org/Home/Publications/Reports/Annual-Statistical-report. Accessed on: 24/5/2021.

Olawuyi, D. (2017). *Local Content and Procurement Requirements in Oil and Gas Contracts*. Retrieved from: https://www.oxfordenergy.org/wpcms/wp-content/uploads/2017/11/Local-content-and-procurement-requirements-in-oil-and-gas-contracts-regional-trends-in-the-Middle-East-and-North-Africa-MEP-18.pd. Accessed on: 4/7/2019.

Panwar, N. L., Kaushik, S. C., & Kothari, S. (2011). Role of Renewable Energy Sources in Environmental Protection: A Review. *Renewable and Sustainable Energy Reviews, 15*(3), 1513-1524. doi:10.1016/j.rser.2010.11.037.

Parast, M. M., & Adams, S. G. (2012). Corporate Social Responsibility, Benchmarking and Organisational Performance in the Petroleum Industry: A Quality Management Perspective. *International Journal of Production Economics, 139*(2), 447-458. doi:10.1016/j.ijpe.2011.11.033.

Prioleau, T. K. (2003). *Environmental Impact of the Petroleum Industry*. Retrieved from: https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.files/fileID/14522. Accesssed on:8/9/2015.

Putri, Y. D., Huda, L. N., & Sinulingga, S. (2019). The Concept of Supply Chain Management Performance Measurement with the Supply Chain Operation Reference Model (Journal review). *IOP Conference Series: Materials Science and Engineering, 505*(1). doi:10.1088/1757-899x/505/1/012011.

Rajeev, A., Pati, R. K., Padhi, S. S., & Govindan, K. (2017). Evolution of Sustainability in Supply Chain Management: A Literature Review. *Journal of Cleaner Production, 162*(8), 299-314. doi:10.1016/j.jclepro.2017.05.026.

Rajović, V., Kiss, F., Maravić, N., & Bera, O. (2016). Environmental Flows and Life Cycle Assessment of Associated Petroleum Gas Utilization via Combined Heat and Power Plants and Heat Boilers at Oil Fields. *Energy Conversion and Management, 118*(7), 96-104. doi:10.1016/j.enconman.2016.03.084.

Ramanathan, V., & Feng, Y. (2009). Air Pollution, Greenhouse Gases and Climate Change: Global and Regional Perspectives. *Atmospheric Environment, 43*(1), 37-50. doi:10.1016/j.atmosenv.2008.09.063.

Ramezankhani, M. J., Torabi, S. A., & Vahidi, F. (2018). Supply Chain Performance Measurement and Evaluation: A Mixed Sustainability and Resilience Approach. *Computers & Industrial Engineering, 126*(6), 531-548. doi:10.1016/j.cie.2018.09.054.

Raut, R. D., Narkhede, B., & Gardas, B. B. (2017). To Identify the Critical Success Factors of Sustainable Supply Chain Management Practices in the Context of Oil and Gas Industries: ISM approach. *Renewable and Sustainable Energy Reviews, 68*(5), 33-47. doi:10.1016/j.rser.2016.09.067.

Sánchez-Flores, R. B., Cruz-Sotelo, S. E., Ojeda-Benitez, S., & Ramírez-Barreto, M. E. (2020). Sustainable Supply Chain Management—A Literature Review on Emerging Economies. *Sustainability, 12*(17), 6972-6999. doi:10.3390/su12176972.

Santos, R. G., Loh, W., Bannwart, A. C., & Trevisan, O. V. (2014). An Overview of Heavy Oil Properties and its Recovery and Transportation Methods. *Brazilian Journal of Chemical Engineering, 31*(3), 571-590. doi:10.1590/0104-6632.20140313s00001853.

Schneider, J., Ghettas, S., Merdaci, N., Brown, M., & Martyniuk, J. (2013). Towards Sustainability in the Oil and Gas Sector: Benchmarking of Environmental, Health and Safety Efforts. *Journal of Environmental Sustainability, 3*(3), 103-117.

Searcy, C. (2011). Corporate Sustainability Performance Measurement Systems: A Review and Research Agenda. *Journal of Business Ethics, 107*(3), 239-253. doi:10.1007/s10551-011-1038-z.

Sen, P., Ray, P. K., & Ghosh, S. K. (2013). Environmental Performance Measurement and Evaluation for Manufacturing Organisations: A Review and Reflection. *In Proceedings of the International Conference on Managing the Asian Century*, 193-199.

Shah, N. K., Li, Z., & Ierapetritou, M. G. (2010). Petroleum Refining Operations: Key Issues, Advances and Opportunities. *Industrial & Engineering Chemistry Research, 50*(3), 1161-1170. doi:10.1021/ie1010004.

Sojinu, S. O., & Ejeromedoghene, O. (2019). Environmental Challenges Associated with Processing of Heavy Crude Oils. *Processing of Heavy rude Oils-Challenges and Opportuties, IntechOpen*, 241-260.

Stewart, R., Bey, N., & Boks, C. (2016). Exploration of the Barriers to Implementing Different Types of Sustainability Approaches. *Procedia CIRP, 48*(6), 22-27. doi:10.1016/j.procir.2016.04.063.

Stock, J. R., & Boyer, S. L. (2009). Developing a Consensus Definition of Supply Chain Management: A Qualitative Study. *International Journal of Physical Distribution & Logistics Management, 39*(8), 690-711. doi:10.1108/09600030910996323.

Sukati, I., Hamid, A. B., Baharun, R., & Yusoff, R. M. (2012). The Study of Supply Chain Management Strategy and Practices on Supply Chain Performance. *Procedia - Social and Behavioral Sciences, 40*(5), 225-233. doi:10.1016/j.sbspro.2012.03.185.

Szklo, A., & Schaeffer, R. (2007). Fuel Specification, Energy Consumption and CO2 Emission in Oil Refineries. *Energy, 32*(7), 1075-1092. doi:10.1016/j.energy.2006.08.008.

Tahouni, N., Gholami, M., & Panjeshahi, M. H. (2016). Integration of Flare gas with Fuel Gas Network in Refineries. *Energy, 111*(8), 82-91. doi:10.1016/j.energy.2016.05.055.

Tajbakhsh, A., & Hassini, E. (2015). Performance Measurement of Sustainable Supply Chains: A Review and Research Questions. *International Journal of Productivity and Performance Management, 64*(6), 744-783. doi:10.1108/ijppm-03-2013-0056.

Taouab, O., & Issor, Z. (2019). Firm Performance: Definition and Measurement Models. *European Scientific Journal ESJ, 15*(1), 1857-7881. doi:10.19044/esj.2019.v15n1p93.

United Nations Development Program (UNDP), (2015). *Sustaninable Development Goals*. Retrieved from : https://www.dev-practitioners.eu/media/key_documents/SDGs_Booklet_Web_En .pdf. Accessed on: 25/6/2016.

van der Vaart, T., & van Donk, D. P. (2008). A Critical Review of Survey-based Research in Supply Chain Integration. *International Journal of Production Economics, 111*(1), 42-55. doi:10.1016/j.ijpe.2006.10.011.

Veerapandian.K. (2010). *List of oil refineries*. Retrieved from: https://pdfcoffee.com/oil-and-gas-company-list-pdf -free.html. Accessed on: 18/3/2017.

Wan Ahmad, W. N., Rezaei, J., Tavasszy, L. A., & de Brito, M. P. (2016). Commitment to and Preparedness for Sustainable Supply Chain Management in the Oil and Gas Industry. *Journal of Environmental Management, 180*(5), 202-213. doi:10.1016/j.jenvman.2016.04.056.

Wan Ahmad, W. N. K., Rezaei, J., de Brito, M. P., & Tavasszy, L. A. (2016). The Influence of External Factors on Supply Chain Sstainability Goals of the Oil and Gas Industry. *Resources Policy, 4*(8)*9*, 302-314. doi:10.1016/j.resourpol.2016.06.006.

Wan Ahmad, W. N. K., Rezaei, J., Sadaghiani, S., & Tavasszy, L. A. (2017). Evaluation of the External Forces Affecting the Sustainability of Oil and Gas Supply Chain using Best Worst Method. *Journal of Cleaner Production, 153*(6), 242-252. doi:10.1016/j.jclepro.2017.03.166.

Wescott, W. A., Atta, M., & Dolson, J. C. (2016). *A Brief History of the Exploration History of the Gulf of Suez, Egypt*. Retrieved from: https://www.searchanddiscovery.com/pdfz/documents/2016/30473westcott/ndx_wescott.pdf.html Accesed on: 7/2/2017.

Winzer, C. (2012). Conceptualising Energy Security. *Energy Policy, 46*(3), 36-48. doi:10.1016/j.enpol.2012.02.067.

Yusuf, Y. Y., Gunasekaran, A., Musa, A., El-Berishy, N. M., Abubakar, T., & Ambursa, H. M. (2013). The UK Oil and Gas Supply Chains: An Empirical Analysis of Adoption of Sustainable Measures and Performance Outcomes. *International Journal of Production Economics, 146*(2), 501-514. doi:10.1016/j.ijpe.2012.09.021.

ZUNIC, T., & VLASIC, E. (2006). Performance Measurement Impact on Organisation Efficiency. *In Proceedings of the 3rd International Conference "An Enterprise Odyssey: Integration or Disintegration, Zagreb, Croatia*, 1503-1517.