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Development of an Asset Management Framework for the Oil and Gas Industry

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DECLARATION

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgement has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

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ABSTRACT

The key objective of this thesis was to improve asset management application performance through the development of an oil and gas industry-specific asset management system framework using a robust and detailed methodology that supported the thesis output. This objective is argued as being crucial, given that there is currently little empirical data regarding asset management systems in the oil and gas industry. The initial scoping research identified that there are very few publications that appropriately address asset management system. This thesis argues that the practitioners have not yet reached a consensus on the standard guidelines. Because of this lack of consensus, there has been poor implementation of asset management systems in organisations, which produces a clear gap in published and current research creating an opportunity for a unique and worthwhile contribution to this specific area. This research thesis aimed to explore specific challenges associated with asset management systems in oil and gas organisations, and to define and discuss viable solutions to develop a suitable framework that can be used by willing parties and organisations in the oil and gas sector to improve their currently underperforming asset management systems. This would provide an opportunity to progress and enhance this area within a high-value industry that provides vital energy sources. This study encompassed a qualitative methodology, including targeted sampling of 50 employees employed by three different organisations within the oil and gas industry. The interviews were planned and conducted between November 2014 and February 2015. The interviews contained structured questions whereby all interviewees were asked similar questions to see whether they had varied views on similar areas of concern. The interviews were conducted face-to-face and within the business premises of the involved participants. They lasted for an average of 45 minutes and responses were noted down on the interview transcripts.

The research was then validated via an organised focus group discussion held with two different groups of eight persons each. One group consisted of individuals drawn from the interviews. The other group consisted of individuals independent of the interviews. The problem statement and the proposed framework was reviewed. The focus groups were conducted between September 2018 and November 2018. The focus groups saw value in certain aspects of the framework that they suggested could help further develop this discipline to progress this area of weakness within the

industry. The thesis identified 12 themes and their overall contribution to the value of an organisation.

The results revealed key challenges that have been hindering a smooth and accurate application of asset management systems within oil and gas industry organisations. These are, first, an information security (identify, protect, detect, respond, and recover); second, information technology (IT) and disconnection between asset management inventory and the integration of systems; third, challenges in strategic objectives, project management (supplier, risk and procurement management, leadership governance, human resources management, and communication management); and fourth, challenges relating to IT business continuity strategies, governance and compliance, risk management, and IT disaster recovery plan.

The study thereafter revealed recommendations in order to aid development of asset management system based on the results and discussions. These were that IT business continuity and IT disaster recovery should be defined and implemented to govern business resilience practices and technology recovery operations. Business impact assessments should be conducted for the IT environment and be aligned to business resiliency requirements and expectations. Organisational communication and data flows should be mapped and external information systems catalogued. Risk assessments should be performed to identify the probability and likelihood of risks that may negatively influence business operations. A skills sizing review should be conducted across IT and a comprehensive fit gap analysis and roadmap provided to achieve the required level of competencies. To keep pace with the changing threat landscape, it was recommended that the cybersecurity strategy be updated and implemented regularly. Governance and risk management regarding cybersecurity should be addressed and mandated throughout the business. Assets (hardware and software) should be inventoried and managed through an automated asset management system. Organisations should also define clear key performance indicators and metrics to measure asset management system. Cybersecurity roles and responsibilities for the entire workforce and third parties (i.e. suppliers and customers) should be established, communicated and practiced. Incident response team section should be established to manage any security assets threats and restoration of the affected IT systems.

This study is important because it develops a pictorial framework that outlines strategies that should be implemented within the oil and gas sector to enhance and automate their currently underperforming asset management application structures.

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ABBREVIATIONS

AM	Asset management
AR	Action research
BCP	Business Continuity Plan
BIA	Business impact analysis
CMMS	Computerised maintenance management system
COBIT	Control objectives for information and related technology
DAM	Digital asset management
DRP	Disaster recovery plan
EAM	Enterprise asset management
ERP	Enterprise resource planning
FGD	Focus group discussion
IDMS	Integration and device management system
IDS	Intrusion detection systems
IS	Information security
ISACA	Information systems audit and control association
IT	Information technology
IRS	Intrusion response system
IRT	Incident response team
LCC	Life cycle cost
NIST	National Institute of Standards and Technology
OTP	Operational transformation program
PAM	Privilege access management
PAM	Plant asset management
PM	Project management
PPRA	Public Procurement Regulatory Authority
RAM	Reliability, availability, and maintainability
RCM	Reliability centred maintenance
R&D	Research and Development
RM	Risk Management
RPO	Recovery point objective
RTO	Recovery time objective
TQM	Total quality management

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Chapter 1: Introduction

1.1 Outline of the Problem

According to Davis (2014), an "asset" entails any tangible or intangible item that can be used to generate economic value for a business. All businesses own assets. However, these vary from establishment to establishment as every business has a unique economic orientation (DiMatteo, 2014). A textile manufacturing plant, for example, has a different economic orientation compared to that of a fast food restaurant. Hence, while the plant owns assets such as chemical purifiers, the restaurant will own ovens and cookers. As Jackson (2012) highlights, these assets are a core component of businesses today as they help generate monetary benefits for these establishments and form part of the key inputs of an organisation that are developed into outputs. Business assets go beyond physical infrastructure alone; they also encompass abstract components such as data, software, and virtual environments.

Data is an increasingly crucial business asset that is utilised by corporations today in obtaining market leverage (Koronios & Gao, 2013). Present-day companies, for example, are outsourcing market research data to learn about product performance, stock prices, and customer preferences, among many other factors. Therefore, it is evident that assets are highly integral constituents in a business establishment, and thus require optimal usage and maintenance. For businesses to be able to make the most out of their assets, they must be able to integrate and maintain competitive asset management practices in their day-to-day operations. The lack of management could result in lost or damaged assets that could have crippling impacts on any organisation.

Asset management is described by Kusumawardhani (2016) as a systematic process that facilitates efficient employment, operation, maintenance, and disposal of assets throughout their lifetime. These activities are geared towards ensuring both proper care and effective deployment of business assets; the sequence of these activities is important in collectively realising these goals within the context of organisational structures and resource constraints. According to Kusumawardhani and Markeset (2015), asset management is the procedure of maximising returns, where possible, by examining performance and making critical strategic decisions during every step of an asset's life cycle.

Lane et al. (2012) offer a different theory and suggest that asset management entails a stratagem geared towards effective asset usage and employment in a way that enables businesses to achieve optimal benefits from them before their economic life cycle lapses. Asset management entails a number of processes such as risk identification, maintenance planning and execution, and asset management compliance (ARC Advisory Group, 2014). The magnitude of the asset management debate has been discussed by academics including Bharadwaj, Silberschmidt, and Wintle (2012); El-Akruti and Dwight (2013); Horn and Granger (2013); and Jeeva and Baswaid (2014). These scholars emphasise that asset management is no longer just a theoretical concept, but is a widespread function in action within many corporations today. They argue that it is imperative for businesses to take note of asset management systems to enable them to manage their assets proficiently; thus, they will obtain optimal benefits and preserve them for future use. Preservation helps them save on costs of unnecessary purchases and frequent repairing expenses. This focus on preventative maintenance supports a higher level of reliability as a tangible return to an organisation.

Manufacturing plants, particularly oil and gas corporations, are increasingly being urged to ensure that their business processes are outfitted with efficient and planned asset management frameworks (Kongezos & Jellum, 2012). Indeed, it can be easily argued that oil and gas organisations ought to make the most of their assets to limit and control capital and operational costs, and boost overall performance. Organisations should be encouraged by the sources already present to frequently upgrade their asset management systems seeing as they are an asset-intensive industry. This industry is particularly engaged in the use of highly mechanical machines and drilling equipment, which can easily stall or become obsolete if not taken care of in the right manner. According to Woodhouse (2014), many operators in this industry are aware of the significance of asset management and have already taken steps to incorporate adept asset management frameworks in their businesses. They utilise these frameworks in the competitive management of their corporate assets such as oil treatment plants, pumping units, heating units, storage tanks, gas generators, metering systems, desalting plants, gas separators, and turbine expanders (Broussard, 2013). These are classed as high-level mechanical pieces of equipment because they are constantly involved and required within a lot of physical motions. This example

equipment experiences a lot of friction over time and, if uncared for, is bound to wear out at a very fast rate.

Fortunately, many companies are aware of the essence of asset management systems and have already begun implementing them in their business processes. However, the application of asset management systems appears to be hampered by a number of different challenges. These challenges relate to the non-integration of systems, government interventions, poor leadership, weak strategic procurement, business continuity, and supply chains (Efzan & Keshavanveraragu, 2014). There is also minimal literature and empirical research regarding how entities ought to employ these structures into their business frameworks. The apparent lack of literature on this topic is detrimental to new and established businesses who might want to learn more about asset management in this industry; thus, the need for solid theory development.

1.2 Justification for the Study

The main justification for carrying out this study is concentrated on the need to develop a suitable framework that will demonstrate better implementation of asset management systems. This framework is proposed to support the gaps in research identified within assets management in the oil and gas industry to enhance the reliability and sustainability of application. This attempts to eliminate the very real and ongoing challenges facing asset management in oil and gas organisations. Poor decision making, poor leadership, legislation irregularities, rigid political framework, non-integration of systems, and weak supply risks have been identified as restricting asset management procedures in many organisations. This thesis, therefore, aims to further investigate these challenges from the few secondary materials that exist as well as from a number of selected employees (research sample group) currently working within this industry. The study aims to reveal the key managerial challenges that are evident and found to be contributing to hindering the smooth application of asset management systems within this sector as well as finding solutions to these problems. The formal research problem in this study is: “How can oil and gas organisations improve the performance of their assets and contribute value to their organisations?” The answer to this question will be further clarified throughout the course of this study and through the discussion of the interview responses given by the interviewees, and then further validated within the secondary focus group sessions.

This study also aims to decrease the prevailing theoretical research gap that exists within the asset management academic sphere. The thesis will look to bring the public and extremal to industry attention to the challenges facing this sector. This spotlight of attention will hopefully encourage scientists, researchers, and even the state to launch more Research and Development (R&D) initiatives geared towards solving these issues and improving the current situation. The thesis can also be considered and employed by potential investors as well as business partners to gain more insight into the implementation of asset management frameworks. It may also double up as a manual or start guide for new entrants who are venturing into the oil and gas industry and would like to gain more knowledge on this area of concern, its challenges, and solutions.

1.3 Academic Significance – Theory Development

This section explains the contribution this study makes to the academic knowledge in this field. As implied above, asset management is currently argued as being in its initial developing stages, and an overview of existing literature shows that there is a tangible research gap. Despite already being implemented in various oil and gas platforms, there is little material explaining asset management implementation in this industry. The material that does exist is almost always presented as a guideline; thus, the few existing sources regarding asset management exist as basic information and never as detailed theory. These sources lack substantial theories from which to reference and, therefore, there is no common ground from which to offer a steady knowledge base. There is even less literature examining oil and gas asset management specifically and, therefore, this thesis aims to contribute towards bridging this gap. It carries out an intensive research study specifically focused on the challenges affecting asset management implementation in the oil and gas sector. It also administers face-to-face interview sessions with selected employees working in oil and gas organisations to hear their views and opinions on this area of concern. This is further developed within focus groups that take the full journey from the problem all the way to the proposed solution with for and against feedback based on the research solutions offered.

Thereafter, the thesis examines the interviewees' responses using the narrative approach to create a real and tangible output as well as utilising NVivo qualitative

software that helps the reader live the experience of the research and be able to truly interpret their attitudes and see where the problems really exist. The thesis then enlists the grounded theory methodology to extract information from the data results and develops concrete theory about challenges hindering asset management implementation and their solutions. This is then compared to the research focus groups answers and discussions to produce a robust research output that is supported by verifiable datasets. The thesis thus attempts to boost the ongoing comprehension of oil and gas asset management by offering empirical evidence and theoretical discussion. Additionally, thesis findings will also provide recommendation opportunities to future researchers.

1.4 Practical Significance – Capability Diagnosis

Due to the lack of academic literature in this field, there is a void in the provision of written guidelines on how to practically implement and facilitate asset management in contemporary oil and gas platforms. This thesis aims to offer beneficial results regarding practitioner guidelines for developing the most suitable and important capabilities in their organisation. Thus, this study attempts to help managers highlight the resources they need to solve these challenges and improve their asset management facilities. Managers must truly understand both the paper and operational value of the resources that allow for, or restrict, the advancement of critical capabilities. This can subsequently affect and influence the ability of firms to uphold and strategically maintain competitive advantages. The theoretical justification for the effective development of a capability model can also increase awareness regarding the importance of advancing the most appropriate elements of oil and gas asset management.

1.5 Research Objectives

This study has the following research objectives:

1) To determine the key managerial challenges hindering asset management in oil and gas organisations.
2) To develop a suitable framework that will demonstrate better implementation of asset management systems to eliminate these challenges.

1.6 Research Questions

The following are the research questions for this study:

1) What is the significance of asset management systems in the oil and gas sector?
2) What are the challenges currently facing the implementation of asset management systems in this sector?
3) How can these challenges be resolved or at least reduced?
4) What is the most ideal framework that can demonstrate better implementation of asset management systems in this sector?

1.7 Organisation of the Study

Following this Introduction chapter, the thesis is divided into six further chapters. The Literature Review is Chapter Two. This chapter provides an overview of secondary literature on asset management and demonstrates the identified gap in the literature. Chapter Three focuses on Methodology and discusses the procedures used in collecting and analysing the primary data from the study respondents and focus group returns. The Fourth Chapter is the Results chapter, which documents the responses of the interviewees in the form of italicised direct quotations to let the participants speak in their own voice. Chapter Five is the Discussion chapter, which breaks down and interprets the final data results by drawing out the various themes and sub-themes prevalent within the interviewees' responses, and then attaching meaning to them by corroborating them to the written literature listed in the Literature Review. The Sixth Chapter is the Validation of the Asset Management Framework, and this illustrates the results of the focus group discussions to develop the final proposed framework. The final chapter is the Conclusion, which is particularly concerned with determining whether the study succeeded in fulfilling the research objectives. If yes, then the study shall be successful; however, if not, then the study shall not be successful and those areas that made the study difficult should be mentioned for future improvements.

1.8 Chapter Summary

This chapter has introduced the aim of the thesis, which is to investigate the challenges facing the implementation of asset management, as well as developing a suitable framework that shall demonstrate better asset management implementation in oil and gas industry. Indeed, there have been several complaints identified within the

provisional research that originate from oil and gas organisations. These relate to the implementation of asset management in reality and how the practice is becoming increasingly difficult to uphold. Unless these challenges are resolved, this industry's operators and service companies will continue to have difficulties in managing their assets, which could result in increased operational costs and threaten future industry growth. Therefore, it is argued as a critical need to conduct a specific research study on these challenges in order to resolve them. The study aims to carry out a qualitative research study featuring face-to-face interview sessions and focus groups with regards to asset management systems.

Chapter 2: Literature Review

2.1 Introduction

This chapter provides an account on asset management based on what previous researchers have written, which presents, analyses, and critically discusses the available and relevant literature. The chapter addresses the issue of asset management within oil and gas organisations, particularly focusing on various factors such as the definition of asset management, background, purpose, core processes, current implementation, and types of asset management, benefits, and challenges. The chapter also identifies and discusses theoretical gaps in the current literature, outlining how deficient it is in addressing asset management implementation particularly within the oil and gas sector. The Literature Review concludes by examining various ways by which the oil and gas practitioners and/or organisations can add value to their currently underperforming asset management systems as well as enhance their skills in this field. This builds upon earlier discussions where it was evident that poorly managed assets reduce operational effectiveness as well as introduce problematic asset performance and reliability.

This chapter considers information from a wide array of secondary sources such as books, peer-reviewed journal articles, news reports, company reports, and research theses. This chapter also helps contribute to one of the main objectives for the study: theory development. The discussion of the purposes of asset management, current implementation, core processes, and its benefits, challenges, and solutions will help build knowledge on the current topic. Furthermore, addressing these areas will also help the researcher to answer the research questions listed in the previous chapter.

2.2 Purpose and Goals of Asset Management

The main goal and purpose of asset management involve utilising efficient employment, operation, maintenance, and upgrading of assets to attain maximum benefits from them during the course of their economic life (Davis, 2014). Businesses have begun appreciating the value of asset management and have integrated it within their departmental segments to preside over their assets (Bolton, Lemon, & Verhoef, 2004). The oil and gas industry has taken particular interest in the application of asset management, considering it as the perfect strategy in managing their corporate properties. This is argued as being a savvy decision, more so when one considers how

oil and gas organisations operate a huge volume of assets including oil treatment plants, pumping units, heating units, storage tanks, gas generators, metering systems, desalting plants, gas separators, and turbine expanders (Broussard, 2013). This equipment facilitates core business functions such as upstream gas exploration, mining, underwater drilling, refinery, and purification of the crude oil and natural gas into pure substances such as gasoline, oil lubricants, diesel oil, kerosene, and asphalt (El-Akruti & Dwight, 2013). However, this equipment is highly mechanical in nature and is always in constant physical motion. As their gears rub against each other, a lot of friction is produced along the joints, which could explain why this equipment starts wearing out in a short period after purchase. If not managed efficiently, the machineries burn out rapidly and longer-term investment becomes less of a reality (Komonen, Kortelainen, & Raikkoen, 2006).

Broussard (2013) points out that, once worn out, this equipment will become inoperable because the repair fees are too expensive, and thus requires a higher cost tempo to replace. This is further aggravated by the length of time this type of equipment needs with respect to lead order times. The operators are then forced to purchase new equipment, which may run into millions or potentially billions of dollars. For this reason, it is argued as critically important for oil and gas operators to implement a competitive and preventative asset management system to care for their physical inventories and prevent them from wearing out too fast. An organisation with an adept asset management system in place can avoid massive expenses incurred during downtime periods when their machinery breaks down and the operators are forced to either halt business on a temporary basis or close up shop entirely (Kolios & Luengo, 2016). As Jackson (2012) points out, the entire process involves a wide range of processes such as mechanical integrity, data management, equipment inspection, corrosion prevention, risk evaluation, procedure safety, metallurgy, machinery maintenance, and operational support. Brogan (2014) adds that the end objective of these processes is to efficiently care for the corporate assets operated by the oil and gas sector to get the best out of these infrastructures in terms of valuation, low operation expenses, low maintenance, high returns, and massive profitability potential. Not only do these processes work to gain maximal value of this equipment, but they also ensure that the human workforce, the surrounding society, as well as the environment are protected against potential risks such as oil spills in the oceans,

blowouts, volatile gas emissions, and personal injuries resulting from handling the heavy machinery (Horn & Granger, 2013). Some asset management systems are advanced to the extent of being able to identify potential risks or breakdowns prior to their occurrence (Broussard, 2013). With such predictions, the oil and gas industry can effectively avoid catastrophes and increase its productivity. Lin, Gao and Koronios (2007) also offer the theory that this helps to improve data capture on asset performance parameters that assists in future operational planning. The more asset data available, the better an organisation can plan ahead in respect to investment beyond a realistic life expectancy for an asset based on detailed data capture points.

Asset management also ensures that the oil and gas operators fully comply with the environmental regulations imposed by the state. As Jeeva and Baswaid (2014) highlighted, the environmental and operational regulations imposed on the oil and gas industry have been very rigid in recent years owing to several hazards perpetrated within this industry such as the oil spill in the Gulf of Mexico on 22 April, 2010. This oil spill, despite being unintentional, was the cause of complications that ranged from thousands of deaths of sea animals, plants, and birds to the long-term poisoning of the surrounding environment. For these reasons, the state continues to impose stricter regulations to help prevent such catastrophes. However, as Kusumawardhani (2016) argues, the imposition of these restrictions is pushing the gas operators out of business and stretching the remaining operators because it has now become difficult to comply with these rules while simultaneously managing assets.

Asset management also helps ensure that the asset's performance meets the needs and expectations of customers and contributes towards meeting the aims of the stakeholder. It helps to consolidate proficient asset performance, business process administration, machinery inspection, and maintenance with government compliance. According to Kusumawardhani and Markeset (2015), asset management not only includes effective management of corporate oil and gas equipment, it also includes additional business processes such as the design and configuration of the equipment, and monitoring their operational activities to prevent them from losing value, wearing out, and becoming obsolete. The motivation to maximise value from physical assets stems from improving customer satisfaction, increasing productivity, improving

output or service quality, minimising environmental impact, or any of a range of other performance indicators related to the operations of the specific physical asset.

Lane et al. (2012), on the other hand, identified several distinct uses of the term "asset management" in contemporary usage. These researchers claim that machinery maintenance professionals routinely employ the term to elevate the prestige of their services. As the term "maintenance" typically carries negative connotations due to its necessity and expense with consequent drains on budgets, by using "asset management' this ties in with the accepted corporate requirement to ensure essential and scheduled maintenance in the interests of preventing disruptions to business activities. These authors also stated that increasing numbers of plant owners or critical infrastructure operators apply the term "asset management" to their primary business activity, which combines investing in and deriving the maximum output from physical assets and infrastructure during the course of its economic life. This suggests early in this discussion where the lean from maintenance towards a preventative approach has evolved from.

For asset management to demonstrate its value-adding role within an organisation, it must be seen to fulfil a specific strategic function. To achieve this function, it must be proactive and respond to issues before they become problems that disrupt the organisation's objectives (Li & Peters, 2016). Asset management needs to forecast the needs of the organisation to develop forward plans that complement the future objectives of the organisation without disrupting them. Consequently, asset management encompasses far more than the maintenance requirements of operational infrastructure. Regarding asset management as an essential strategic component of the organisation's operations is both important and requires adopting a long-term view of the enterprise's performance. Narayanamurthy and Arora (2013) describe strategy as matching the organisation's internal set of skills and resources, with the opportunities and risks that are present in the external environment.

Strategic asset management also encompasses determining long-term organisational objectives and goals, and designing a course of action to accomplish them, while ensuring the allocation of necessary resources is made to realistically accomplish these goals (Parida, Kumar, Galar, & Stenstrom, 2015). Consequently, strategic asset

management seeks to effectively incorporate the organisation's long-term asset management needs into the organisation's overarching plans as an essential element of meeting the evolving needs of the customers. A component of this is the requirement to predict future asset needs and to develop plans that ensure their timely provision. Approaching physical asset management from a strategic perspective enables a comprehensive understanding of how aligning the organisation's asset portfolio enables service delivery, which actually meets present and future customer needs (Ramasamya & Yusof, 2015). The strategic process is holistic, which is made evident in the requirement for corporate objectives to coordinate the operations of asset owners, managers, and service providers. Consequently, the driving force shaping the policy objectives and goals of asset management is the performance and sustainability of assets in the service of organisational objectives. Therefore, adopting a strategic approach requires establishing asset management goals, which are based on a need to support the strategic goals of the business. One of the aims of this study is to fill a research gap relating to this aspect of strategic asset management. The indication of strategy linked within assets management is a very new aspect within any industry argues Chareonsuk and Chansa-ngavej (2010). They add that this strategy is contained within the larger operational stage that considers the wider business performance. They simplify the argument by stating that a tradesperson needs their tools to complete a job; thus, industry players need to consider their assets in the same manner. The clear gap in research on strategy does support this thesis in respect of uniqueness as well as the value it adds within a lean approach concept.

2.3 Origin of Asset Management for the Oil and Gas Industry

Although asset management as a concept has existed since before the 1980s, the oil and gas industry operators did not take its enforcement or implementation overly serious (Kusumawardhani & Markeset, 2015). According to the National Aeronautics and Space Administration (2013), the practice only became a necessity after the massive oil fire at the North Sea Piper Alpha oil platform. The Piper Alpha was an oil platform that worked to collect oil, gas, and salt-water brine from underneath the seafloor of the North Sea Ocean. The platform had been originally erected by McDermott Engineering, in 1976, but was administered by Occidental Group. The platform had its offices and drilling site at the northeast of Aberdeen in Scotland (Ion, 2012). Everything was running smoothly until the evening of 6 July

1988, when one of the maintenance personnel (who had been working the day shift) removed the safety valve from Pump X to examine it and perform a scheduled maintenance service. However, it was already 6 p.m., which meant that the day shift was over, and staff members who were working the night shift were coming in to take over from the day shifters. Therefore, the worker opted to replace the safety valve that he had previously taken off with a temporary blind flange. Thereafter, he also filled a permit form clearly stating that he had taken off the safety valve, and thus Pump X should not, at all costs, be operated. Even though the valve had been replaced with a blind flange, the flange was just intended to temporarily seal the pump and prevent the condensate gas from seeping out (Efzan & Keshavanveraragu, 2014). After this, he placed the permit form in a chest behind several other items just before he left work.

After the two shifts exchanged and the night shift staff took over, they began encountering some problems operating Pump Y. Inside this particular pump, there was a blockage that had been caused by some crystallised water molecules. This blockage meant that the pump could not compress the gas that was being collected from underneath the ocean. The blockage forced the staff members to activate the other pump, Pump X, to avoid bringing the entire drilling process to a standstill. They, therefore, decided to activate Pump X while Pump Y was being rectified. First, though, they opted to search the records from the day shifters to verify whether Pump X was safe for operation or not. They, however, did not find any records left behind neither they did they see the box containing the permit form left by the worker from the earlier shift (National Aeronautics and Space Administration, 2013).

Assuming that Pump X was risk-free, the workers activated the pump at 9:55 p.m., unaware that the opening was only sealed off with a temporary blind flange. At the time, the pump contained highly-flammable condensate gas, which, as soon as the pump was activated, started leaking via the frail blind flange. The gas was under very high pressure and even crushed the firewalls that had been erected by the engineering group to stop any instances of oil fires that may erupt within the plant. The leakage and crushing of the firewalls triggered such a thunderous explosion that caused yet another smaller condensate pipe to break open and gas to leak out yet again; this gas from the now smaller pipe also caught fire similar to the gas from the larger pump,

Pump X. The ignited gas, now in the form of an oil fire, spread from both pipes over the oil rig and even to the staff quarters that were fireproof.

Because the neighbouring oil rigs of Tartan and Claymore were still harvesting oil from underneath, the oil and gas produced from their pipes both ruptured to expose yet more fuel to the oil fire that was already blazing in Piper Alpha. By exactly 11:20 p.m., the oil fire had spread across the entire platform, raising the temperatures therein to extremely high levels such that portions of the platform melted and slipped in the sea below. The portions continued to melt and slip into the sea until approximately 12:45 a.m. A total of 167 workers were killed and the 61 survivors incurred grave injuries (National Aeronautics and Space Administration, 2013).

The Piper Alpha incident served as a wake-up call to strengthen the implementation of strict asset management systems, especially with regards to proper maintenance, inspection, risk analysis, workforce health and safety, and workplace integrity (Kusumawardhani & Markeset, 2015). These measures were first instigated by an inquiry issued by Lord William Cullen immediately following the Piper Alpha incident. According to the National Aeronautics and Space Administration (2013), four months after the infamous disaster, in November 1988, Lord Cullen issued an inquiry that he placed in the public domain with the interest of finding out the start and cause of the catastrophe. The inquiry ran for two years and deduced several causes and reasons for the fire outbreak. These reasons included poor permit recording, flawed communication channels between the workers' shifts, lack of adequate fire control measures and backup processes, and an indifferent working culture on the oil rig. The report stated that if the permit recording and filing system had been thoroughly investigated, the night shift workers would not have activated Pump X, which was the initial start of the oil fire. They also inferred deficient communication channels between the workers' shifts as well as in management. During the exchange of shifts between the day shifters and night shifters, no proper communication of the day's activities was handed over to the night staff. In addition, there was flawed communication among the Occidental Group Management, as they were in charge of the administration of the Piper Alpha platform as well as the Tartan and Claymore platforms. When the condensate gas from the two pipes ignited to form a hot, blazing oil fire, the management made no communication to either Tartan or Claymore to

cease pumping in more gas. It was this extra gas from Tartan and Claymore that aggravated the oil fire in Piper Alpha to burn more, causing loss of life (National Aeronautics and Space Administration, 2013).

Lord Cullen's inquiry strongly contested the flawed communication within the Occidental Group and pushed for 106 propositions, which recommended oil and gas operators become much stricter with respect to their safety processes and workplace integrity. The industry practitioners consented to the propositions and instituted them as safety regulations that should be adhered to at all times. The propositions constitute the asset management systems that are in place today and strongly encourage all other upcoming oil and gas operators, platforms, and plants to practice appropriate asset management to avoid cases such as that of the Piper Alpha oil rig incident.

Following the North Sea incident, oil and gas companies are now urged to take asset management into great consideration. Asset management encompasses an umbrella of business processes (including health and safety, proper plant design, and centralised communication systems) that allow for effective and instantaneous communication, thorough equipment inspection and maintenance procedures, dimensional control policies, and even predictive intelligence. This communication makes it possible for the operators to detect risks before they occur (Hongxun, Peng, & Tao, 2014). This section offers some substance with respect to how important large-scale asset management is as well as some clear links in maintaining a safe operation. This, when added to the financial aspects discussed earlier, adds further strength to the value of research into enhancing asset management within the oil and gas industry.

2.4 Current Asset Management Theory

According to Brogan (2014), asset management for oil and gas corporations and platforms has evolved considerably since the 1980s. The institution of the 106 recommendations set the foundation for more thorough and revised asset management systems. Unlike before, when asset management policies were regarded as almost insignificant and somewhat trivial processes, now oil and gas plants choose asset management as their proven strategy for improving their operational performance, asset reliability, workplace integrity, and effective maintenance of their equipment. As DiMatteo (2014) argues, the majority of oil and gas practitioners have in place an

active and publicly announced allegiance to execute asset management processes and safety procedures. Not only have they publicly vowed to devote themselves to these asset integrity procedures, but they have also integrated the same into their corporate business policies and code of ethics. All states, in general, have also taken steps in further reinforcing stricter asset management and workplace integrity in the petroleum industry (Nakov & Nuño, 2013).

Contemporary asset management systems are an important component of an asset manager's duties. Core protocols and standards have been established with respect to maintaining and adhering to proper asset management procedures. They include level-of-service procedures/inspection codes such as API-510, 570, 579, 580, 581, and ASME FSS-1 (DiMatteo, 2014). The codes entail a set of guidelines and specifications that in-service inspectors should follow whenever they are repairing, altering, or examining oil and gas infrastructure. In addition to these codes, there is also another new regulation, which is known as the PAS-55. The PAS-55 code stands for Publicly Available Specifications, and was founded by the British Standards Institution to purposely serve as a guide for optimal techniques of asset optimisation, particularly physical asset management (Griffin, 2015). The PAS-55 includes 28 considerations that relate to how physical assets are affected during the cause of their economic live span. Since its inauguration, the initial standard has been updated by newer standards such as the ISO: 55000. The ISO: 55000 encompass a global standard that is used to supervise the usage of physical assets and is quite recent as it was officially inaugurated in 2014 (Kusumawardhani, 2016).

Asset management itself comprises standardised procedures that have been specifically designed to match the risk profiles of assets to achieve their maximum utility and value via precisely timed acquisition, disposal, maintenance, and rehabilitation. The precedence of infrastructural engineers and managers forms the foundation of asset management practices, yet a substantial knowledge gap persists that is specific to contemporary infrastructure risks concerning framework development. According to Davis (2014), asset management can be regarded as a collection of disciplines, techniques, approaches, policies, and applications designed to prolong the commercial life of assets by managing risk, improving performance, and controlling related expenses. Riddell (2014), however, regards the objective of

asset management as minimising asset life cycle costs, controlling risk by fully analysing and comprehending it, enhancing reliability, improving knowledge management while improving communications among both internal and external stakeholders, with improved decision making specific to maximising value from infrastructural investments during their economic lifespan. According to Riddell (2014), asset management comprises finance, planning, personnel, engineering, and information management coordination that strives to assist decision makers in managing costs pertaining to managing physical assets; however, this author writes that this field is yet to mature. This demonstrates that the term is open to many different perceptions even within academia, which reveals the challenges and gaps within this important and lifesaving factor of the oil and gas industry.

More broadly, research findings agree that asset management is the strategic maintenance of physical assets that strives to maximise their contribution to the enterprise, by preventing avoidable expenses resulting from inefficient usage. Because physical assets possess an economic lifespan that is foreknown, their use can be planned, utilised, and maintained. Additionally, the commercial lifespan of physical assets may be extended in certain cases and, when their use becomes uneconomic to operate, or they become obsolete or surplus to requirements, then asset management's principles can provide strategies to deal with their approaches towards disposal.

The oil and gas industry is an asset-intensive and heavy industry and most, if not all, of its business operations are centred on its plants and infrastructure (Brogan, 2014). Thus, the involved asset management practices encompass intensive physical asset management (PAM). Asset management does not exist in isolation from other departments and business processes within corporations. Rather, it coordinates input from these departments to increase long-term efficiency in the interests of improving the organisation's financial, and thus its operational performance. The most important considerations in the design of an effective asset management framework, according to Horn and Granger (2013), are long-term relationships with suppliers, information transparency in negotiations, recognition of risk consideration prioritisation, and planning component coordination. Asset management must be in tandem with the organisation's supply risk/strategic procurement departments for successful outcomes. Abubakar (2014) agrees with this opinion, stating the relationship with suppliers,

sharing information, and accurately identifying risks are all essential elements to overcome problematic areas in asset management. Any endeavour to improve the effectiveness and operational performance of managing an ageing asset portfolio requires an understanding of how to balance the needs of utilising current infrastructure while simultaneously investing in replacement or new assets to satisfy future requirements.

Consequently, organisations responsible for managing such assets must adopt a holistic approach to deliver the necessary services while containing costs. In recognition of the need to professionally develop the concept of efficient asset management, several councils and institutions have been formed to promote this sector. These include the United Kingdom (UK)'s Institute of Asset Management and Australia's Asset Management Council. Therefore, recent decades have witnessed a proliferation of conferences, symposia, discussion meetings, and specific professional courses dedicated to highlighting the benefits that improved management of assets can bring to the sector. Asset management has proven its worth by demonstrating that the adoption of a holistic approach can materially improve management practices relating to extracting the greatest value from physical assets. According to Jeeva and Baswaid (2014), the benefits of adopting a holistic approach to asset management are as follows:

i) Improved allocation of limited resources;
ii) Enhanced alignment of services to physical assets;
iii) Improved integration of services reduces demand for new assets;
iv) Greater efficiency of use and maintenance of existing physical assets;
v) Opportunities to partner with private sector enterprises can be improved;
vi) Greater consideration given to finding non-asset solutions to satisfy service demands;
vii) Finding sustainable development solutions to avoid conflict with environmental, cultural and heritage interests;
viii) Actualising a return from surplus assets; and;
ix) Enhanced processes and accountability relating to capital and ongoing undertakings.

2.5 Types of Asset Management Services in the Oil and Gas Industry

There are many services involved in asset management systems that are specific to the oil and gas industry (Premier Oil, 2014). All these services have one common purpose: to avert any type of destruction or impairment of physical equipment, electrical pathways, safety controls, piping systems, pressure vessels, subsea connections, drilling equipment, and storage plants among many other infrastructures. These services are executed in phases to ensure that their impact in preventing damage to the physical equipment of these businesses is as it is supposed to be. The phases followed during the execution of these services are as follows:

i) Recognition of the most run-down or marred infrastructure that urgently needs repair or maintenance;
ii) Formulation of a plan on how to best repair and maintain the asset;
iii) The actual facilitation of the maintenance plan;
iv) Monitoring and evaluation check-ups of the repair process during and after its completion; and;
v) Aftercare services and regular check-ups to ensure that the asset is in good condition.

The subsections below discuss the various services contained within the oil and gas asset management systems.

2.5.1 Risk-based inspection

According to DiMatteo (2014), risk-based inspection (RBI) comprises an asset management tactic that is used to minimise the potentiality of future risks in a given plant or physical equipment. RBI refers to a calculating risk-prevention method, which comprises a set of programs that analyses possible risk aspects and then develops a befitting action scheme. Following this, the action scheme will be executed to prevent and reduce the chances of that risk occurring. According to Torretta, Raboni, Copelli, and Capodaglio (2014), these action schemes vary from plant to plant, and their implementation depends on the magnitude of risk observed. This means that RBI servicing for low-risk plants is more spaced out compared to that of high-risk plants. RBI is a core asset management procedure that is implemented in a multitude of oil and gas corporations and platforms as it helps avert expenses that would have otherwise being spent on the repair and maintenance of ruptured machinery.

RBI integrates an innovative technology that enables the prediction and detection of risks before they actually occur. The name of this technology is plant asset management (PAM, which identifies possible or hidden hazards in a plant prior to them happening. To achieve this, PAM appraises the status of plants using a mixture of computerised processes and generates a list of pointers that are used by the technical maintenance team when performing the check-up procedures. The integration of PAM within oil and gas corporations has significantly helped these corporations optimise their assets, thus reducing unnecessary expenses, and even producing cost-effective services. The protocols involved in RBI are derived from the API-580 code, one of the numerous codes configured by the American Petroleum Institute (DiMatteo, 2014). The code contains the following stipulations:

i) The plant design should be fully understood prior to the execution of any check-ups;
ii) A well-laid out procedure for evaluating risks should be formulated;
iii) There should be consistency during risk evaluation plans for every asset;
iv) A suitable apparatus should be identified for the risk evaluation procedure;
v) A well-detailed methodology should be defined to demonstrate how the evaluation is being carried out, after which a documentation of the analysis should be made;
vi) The maintenance team should make clear and consistent their method of fixing possible risks;
vii) After fixing, the team should outline an appropriate monitoring and evaluation process; and;
viii) Proper reporting of the entire operation should be undertaken through exhaustive documentation.

2.5.2 Data integrity management

Data integrity management refers to the systematic methods through which oil and gas platforms collect data and information about their business processes and plants; then use them for making critical business decisions for future operations (Perrons & Jensen, 2015). Data integrity management is another core asset management process as it enables these businesses to collect information about their business structure and produce reports. The generation of this information is extremely

important for the smooth functioning of operations in all industries, not just the oil and gas industry (Koronios, Lin, & Gao, 2013). Production industries function better with real-time data, and thus require real-time data integration systems. This way, they can have information access to events occurring in real-time such as plant availability, asset performance, maintenance efficacy, electricity distribution, and oil and gas production. Information access to these events helps elevate process uptime and asset optimisation in addition to decreasing repair expenses, which are the objectives of asset management systems (Lillis & Szwejczewski, 2012). McMahon (2016) argues that data integrity and consolidation is one of the most competitive ways that oil and gas operators achieve from their asset management procedures. This author argues that data integrity and consolidation allow for real-time asset optimisation, monitoring, and alerting of problems that currently occur. This builds upon the earlier research by Lin, Gao and Koronios (2007) who strongly support the utility of data management within asset management.

Data integrity management consists of a computerised platform that streams real-time data from distinctive departments within a given corporation and then consolidates this data onto a single dashboard, to make information access easier and faster (DiMatteo, 2014). This data is streamed from departments such as the risk department, maintenance department, monitoring department, electricity production and distribution, drillers and divers, and the refinery section. Data from these traditionally disparate departments are then combined into a single interface to showcase a complex range of vision of the status of the plant as reported from different departments. The interface is then keenly reviewed and the information technology (IT) operator is able to distinguish the present conditions of the plant, such that in the event of a problem in any section, action can be taken immediately to prevent damages (Mitchell, Marcel, and Mitchell, 2012).

2.5.3 Maintenance management

Maintenance management constitutes yet another core asset management procedure, which is put in place to examine and repair damages in the event of machinery deterioration, break down, or reactive rupture (Vanier, 2012). Ossai (2013) argues that machinery maintenance is not meant solely for times when the equipment

has broken down or has ruptured; rather, repair and maintenance should be a frequent activity that is affected regularly to ensure that the equipment is always in good condition and fit for service at all times (Preventative). According to Ossai (2012), maintenance agendas and planning derive their data intelligence from the reports generated from the PAM technology discussed above, as well as the real-time data streamed from disparate departments within a given corporation. For PAM technology-centred corporations, as soon as a risk is identified, maintenance operators and technical personnel are immediately notified of the risk before they investigate the reported issue and carry out the actual rectification. The same is also applicable for those organisations that opt to use real-time data automation platforms. As soon as a problem is detected using the streaming data, the maintenance personnel are notified and they are required to fix the situation. After the situation is fixed, a detailed report and documentation are prepared. These reports are crucial as they provide step-by-step information about how the maintenance or repair was undertaken, and how the situation could be dealt with should it reoccur in the near future.

As McMahon (2016) comments, every business entity is exceptional and specific to its own business objectives, goals, and missions. Thus, it follows that different corporations in the oil and gas industry carry out their maintenance management in their own different, specific ways. For example, Bentley Systems (a world-renowned leading organisation that deals with asset integrity management) uses a reliability centred maintenance (RCM2) methodology (DiMatteo, 2014). Unlike other maintenance management systems, Bentley's RCM2 is set to identify the outset of machinery breakdowns prior to them happening in a bid to optimise maintenance tasks and ensure that the entire asset integrity management is always up to date. This RCM2 is powered by the company's intelligent software called Asset Wise APM, which is the powerhouse of all the technical support and sustenance activities in the firm (Dimatteo, 2014). The software comprises business-centred applications whose main focus is to effectively supervise the soundness and sustainment of the firm's assets during the entire course of their economic life. These applications adhere to the commonplace standards of the industry namely the PAS-55 and the ISO 55000 (Kusumawardhani, 2016). Being an observer of these standards helps ensure that the application of the RCM2 in Bentley enhances employee competency and accountability with respect to efficiently supervising physical asset maintenance,

productivity, profitability, and reliability. In addition, when real-time data is streamed and fused on a single interface, it is reviewed and orders are issued to the appropriate maintenance personnel to either obtain a work permit, regulate inventory counts, keep servicing scheduling up-to-date, or examine the physical equipment for possible flaws (McMahon, 2016).

2.5.4 Health, safety, and environment (HSE) management

Kusumawardhani (2016) defines "HSE management" as the enforcement of the applicable rules, regulations, directives, and safety measures devised to safeguard the work staff, the public, as well as the environment from possible harm at a production site or power generation houses. HSE is a fundamental aspect of asset management as it helps to ensure that a company's assets (physical infrastructure and human subjects) are safe from injuries of all forms, including physical, psychological, emotional, and intellectual. Oil and gas platforms are production utilities and are involved in the heavyweight production processes of mining oil and gas from beneath the Earth's surface. Therefore, it is prudent that these aspects take human safety and environmental conservation into serious consideration. It is the duty and responsibility of the company to assure that no harm befalls its workforce personnel, clients, stakeholders, the environment, or the surrounding community (Bharadwaj, Silberschmidt, & Wintle, 2012).

To make this safety measures a reality, the oil and gas industry has incorporated corporate HSE regulations, which outline the steps necessary in environmental conservation and preservation as well as industrial safety and healthiness of its human participants. HSE regulations are two-tiered in the sense that they stipulate the requisite means with which people and the environment should be safeguarded from potential harm; they also define the necessary steps to be followed in the event of an already occurred incident (Radoszewski, 2015). The UK legislation demonstrates how seriously the government takes asset management and safety of equipment and people within the UK marketplace. The UK regulator has specific arms for supporting and enforcing the respective legislation to ensure that the operations remain as controlled and safe as possible. This involves inspections of assets on platforms, where the regulator can visit at any reasonable time and review and inspect the equipment. This

builds upon the output from earlier incidents. This is supported by Baaziz and Quoniam (2013) who add that the health and safety components of the HSE regulations cater for the protection and well-being of all human participants that are associated with the power-generating activities of a given firm. These human participants include the direct employees, suppliers, creditors, debtors, investors, clients, independent contractors, and business partners. The regulations help identify work-related perils and possible accidents, and suggest viable ways with which these accidents can be reduced or mitigated altogether. In addition to this, they also stipulate that the workforce personnel must receive adequate training with respect to hazard blockage, reaction, disaster preparedness, and how to use protective garments (Bigliani, 2013).

The environmental component in HSE, on the other hand, provides suitable means with which to protect and preserve the surrounding environment and natural sceneries. It provides stipulations that restrict power-production houses against emitting industrial waste such as radioactive products, metals, poisonous gases, hydrocarbons, and chemical substances on land; water bodies such as the ocean, lakes, and seas; the air atmosphere, and marine life. HSE protocols include measures that encompass safety parameters, risk evaluations, enhancement of viable health plans, instructions on how to use protective garments, disaster response coordination, licensing, and certification for the use of heavyweight equipment such as drillers, cranes, and high-level pressure vessels (El-Akruti & Dwight, 2013).

2.6 Benefits of Asset Management

2.6.1 Amplifies the reliability, availability, and maintainability (RAM) of physical infrastructure

Implementation of asset management, through adequate risk inspection and maintenance management, helps identify any problems or obstacles associated with physical equipment. These issues may present themselves in two distinct forms, namely physical and availability obstacles (Brule, 2013). According to El-Ghazali, Lefebvre, and Lefebvre (2013), “physical obstacles” refer to the production constraints experienced when machinery unexpectedly breaks down and fails to operate. Such constraints trigger availability constraints or rather make this particular machinery

unavailable for use at that moment, hence decreasing the overall production capacity of the entire oil and gas plant. Such issues can be reduced and ultimately eradicated via the effective integration of risk-based inspection and maintenance management (aspects of asset management systems), which are capable of detecting such obstacles prior to their occurrence (Nguyen, Tock, Breuhaus, Marechal, & Elmegaard, 2014).

2.6.2 Boosts asset management performance and overall profitability

When the RAM of a given asset is amplified as outlined in the previous subsection, the asset's performance is improved. Eliminating the physical and availability obstacles within a given equipment helps ensure that the machinery is clean, in terms of operability, and therefore its current (and future) status, condition, and performance is of high-quality and is reliable (El-Akruti & Dwight, 2013). If the performance is satisfactory, then it follows that the profitability of that asset is first-rate; that is, an increase in asset performance triggers a similar increase in its profitability and productivity levels because the asset is available for use and is physically fit for service.

2.6.3 Ensures health and safety measures

Tippins et al. (2016) suggest that the application of efficient asset management via competent and achievable HSE regulations helps to ensure that the industrial health and safety of the involved human participants, as well as the environment, are secured. SEI (2016) showed that it is the duty and obligation of the organisation to guarantee its stakeholders as well as the surrounding environment absolute safety and protection from all types of harm, be it physical, emotional, psychological, or environmental degradation. Therefore, the application of HSE (another detailed aspect of asset management) helps oil and gas platforms ensure that optimal health and safety measures are secured at all times.

2.6.4 Reduces repair and maintenance expenses

Effective implementation of risk-based inspections, through PAM technologies, and maintenance management, through immediate action on real-time data, helps identify real-time bottlenecks within both physical and information assets (Schneider Electric, 2015). PAM technologies provide predictive risk intelligence that

enables oil and gas operators to predict potential risks and problems even before they occur. This assists in saving unnecessary repair and maintenance fees because the risk is evaluated at that time and correctional repair is undertaken, which is something that costs less than what the actual repair process would have cost had the plant broke down (Refsdal & Ostby, 2014). Streaming of real-time data greatly assists in saving on costly maintenance expenses as current problems are detected and promptly rectified. In addition to saving on costly repair and maintenance fees, proficient risk-based inspections and maintenance management helps oil and gas plants save a huge amount of production time. Whenever plants break down and fail to operate, the operators have to shut them down to allow time to fix and repair the issue, which leads to massive downtime as that particular plant cannot be operated, hence leading to loss in work productivity as well as a massive decrease in production time (Westall, 2014). This results in a relative organisation that could ultimately present an unsafe workplace where assets are run until failure.

2.6.5 Optimisation of assets

The entire set of asset management services, namely risk-based inspections, real-time data integrity management, maintenance management, and HSE applications contribute to amplified asset optimisation. RBIs help to predict the possible future occurrences of certain risks, which are then solved to ensure that the machinery is free from that risk and is, therefore, free from physical and availability bottlenecks. Through the help of real-time data consolidation, maintenance management also increases asset optimisation via thorough servicing of plant equipment, thus ensuring that this equipment is always in good condition and fit for service at any time (Wooldridge, Schmid, & Floyd, 2013). HSE also boosts asset optimisation as it ensures that a company's assets are always safe and certified for operation and is compliant with governmental rules and regulations. Without proper compliance of statutory and industrial regulations, a company is bound to fail, be heavily taxed, or be shut down completely (Vestre, 2016). Therefore, HSE also contributes to asset optimisation. Asset optimisation is an increasing factor for success in power-generating houses, such as the oil and gas industry, because it helps to ensure that the most is made out of the asset during its economic life and, therefore, little or no losses are made (Kusumawardhani, 2016). It can be easily argued that unsafe operations that

result in injured employees is not a recipe for a long-term successful business operation. The regulator will quickly inspect and shut down operations and follow-up with prosecution that usually involves unlimited fines.

2.7 Factors That Impact the Success of Asset Management in Oil and Gas Industries

2.7.1 Strategic procurement

Strategic procurement, as Binlootah and Sundarakani (2012) explain, comprises a comprehensive plan that is carefully crafted to enable businesses to obtain the goods, services, materials, and equipment required for project deliverables. According to Hallgrim, Ola, and Jardar (2014), strategic procurement can be thought of as tactical planning that is conducted prior to a project to ensure that the project runs smoothly from start to finish. For a project to run smoothly, certain requirements are important such as the raw materials, human labour, land (project site), buildings, equipment, and machinery. A well-planned time schedule is also required to ensure that the program is well organised and runs along with the stated project calendar, ensuring that no time is wasted. Monitoring and evaluation courses are also required to verify that the project is being executed with the highest levels of value and integrity. If all these considerations are to be effectively considered, then there needs to be a strategic procurement policy put into place. Ramamurti (2012) asserts that such a policy should outline suitable rules and guidelines usable by any business to obtain all these requirements in an efficient manner and deliver excellent outcomes.

According to Amue and Ozuru (2014), strategic procurement has evolved considerably over the past 20 years as the interest has shifted from merely lowering the acquisition costs to improving the entire life cycle cost management. Traditionally, the chief goal of strategic procurement was to help reduce the costs of acquiring the raw materials, goods, services, equipment, and human labour (Wincel, 2003). Cost reduction was the scope of strategic procurement to cut back on production overheads and increase the gap in sale returns. However, as Andersen and Ross (2013) point out, successful project facilitation does not only encompass upfront cost reduction. Other factors are also included such as effective monitoring and evaluation, employee motivation, project budgeting, cost control, risk mitigation, performance, marketing, and final implementation (Birasnav, 2013). Thus, several key players within the

industry (for example ministries and statutory agencies) expanded the scope of strategic procurement from a mere cost reduction to an umbrella of many functions. These functions are all-inclusive with the main intent of generating value for the entire life cycle of a given project from start to finish.

Smith (2014) argues that strategic procurement policies are developed in line with a company's strategic objectives. Different companies have different strategic objectives, visions, missions, and goals; therefore, their strategic procurement policies also vary. Because one of the core strategic objectives of an oil and gas corporation is asset management, then a strategic procurement policy overseeing the function of asset management should be in place. A failure to link these two functions will result in a disruption to effective asset management (Liu et al., 2015). Strategic procurement during the asset management business process should oversee good practices in asset management and ensure that everything runs according to plan. According to Hallgrim et al. (2014), strategic procurement adds significant value to asset management functions as it ensures that infrastructure is appropriately purchased, installed, designed, commissioned, and handed over efficiently. The outcomes of strategic procurement in asset management encompass the employment of infrastructure at an affordable life cycle cost management, within a high-quality yet economical parameter to satisfy the final project deliverables (Mohammed & Price, 2015). Below is a list of the most crucial elements expected in an ideal strategic procurement policy for asset management:

i. **Procurement:** The procedures necessary in the acquisition of goods and services that are key for accomplishing the final asset management deliverables.
ii. **Purchasing policy:** Defines the standard/net value of costs and profits as per the current market prices. The objectives are focused on obtaining value for money on all goods and services purchased, and being accountable to the company's stakeholders, as well as to the end clients.
iii. **Integration:** The procedures that are necessary to ensure that all asset management functions are adequately coordinated.
iv. **Quality:** The procedures that are necessary to ensure that the goods, services, and equipment acquired will gratify the desires for which they were contracted.

v. **Human resources:** The procedures needed to employ the most skilled persons required to carry out a given task to successful completion.

vi. **Communications:** The procedures necessary for ensuring effective information exchange and sharing of ideas or concepts between two or more departments.

vii. **Risk:** The procedures that are necessary for recognising, evaluating, and resolving asset risks.

viii. **HSE regulation approvals:** The procedures necessary in ensuring that all relevant compliance rules concerned with asset management are satisfied.

2.7.2 Supply risks

Vilko and Ritala (2014) describe the term "supply risk" as referring to the likelihood of an incident occurring amidst any inbound supply of goods, services, materials, and equipment in an organisation. Incidents occur all the time, and usually result from supplier insolvency, strained supplier relationship, shortage of raw materials, natural disasters (e.g. earthquakes), political upheavals, financial receiverships, production plant collapse, commercial industrial strikes, logistic errors, or even convictions resulting from compliance non-conformity (Viator, 2015). Supply risks are extremely adversarial to the progression of business operations as they create supply delays, inadequate raw materials, poor supply quality, counterfeit products, and high financial losses (Tamzidul, 2012). When such risks abound, businesses become constrained and are unable to perform their operations effectively. The oil and gas industry is especially affected by such supply risks, which inhibit the normal flow of day-to-day business transactions. The operators find it extremely difficult to conduct their functions and deliver their end objectives to the end clients. Many functions come to a halt, for example, environmental safety, oil and gas exploration, production operations, field development, petrochemical refining, as well as product marketing and distribution to the end customers.

Supply risks also affect asset management systems in oil and gas corporations. At present, many oil and gas organisations rely on external, third-party agencies for asset management solutions (Blokdijk, 2012). They prefer to outsource their asset management functions to external service providers wherever practical. These external service providers promise to deliver their clients with superior asset management

system solutions on their behalf (Zabyelina & Kustova, 2015). This way, the hiring organisations can concentrate on other activities that require their attention such as product distribution and marketing. The firms may also outsource because of the constant demand increase in oil and gas products as well as the current shortage of skilled labour. Pellegrini, Lazzarotti, and Pizzurno (2012) state that, due to recent increases in demand, there are many asset projects underway that oil and gas companies routinely outsource to consultant firms to undertake the entire project. Outsourcing in this manner ultimately increases costs for these companies beyond what they would achieve if they did the tasks in-house.

Conversely, Blokdijk (2012) states that due to a shortage in local skilled staff, the in-house staff struggle financially to deal with the huge workload expected of them; therefore, outsourcing is resorted to as the ultimate solution. The external service providers, in this case, serve as the suppliers for the hiring oil and gas companies and supply them with various solutions including risk assessment software, technology packages, asset trackers, and maintenance instruments, among many other IT implements. All these items are required by operators to perform the necessary asset management processes mentioned above. Should there be any form of threat or disruption to this supply chain, everything would fall apart and the operators would not be able to conduct the necessary asset management processes. Timely delivery of goods and services to the end clients will also be hindered because of supply risks (Kumar, 2014b).

Besides outsourcing, supply risks also emerge from situations such as globalisation, digitisation, supplier rationalisation, and lean inventories. According to Changarawe (2014), globalisation and digitisation, in particular, have catalysed the frequencies of supply risk probabilities because of increasing technological innovations worldwide. Technology revolutions have made communications and global product marketing easier, especially through social media platforms. Suppliers of all types of goods and services can now easily market themselves on the internet as well as on social media networks, making it extremely easy for manufacturers to locate them and contact them for their supply services (Lambert & Schwieterman, 2012). In the process, these manufacturing companies widen their supply base as well as the probabilities of supply risks from each contracted supplier.

To avoid the proliferation of these supply risks, it is prudent to develop appropriate supply risk policies. As Green, Zelbst, Meacham, and Bhadauria (2012) claim, such a policy integrates all the necessary procedures in planning for and mitigating the occurrence of these risks. This policy embodies well-synchronised risk premeditation, identification, monitoring and evaluation, response, and control parameters of the organisation's supply chain. These parameters feature the following three elements: predictive, proactive, and reactive factors. Wei and Xiang (2013) define the predictive element as a system of predictive analytics used by organisations to detect early warning signs of looming risks and prevent their occurrence before their time. The proactive elements refer to the strategies used to evaluate the risks that are occurring presently and respond to them as fast as possible. The reactive element refers to the strategies used in mitigating crises that have already occurred (Sepehri, 2013). Accurate responses to these risks involve a number of stratagems such as articulate logistics, financial planning, and cybersecurity.

According to Walker and Jones (2012), it is prudent to link supply risk policies to the procurement policies of any organisation. The reason for this is because the strategic procurement policies will help outline the means with which that organisation can prevent a particular identified risk. The supply risk policy will also help outline alternative procurement methods with which to acquire other goods and services, assuming there is a shortage of the first selection of goods and services (Gopalakrishnan, Yusuf, Musa, Abubakar, & Ambursa, 2012). These two segments are symbiotic and run parallel to each other's functions. According to Dashore and Sohani (2013), the benefits of developing supply risk policies are as follows:

i) To ascertain adequate asset acquisition, consignment, and handover capacities;
ii) To avoid sale losses;
iii) To ensure excellent project deliverables and client gratification;
iv) To avoid disruptions in asset management (deployment, utilisation, upgrading, and rehabilitation); and;
v) To ensure adherence to asset compliance rules.

2.7.3 Asset management tools

Asset management tools form yet another crucial cornerstone of the successful implementation, or lack thereof, of asset management systems. Utility tools refer to the type of facilities employed by organisations to perform the processes necessary for asset management (Baaziz & Quoniam, 2013). The types of tools that are used determine the quality of the outcome of the asset management functions. Organisations no longer use cartons of receipts to calculate their yearly expenses and then physically record the amounts on a paper inventory. This was only possible in times when businesses had one or two assets to manage (Marakas & O'brien, 2013). This method, although cheap, was disadvantageous to companies in terms of storage and tracking because it consisted of manual bookkeeping systems whereby accounting records were filed by hand, and also retrieved by hand. The system was highly defective because of numerous human errors during account recording, financial reporting, asset tracking, and inventory maintenance.

The manual bookkeeping system was replaced with Microsoft Excel spreadsheets (IBM Corporation, 2012). Spreadsheets are an excellent choice if you only want to store basic asset information such as the name of the manufacturer, buying price, serial number, and the model. They have tabular structures, with rows and columns that are perfect for registering assets using their serial number in addition to tabulating a list of available assets within an organisation (Red Beam Consulting Limited, 2014). However, asset management functions go beyond merely registering assets and keeping a list of available equipment. Asset management functions are much more sophisticated. After registering assets, more functions are required, for instance, generating a maintenance schedule created alongside a designated calendar event or meter reading (IBM Corporation, 2012). Spreadsheets are not capable of producing such a schedule. There is also the need to generate a parts inventory as well as the costs of these parts. After this, one needs to track the labour of all these tasks and price them accordingly. These are functions that go well beyond the basic abilities of spreadsheets, and attempting to execute them can involve putting the spreadsheet database administrator under duress. Hence, spreadsheets are defective asset management tools as they are only capable of arithmetic computations/accounting and not asset management functions (Sage Fas, 2014).

The modern-day asset management models advocate for use of digital asset management (DAM) platforms such as PAM technology, RCM2, computerised maintenance management system (CMMS), integration and device management system (IDMS), Asset Labs Streamline, A1 Tracker, Asset Track, Asset VUE Inventory, as well as the Remedy Asset Management, among many other examples (DiMatteo, 2014). These software packages are dedicated to specifically handling asset management tasks only and therefore are capable of complex activities, e.g. maintenance planning and predictive analytics (Westall, 2014). Marakas and O'brien (2013) assert that there are many upcoming software developers in the IT world who are building dedicated asset management software packages. Such packages are ideal for business asset management as they are fitted with special tools and features with which to accomplish various tasks such as real-time data streaming, data integration, data integrity, intelligent risk-based inspections, updated asset maintenance applications, and compliance management. These features help organisations fulfil their asset management obligations in addition to optimising the usage and economic endurance of their physical equipment. The only difference among them is how they vary in terms of purchase costs, reporting scope, licence types, end-user portals, update frequencies, programming interfaces, usage subscriptions, and purpose differentiations. Businesses are now spoilt for choice. Baaziz and Quoniam (2013), however, urge businesses to choose these tools wisely. These researchers say that, before procurement, one should extensively reflect on the strategic objectives of the business and then evaluate the available tools to see which one satisfies the stated objectives. This way, a business will procure the correct tool without necessarily wasting funds and other organisational resources.

2.7.4 Business continuity

A typical business continuity plan (BCP) for an asset management department may suggest several approaches to prepare for any possible future disaster. These approaches could include purchasing spare equipment, back up servers, conducting drills, amplifying employee vigilance, and performing frequent data backups off-site (Horne, 2016). These approaches aim to achieve business resilience, speedy recovery, and contingency. Business resilience helps to ensure that essential operations remain unaffected during and after these disasters, while speedy recovery ascertains that these

operations resume back to normal as soon as possible without affecting productivity (SAQA, 2013). Contingency, on the other hand, encompasses a comprehensive capacity for businesses to muddle through any disruption whatsoever, including those that were foreseen as well as those that were not foreseen (Flinders Ranges Council, 2015). Business continuity frameworks consist of several components such as those listed below:

i. **Business Continuity Plan/Policy (BCP):** A collection of directives and protocols specifically set to help businesses respond to anticipated/unanticipated disasters without disrupting normal operations or productivity. The BCP consults the strategic objectives, procurement policies, and supply risk strategies of a business to ascertain that the post-disaster operations still resonate with the original business goals.

ii. **Risk Identification:** Tactics used in detecting and isolating potential business threats, for example through brainstorming, surveys, interviews, focus groups, historical information, risk lists, and experience.

iii. **Business Impact Analysis (BIA):** After a potential threat has been detected and isolated, a BIA is then carried out. The purpose of the BIA is to evaluate this threat and examine the ramifications it could have on a given business function. The BIA is ideal in allocating the degree of threat damage and researching the most feasible recovery means.

iv. **Disaster Recovery (DR):** Set of risk mitigation strategies developed to respond to, mitigate, and completely eradicate disasters that have already occurred. Complete resolution may range from a few milliseconds to a number of days.

v. **Change Control**: A set of protocols necessary in enforcing new designs, ideas, and concepts in a business setting to help overcome the identified/already occurred disasters. Implementing change in organisational setups may be quite an intricate process because of the conservative nature of people and reluctance to adapt to new systems. Thus, besides DR, these change control protocols also assist in managing people's reluctance.

vi. **Audit Management:** A set of checklists specifically created to help organisations review the status of DR schemes as well as change control protocols. The aim is to verify whether the recovery plans are working

effectively to mitigate these risks/disasters and evaluate their performance so far.

vii. **Communication Systems:** Effective communication systems are crucial for facilitating all the aforementioned processes starting from the development of BCPs to audit management. All these processes must work together to create seamless DR strategies and business continuity. They must all be interlinked with each other through the integration of asset management tools to realise viable solutions. Hence, a BCP must extensively consider active communication systems as well as a lead manager who will supervise all these processes efficiently.

2.7.5 Integration of systems

The non-integration of asset management systems is another influential factor that influences asset management departments in the oil and gas sector. The term "systems non-integration" refers to a situation whereby an organisation's local networks—found in different departments—are not interconnected with one another (Vasel, 2012). Rather, they work as independent workstations and seldom share information together. Thus, they basically have no means of communicating with each other to share common data, updates, financial reports, asset health statuses, or any other technical information. It is very unfortunate to have very little communication with other departments within the same organisation.

Patil, Suryawanshi, Suryawanshi, & Patil (2014) argue that asset management cannot thrive in a non-integrated system environment. This is because there will be a lack of seamless information exchange between key departments, for example among the strategic procurement department, the supply risk, and business continuity operations, as well as the asset management department. As outlined in the previous sections, these departments need to interlink and create policies together to benefit the organisation. They all need to create proper communication channels where they can easily share information and decision-making processes regarding the progress of asset management functions in a prompt manner (Samara, 2015). A lack of such communication and information sharing will lead to many contentions including poor data access, decision making, information transparency, and data integrity

(Narayanamurthy & Arora, 2013). Trustworthiness between the company's stakeholders will also be ruined, resulting in a breakdown of organisational relationships/partnerships. There also emerges a communication void in the company whereby no one knows the real status of the company in question.

Therefore, it is vital to implement effective system integration in any organisation seeking to have smooth business operations. The oil and gas industry is specifically urged to ensure that it has robust systems coordination that enables seamless information sharing and correspondence among its various departments (Lipaj & Davidavičienė, 2013). The asset management function also benefits from robust systems coordination as its operators can keep each other informed about various aspects including asset maintenance statuses, repairing, regulation approvals, new infrastructure procurement, and new supply risk policies. The system integration of databases and information tools enhances record keeping, data consistency, and inspection controls. System integration further enables the risk department, maintenance department, monitoring department, electricity production and distribution, drillers, divers, as well as the refinery section to stream and collectively share real-time data on a common dashboard. By streaming and sharing real-time data on a common database/dashboard, information access is made easier and faster (Litan et al., 2012).

2.7.6 Poor leadership

The first important aspect is to define leadership so that it is clear within this section how this can influence the output of effective asset management. Leadership is defined as: *"The action of leading a group of people or an organisation, or the ability to do this"* (Oxford Dictionary, 2018) According to Alemu (2016), poor leadership represents a real obstacle to organisations that are trying to meet their strategic objectives. This relates to the inability of leaders to use their skills to guide their businesses towards the stated strategic objectives. A leader that cannot strategically plan their schedules for the future is greatly contributing to that organisation's collapse. Poor leadership gives rise to issues such as weak morale, mismanagement of organisational culture, inefficient business planning, non-forward planning of the business design, and lack of a clear strategic vision (Aubrey, 2012).

Poor leadership also triggers insufficient employee engagement; however, it is acknowledged that these factors are difficult to accurately evidence.

Organisational leaders are accountable for their employees' conduct and performance. To ensure that employees are always performing their duties well, leaders should employ appropriate management skills to encourage and motivate them, without necessarily intimidating or micromanaging their employees (Dandira, 2012). They should interact with their junior staff members and regularly engage them in decision-making exercises, team building, conflict resolution, and strategic workplace politics. If leaders continually segregate employees and seldom engage them in the organisation's affairs, they increasingly add to the employees' lowered self-esteem levels. Lack of employee engagement results in a lack of direction; they will not know what the goals of the company are, and they will not know why they are working with specific processes (Jeremy, Melinde, & Ciller, 2012). Thus, the management is not effective and, therefore, there can be no improvement or development of the asset management framework, until it is directed from senior management.

The competency in decision making is also affected by poor leadership and governance. Nanjundeswaraswamy and Swamy (2014) attribute this to a lack of consultation from other company stakeholders, the employees included. According to Jeremy et al. (2012), failing to consult and involve company employees in decision making may stir conflict between the top management and the junior workforce. In addition, employees remain unaware of the new decisions or policies made by the company's management team, hence creating an information breakdown. According to Neves and Eisenberger (2012), many organisations rarely involve junior employees in decision-making processes, thus contributing to poorer worker performance. Company leaders can really drive the business forward, particularly if they are well liked. Well-liked leaders have great influence, and this is because staff members enjoy working with them. Good leadership and employee engagement are especially important for the asset management functions of oil and gas platforms. Any miscalculations or oversights in orders from above will mess up the entire asset management function starting from the development of the sector's strategic objectives, strategic procurement, BCPs, and also the choice of utility tools. The sector also requires shrewd leaders to appropriately manage any unexpected disasters that

may suddenly emerge, for example, the recent downturn in current oil prices (Brollo, Nannicini, Perotti, & Tabellini, 2013).

Astute decision making is also necessary for the purposes of making sound investments. Good leaders will ensure that they employ healthy relationships with their workforce such that they create a healthy interactive atmosphere with them, improve their motivational levels, encourage more teamwork, and reduce employee dissatisfaction/attrition (Oladipo, Jamilah, Abdul, Jeffery, & Salami, 2013). There shall be more consultation in making decisions that involve the employees and incentives may be provided such as bonus perks, salary hikes, and promotions. Thus, it is crucial to have good leadership in the company as it is a great morale booster and has an effect throughout the entire organisation. When there is good leadership, the corporate culture is not forced onto employees, it just voluntarily develops. Engaged employees are enthusiastic employees as they give the company a competitive edge. Levels of employee engagement are often a reflection of performance and, furthermore, there is a lot of evidence that shows that improved engagement equals improved performance. Leadership support is actually the cornerstone. Without a strong cornerstone in place, everything else might fall apart (Dandira, 2012). This section highlights some of the challenges that this research has identified with respect to leadership and employee management. Within these factors, it is challenging to define and indeed identify improvement opportunities. The leadership discussion as a topic is an entire series of thesis on its own. This research acknowledges this and will not look to offer improvement within this particular topic area; it is, however, still worthy of inclusion to validate the depth of this research.

2.7.7 Training and process awareness

Process awareness entails the absolute understanding of business processes and knowing how to execute them efficiently (Proctor, 2012). Wakeman (2013) argues that, on many occasions, employees rarely understand the root basics of the processes they carry out at their workplaces. It is no surprise to find employees nowadays who know very little or even nothing about the base concept of a certain business function, culture, financial reporting, or network. Rather, they just perform a batch of tasks for the sake of completing them and getting paid. This creates a disconnection between

the workforce and the technical aspects of business functions such that if a disaster were to occur, no one would be able to solve it. According to Boohene and Williams (2012), this obliviousness triggers errors, inaccuracies, and miscalculations when handling a given task or assignment, which may cost organisations millions or even billions of dollars just to correct them and earn back their good reputation and trust from the public domain. The petroleum industry is particularly sensitive to its operations as it deals with highly volatile products; any errors in oil and gas drilling, refining, mining, or manufacturing could result in destructions and deaths. Process awareness in this sector is, therefore, a priority.

However, there is inadequate process awareness with regards to the application of asset management in this sector (Lillis & Szwejczewski, 2012). This lack of awareness has greatly contributed to asset deterioration and obsolescence. Kolios and Luengo (2016) define obsolescence as the state whereby physical equipment becomes outdated and phased out of the market to the extent that it can no longer be used for any economic gain. Assets become obsolete when they are poorly managed or when physical inspections are not sufficiently conducted. According to Andersen and Ross (2013), an essential part of asset management is checking the reliability and functionality of physical assets, which frequently does not occur. Numerous oil and gas companies manage significant infrastructure whose economic lifespan they have not been able to determine. This includes underground and underwater facilities such as pipelines, which can extend thousands of kilometres long and can be over a century old, and can potentially be obsolete.

The aspect of process unawareness is widespread today thanks to poor training and orientation to the organisational culture (Umesh, 2014). Wakeman (2013) argues that employees must be sufficiently oriented to their roles and task performance expectations during their on-boarding process, as well as during their tenure, to show them exactly how the organisation operates. This way, they become masters of their roles and are able to perform them according to industry standards. Corporate training sessions should be incorporated into an organisation's work schedule through regular workshops, conferences, and coaching sessions. This will help reinforce a strong learning culture within the organisation and equip the trainees with the requisite intellectual capacity as well as adequate hands-on skills required to efficiently handle

business operations (Serban & Iorga, 2016). Incorporating the senior management team into the training sessions is another way of enhancing the value of the process awareness program. The trainers should make it clear to all employees and stakeholders about the importance of training; how it helps to enhance their working capacity and elevate their competency within their career fields.

According to Umesh (2014), most organisations are apprehensive about rolling out employee training classes because they presume that they are an unnecessary cost for the company. This, however, does not have to be the case, as one can always start small. Before initiating any classes, some elements of the imminent training workshop can be tested on a small sample group to verify the viability of the training classes and determine whether they are worth the time and money (Proctor, 2014). The selection of highly adept and well-experienced instructors is also vital in ensuring the success of the workshops. Umesh (2014) explains that the issue of employee unawareness is sometimes caused by shallow training content from the hired instructors. The quality of the education given by the instructors may at times be lacking in value and significance; the material given may even be lower than what is defined by the oil and gas industry standards. For this reason, it is extremely important to take the time in selecting instructors who have a background of gratifying achievements and receiving positive reviews from their clientele.

Finally, organisations should ensure that they put in place an effective monitoring and evaluation program that will gauge the performance of the employees as well as the value of the workshops (Serban & Iorga, 2016). Goals and expectations should be defined to enable the trainers to track whether the training has been successful. The monitoring and evaluation team, for example, can declare that at the end of a training conference, the trainees should have consummate expertise on how to handle dedicated asset management software, how to react to natural disaster strikes, and how to manipulate real-time data streams on the current status of organisational assets (Viator, 2015).

Process awareness could also be further promoted through the incorporation of asset management courses in higher learning institutions (Tremblay, Lalancette, & Roseveare, 2012). Industries, including the oil and gas sector, ought to collaborate

with higher learning institutions, as well as statutory education boards, to allow for asset management courses to be incorporated in the institutions' educational curricula. These courses should feature administrative units on asset risk inspection, asset maintenance, data integrity, and maintenance regulations. They should be delivered over an entire university semester, thereby giving students ample time to learn, not only about the theoretical facts, but also the practicality aspects. Hénard & Roseveare (2012) argue that similar courses should also be implemented in polytechnics as well as other vocational institutes. This will ensure that even those students who do not study at the universities or colleges still obtain the chance to learn about asset management. This way, more and more people will know about asset management practices and will be able to put their skills into practical use.

2.7.8 Government interventions

Weghorst and Lindberg (2013) suggest that government interventions constitute any action undertaken by the state or public body in a bid to stage-manage any market failures and ameliorate economic efficiency. The state may opt to intervene in the market economy to remedy or mitigate risks such as high unemployment, low business productivities, competition from foreign markets, devaluing currencies, diminishing economic growth rate, and deficient social capital (Ajefu & Barde, 2015). The state may use several measures to implement these changes such as increased taxation, minimum wages, import tariffs, high pricing, interest caps, production quotas, and nationalisation of oil supplies, among many other examples.

The nationalisation of oil firms (state oil), in particular, has been very apparent over the past few years. Victor (2013) defines nationalisation as the move by the state to take over private oil companies and assume absolute proprietorship of them. This move is primarily geared at eliminating private ownership then taking all the revenues for the benefits of the state. According to Mahdavi (2014), the nationalisation policy originated in Middle Eastern countries such as Kuwait, Bahrain, Jordan, and Saudi Arabia. The chief aim of this policy was to help promote oil production and skill development to improve the overall economic proficiency/profits returns in these regions. However, the outcome of this policy was increased levels of exploitation in the industry. Industry operators are now forced to pay 50 percent of its total revenue

earning to the state in the name of royalties and taxes, yet they still have to cater for all business risks and losses (Mahdavi, 2015). This new policy also granted the state power to frequently alter the oil and gas prices, hence creating severe oil price fluctuations. This, in turn, affected the balances in supply and demand as well as the market base. Revenues began to fall and the industry operators were the ones that suffered the biggest impact, rather than the state.

The nationalisation of oil companies and supplies still thrives even despite its adverse effects on the oil and gas industry. Presently, only 7% of the world's oil and gas supplies/reserves operate in a free market environment; all the others have been nationalised (Mahdavi, 2012). Another effect is the increased environmental regulations stipulated by the state. As Victor (2013) claims, environmental considerations (for example, climate change and proximity to urban and rural development and economic interests) are only expected to increase. The consequence of this will be that more regulations will continue to be given to the approaches taken to physical asset development.

These measures usually go beyond the basic legislation of public goods production and incorporate additional economic policies (for example, Keynesian and Monetarism policies) that are geared towards improving economic performance (Abdelghani, 2013). Although they are well-intentioned at the beginning, these interventions tend to further harm the market economy rather than improve it. According to Arezki and Bruckner (2012), intervention by the state has, so far, resulted in the weakening of managerial authority over the financial and operational aspects of businesses. This intervention has imposed contradictory objectives and highly politicised investment decisions, labour relations, prices, and the choices of technology used (Cuervo-Cazurra, Inkpen, Musacchio, & Ramaswamy, 2014). The oil and gas sector, for example, is often caught up in numerous government interventions because of the high revenues it cashes in. It is these interferences that have affected the performance of businesses, product prices, and revenue generation, and has generally deteriorated the industry's productivity.

As Cui and Jiang (2012) assert, since the 1990s, state-owned oil and gas industry assets have generally experienced low productivity in terms of labour and deterioration in fixed facility and equipment utilisation. There has been an unsatisfactory service

quality as well as financial shortages; assets have suffered from underinvestment. The involvement of the government by way of regulation, financial controls, and, in some cases, the actual delivery of specific asset services (such as Australia's NBN) has resulted in numerous cases of poor performance. Managerial authority over the financial and operational aspects of their business has also been considerably weakened. Furthermore, long-term planning and focus have been obstructed by short-term political considerations (Janvry, Finan, & Sadoulet, 2012).

While regulations are a fundamental part of a business, too many regulations constrain the normal functioning of an enterprise. The laws imposed on businesses appear to favour the state and implicate free enterprises instead (Kumar, 2014a). Examples of implicating laws include high taxations, import quotas, trade embargoes, and monopolisation of specific industries that dominate private businesses, minimum wages, expensive land leases, rigid vetting, weakened managerial authority, and price caps (Matter & Stutzer, 2016). These regulations only serve to benefit the state whereby it stands to cash in a lot of money from several points, for example, the value added tax imposed on businesses today. Laws are not supposed to constrain business operations. Rather, they are meant to enforce the rule of law, peace, and order, and safeguard the entities of life, environment, social interactions, social capital, economy, and safety to all individuals (Musacchio & Lazzarini, 2014).

As Mahdavi (2012) writes, the majority of oil and gas organisations are owned and controlled by the state. The industry is a cherished domain for the state to utilise and stream in these revenues, which are later used to finance other governmental projects. More often than not, these revenues are directed into the government rather than boosting the industry itself (Rogger, 2014). Because of this, the industry becomes vulnerable to increased domination by the state through the bombardment of new laws and regulations, higher taxations, high oil prices, and strategic control (Obinger, Schmitt, & Zohlnhöfer, 2014). There is also a high level of ambiguity in the legislations formed. Some of the terminology and statements that the lawmakers use in constructing law statutes and bills are at times very complex. Lawmakers tend to use very difficult grammar, which has been seen as one of the challenges when it comes to the application of these legislations by industry operators. At other times, it may not even be the complexity of the words or the grammar used, but rather the

structure and formation of a sentence or clause. The structure of a clause in a constitution may also be confusing because the author may have written the clause to mean one thing (Tuyucu, 2013); however, the audience (industry operators) may interpret it in another way.

The end result of these lexical glitches is ambiguity. Because of this ambiguity, the regulations are often misunderstood and interpreted differently by different organisations, which consequently leads to industry agents violating laws. In actual fact, the agent may not have violated the law in his/her own personal view. In the eyes of the lawmaker, however, the agent has infringed upon the law because of the wrong interpretation, and is bound to either pay a fine or face gaol time. Corporations that infringe laws in such a manner may be even labelled as punitive criminals in addition to facing civil liabilities. It is beyond doubt that there are no actual applicable regulations and guidance governing asset management areas that employees can directly apply to their operations.

Ambiguity in regulations also encompasses situations where laws on asset maintenance and guidance are inadequate or even non-existent. For example, there are no suitable regulations regulating the transaction of mergers and acquisitions (M&A) for the oil and gas industry. Malik, Anuar, Khan, & Khan (2014) describe M&A as those corporate transactions that involve two or more business entities consolidating/merging into one organisation (mergers) or transferring ownership of company shares or intellectual property from one entity to another. M&A are extremely intricate commercial processes and call for adequate legal procedures and regulations to avoid mishaps. Even so, the regulations that should govern and foresee these M&A transactions for oil and gas assets are very scant and have contributed to hindering the successful operation of asset management. Because of insufficient regulations, businesses have been unable to properly manage their assets as they should. Inadequate regulations or ambiguity in law statutes have reportedly generated situations whereby there is non-conformity in regulation application. Managers, instead, apply the rules in the guidelines and regulations as they see fit. This is because they do not understand them. Lageson, Vuolo, and Uggen (2015) say that operators have been unable to apply the regulations because they possess insufficient knowledge about how they should be carried out.

In response to this, several scholars have argued for the discontinuation of state interventions, stating that these interventions can be disruptive (Abdelghani, 2013; Belloc, Nicita, & Sepe, 2014; Goucha, 2012; Juel and Aslaksen, 2013). Instead, they advocate for the adoption of free markets. Free markets refer to market economies that rely on the dynamics of supply and demand to define market prices and output quantities (Belloc et al., 2014). This creates an environment where the merchants and consumers operate by free will and not under strict directives and laws enforced by the government. The government does not interfere at all. Instead, the government observes from the sidelines and develops the basic public good policies such as property rights, the rule of law, and currency rationalisation (Arocena & Oliveros, 2012).

As for the issue of ambiguity, there is a need for more lucidity on lexical and grammatical structure. Lucidity, in this context, refers to more clarity and exactness in a word, sentence, or clause meaning (Schane, 2012). Lawmakers and legislators are recommended to adopt easier and simple terminologies whenever constructing statutes and bills. No bill, clause, or statement should feature words that have two or more meanings as two different entities can interpret this same word differently. Instead, they should choose words that have no synonyms or more than one meaning. In addition, the grammatical structure of these legislations should be designed carefully to avoid confusion and misunderstanding on the part of the reader. Similarly, lawmakers should be cautious of their syntactic sentence structure to eradicate instances of ambiguity (Schane, 2012). This way, industry operators will be able to develop a stronger understanding of the present regulations.

2.7.9 Reluctance to change

The reluctance to change to the application of an improved asset management process is quite evident in the present day. Human beings are slow to change even when it means changing for the better (Yılmaz & Kılıçoğlu, 2013). They might be fully aware that their current situations are undesirable. They might also be aware of the solutions to their problems but are still very averse to implementing these solutions. According to Wittig (2012), this aversion to new ideas is detrimental for business. Economies cannot flourish if every time a better concept, technology, or

design is produced, people do not want to implement it. Change averseness crashes innovativeness and originality. People are advised to welcome new ideas and business structures to beat old, failing systems and accomplish more competitive initiatives. Nonetheless, there has been an aversion to change in the implementation of asset management practices. Many people say that they believe in change, yet seemingly are not necessarily willing to change, until something goes wrong (Berna-Martinez & Macia-Perez, 2012). Management tiers already know that their organisations require asset management systems in place to facilitate better business productivities, yet they do not do anything to achieve this (Graham, Harvey, & Puri, 2013). Management tiers always talk of how asset management can be used as a tool to improve business operations; however, other than the slogans spoken, no one actually makes any changes regarding asset management. They speak of change, but just keep doing it the same way. In reality, most departments want change for other departments but not for themselves, such as the finance department, materials department, asset management department, operations, procurement, and logistics. Even the project managers and human resources departments who most speak of change are the ones who resist change the most in their own areas (Christensen, Dhaliwal, Boivie, & Graffin, 2013). People seem to like change in the abstract more than in reality. Action is only taken after a disaster occurs; however, by that point, the business would have already lost a lot in terms of its good reputation, revenue, public approval, and market share.

This negative attitude extends to the organisational structuring of the departmentalisation of roles. Rather than establishing asset management as an independent department in its own rights, often asset management is merged into other departments. If corporations were strongly committed to asset management, they would permanently establish a team of highly skilled dedicated resources to focus solely on this aspect of the business (Wittig, 2012). They would establish a separate department for overseeing this function, which would eventually deliver the greater outcomes managers constantly speak of. They would not put it as a subdivision of other departments that already exist in the business. Merging it diminishes its prestige, lessens focus, and makes the industry operators overlook its importance (Bernardoa, Casadesusb, Karapetrovicc, & Heras, 2012). It serves to show that asset management is essentially not a strategic level responsibility, but that it falls within the jurisdiction of operational managers. There needs to be a

preparedness to change thinking towards the application of asset management, as the framework is not just an accounting tool, which many treat it as. If asset management is to improve, organisations must go through a change in culture before they can operate differently. The current leaders ought to take charge and enforce these changes. Leaders need to show strong support for the asset management program by appointing the right managers to support people trying to undertake such a program. They also need to be held accountable, rather than blame the low-level workers for any issues (Clarke, 2012).

Reluctance to change mainly stems from the lack of commitment to an organisation's goals (Islami, 2015). This is evident in the poor asset maintenance observed in organisations today. The problem with asset maintenance is that it tends to be overlooked by numerous business establishments as a non-essential process (Islami, 2015). The majority of these businesses view asset maintenance as a minor and inconsequential function that they only indulge in when necessary, that is, when one of the machines actually breaks down. There is no genuine coordination and correct asset data documentation sharing within organisations, which has caused a big impact on maintaining assets (Fazlollahi, 2012). According to Davis (2014), most of the time, most company information is recorded in different registers and reports, which literally means both business units are recorded on different pages. Because maintenance data is kept separately, it becomes impossible for managers to quickly review the asset's performance; therefore, underperforming components can go unnoticed for some time, contributing to poorer outcomes all round. Put simply, asset maintenance data is not seen as a priority. Sometimes, it is not even collected at all. This leads to asset managers having to make important decisions when they do not have all of the information.

Without comprehensive maintenance, you cannot effectively employ your assets. Time and again, most assets are found to be in a critical state and must go off-line, and the cause is traced to not complying with the asset maintenance schedule list that the regulatory body had not updated. Being ignorant of the critical information contained in the updates means that the assets might be non-compliant, and this may make the organisation legally liable. Asset maintenance is not for only when assets break down. Rather, it should be carried out at all times even when there is no reported break down

(Hongxun et al., 2014). Maintenance should be an ongoing process. This way, machines are regularly checked. Additionally, these regular checks enable the technical team to identify any early signs of deterioration or machinery failure prior to their actual occurrence. Horn and Granger (2013) argue that the identification of such early signs makes it possible for the technicians to correct these errors before they spread throughout the machines. Thus, the assets are saved from complete deterioration and their economic lives are prolonged. All assets must be scheduled for maintenance and the type of maintenance depends on what type of asset it is. It is of paramount importance that companies practice good maintenance planning as they can extend the life of assets. Maintenance processes must be considered seriously. Prioritising maintenance is crucial, as it ultimately adds value to businesses by reduced repair bills, and it also means better services for customers. Oil plant assets (particularly those not physically attached to the ocean floor) must have a well-scheduled maintenance program in place (Kolios & Luengo, 2016). Resistance to change is a reality in every industry as Kotter (2008) argues; however, the pace of change is now in an almost constant state. The ability of an organisation to facilitate effective management of this process as well as develop effective change agents ensures such changes such as asset management occur easily. Change also links heavily with leadership as discussed earlier. Kotter (2008) argues that they are linked and effective change management requires great leadership.

2.8 Gaps in the Asset Management Literature

There are a number of gaps in the academic literature relating to asset management functions. The most eminent one is the inadequacy of empirical studies in this sector. There are not enough publications outlining factors that influence asset management. There has been even less research undertaken on how to develop better asset management frameworks. The few existing studies lack a consensus on an appropriate framework for asset management. Some researchers have suggested that the perceived absence of theory and principles has resulted in widely divergent methods of asset management (El-Akruti & Dwight, 2013). This divergence in methods is one of the reasons that there has been poor implementation of asset management.

The literature on asset management also appears to be fragmented. There does not even appear to be a general definition of “asset management”. Instead, there are many

different definitions and understandings of this profession, and they all seem to clash or disagree with each other. A general definition is important because it enables organisations to effectively define their purposes, interpret their benefits, and appreciate their contribution towards the greater objectives of the organisation (Farnsworth, Guzior, & Malani, 2012). Different definitions, on the other hand, trigger different understandings of the profession and even lead to divergent methods of application. An extensive review of asset management frameworks in different companies highlights the existence of several models that differ greatly in their design, complexity, and specific details.

The most popular asset management framework implemented by the greatest number of industries consists of the enterprise resource planning (ERP) asset management module process framework, which dates back to the 1990s (Fazlollahi, 2012). This framework incorporates strategies applicable to the industry such as cost-benefit and return on investment; vendor capability analysis, and best practice; and fast track and outsourcing methodologies. Features of the ERP include:

i) Enterprise management, for example, resource planning, performance management, product life cycle management, workforce relationship management, procurement and strategic sourcing, and enterprise asset management;
ii) Supply chain management, which includes planning the supply, demand, and distribution; supply event; warehousing and transportation management; trading; and e-commerce;
iii) Frameworks for manufacturing and plant; and;
iv) Operational management, which includes manufacturing execution systems, program management, value and quality management, plant automation and control systems, lean manufacturing and maintenance, and repair and overhaul (Patil et al., 2014).

Within the manufacturing sector, the adoption of technology models has been popular. These models include specific components such as system engineering, demand management, integrated logistical support, configuration management, and total quality management (TQM) (Jackson, 2012). Other areas have had other slightly different asset management frameworks, such as transport, utilities, and service

providers to asset managers (Riddell, 2014). Within a hierarchy of importance, processes range in descending order, beginning with asset planning, and moving down to include asset creation (including both acquisition and finance), operations, and maintenance, which includes ongoing monitoring, renewal, replacement, and disposal of surplus assets. Performance measurement occupies the final position. Frameworks specific to the asset life cycle typically encompass quality, environmental management, and risk to constitute the entire asset management framework.

The diversity in approaches spanning the asset management profession, which typically customise their frameworks to specific organisational types, does not, however, advance the development of asset management. Rather, it confuses practitioners. Liu et al. (2015) point out that the organisational practice of functioning as "silos", that is, traditionally isolating operations, engineering, maintenance, and other functions separately, results in significant missed opportunities. Consequently, the discipline of asset management remains fragmented, and lacks a consensus concerning its constituent parts. This effectively means that asset management is unable to adequately fulfil its potential towards enhancing overall organisational performance. Thus, Kusumawardhani (2016) argues that studies on asset management should be consolidated to amalgamate the world view on this profession and improve its application.

2.9 Chapter Summary

This chapter has reviewed the literature relating to asset management as it is currently practised. The factors influencing the practice, as well as the gaps in research, were also reviewed. The material discussed herein centred on the prime significance of effectively managing assets, more so the physical infrastructure, within the oil and gas industry. Oil and gas platforms are asset-intensive and the majority of oil and gas organisations' business operations are centred around the handling of physical equipment (for example, drillers, pressure vessels, pumps, oil and gas tanks, and refiners). These utilities are extremely heavy duty as they are used to mine petroleum, as well as other petrochemical substances from beneath the surfaces (McMahon, 2016). Because they are regularly operated, they require efficient asset management to keep them in good condition and to avoid them from becoming obsolete before the end of their economic lifespan. Asset management ensures that

equipment is well maintained so that the industry operators may achieve optimal functionality throughout their economic lives. There have, however, been several challenges constricting the application of asset management throughout present-day industries. The purpose of this thesis is to investigate the sources of these challenges and develop a proposed framework that offers a clear contribution to this area of research. This chapter has identified the current factors that create the intricate web of asset management as well as the potential results and impacts if not applied correctly. There is little doubt that the literature and research conducted thus far is limited in respect to offering solutions that are specific to the oil and gas industry. The research argues that this high-risk industry relies on assets to operate and has some frightening history with respect to poor asset management that resulted in fatalities. This demonstrates why a new framework that would support a more effective and dynamic approach to asset management is critical and of value. This chapter was developed to build that picture for the reader to understand the gaps, the need, and the value of the contribution this research aims to make.

Chapter 3: Methodology

3.1 Introduction

This chapter provides an overview of the logical contexts, ideologies, and methodological principles adopted by the study during the primary data collection process. The chapter outlines the data collection methods, the research approach, strategies, sampling techniques, ethical guidelines, and the data analysis that was undertaken for this thesis. It is important that any future research, in the same study area, makes complete use of all philosophies and procedures. This will allow researchers to verify their findings against the existing results and, as such, makes an important contribution to this field of research.

3.2 Research Philosophy

According to Saunders et al. (2016), during the first phase of a research project, the researcher should specify the research philosophy that will be adopted for the study. This step assumes great significance as all the subsequent phases of the research will have to align with the chosen research philosophy. In other words, the choice of research philosophy influences the research design, research strategy, and the choice of data collection and analysis methods. According to Bhattacherjee (2012), research philosophy can be thought of as a researcher's strong beliefs about the ontological nature of the social/management world, epistemological dimensions related to what type of knowledge is valid and acceptable, and about the role of the researcher in the research process (the axiological dimension of the research philosophy). Furthermore, a researcher must decide the most appropriate research philosophy before moving on to the stages of research design and primary data collection. Essentially, research philosophy is the primary driver of the choices to be made regarding the type of data to be collected together with the choice of research approach, strategy, and research design (Øye, Sørensen, & Glasdam, 2016).

Edmonds and Kennedy (2013) suggest that a research philosophy can be categorised as constructivism, pragmatism, realism, or positivism. The research philosophy of positivism refers to an epistemological stance that valid knowledge is produced via the collection of data from a large sample set and analysis of that data using scientific methods of hypothesis development and testing (Cottrell, 2014). Thus, the focus is on producing knowledge by collecting numeric data and applying statistical tests to

produce law-like generalisations. In addition, the ontological dimension of positivism dictates that reality is external to the observers and it is independent, i.e. it is not influenced by the perceptions and experiences of the participants. Furthermore, the contributions of positivism are in the form of causal relationships and predictions. Lastly, from an axiological perspective, the role of the researcher is to remain detached throughout the research process so that objectivity is preserved. In contrast, the philosophy of realism is grounded in the belief that *"what is seen by the eye is what truly exists*" (Saunders, Lewis, & Thornhill, 2007). Thus, positivism and realism are alike in terms of ontological beliefs—both assume that an objective world exists independent of everything else (Edmonds & Kennedy, 2013).

The philosophy of pragmatism maintains that knowledge is truly valuable when it supports action that must then be executed successfully (Cottrell, 2014). Furthermore, a pragmatist researcher treats reality as a practical effect of ideas and aims to merge and reconcile the theories of objectivism and subjectivism. In other words, the origin of pragmatism lies in the attempts made by researchers to amalgamate facts and values, accurate and rigorous knowledge, and different contextualised experiences (Saunders et al., 2016). According to Edmonds and Kennedy (2013) Constructivism, which is also referred to as interpretivism, is based on the belief that reality is not universal—instead, it is complex and rich and constructed by the participants/observers in social settings via the use of culture and language (Sekaran & Bougie, 2013). Constructivism suggests that reality cannot exist independently of human beings and that human beings develop their understanding of reality only when they undergo/accumulate experiences and later reflect upon these experiences. Furthermore, observers can experience or construct multiple realities and they can derive different meanings or interpretations. Constructivism rejects the beliefs of positivism as too simplistic and instead focuses on human perception, attitude, reviews, feedback, opinion polls, interview responses, faith, customs, religion, political beliefs, ethics, and logics (Creswell, 2014). According to Edmonds and Kennedy (2013), constructivism constructs knowledge or insights from main themes, implications, or key insinuations prevalent in these sources.

This thesis is based on the constructivism research philosophy as the researcher believes that the domain of oil and gas asset management is complex and the

knowledge about this domain can be best obtained by collecting and analysing qualitative data, which is more processual in nature. Furthermore, the researcher aims to extract insights about this topic by collecting and analysing subjective information provided by the subject matter experts. Evidently, each subject matter expert is expected to view asset management differently and each may derive different meanings and interpretations based on individual experiences in this domain. Different organisations follow different procedures and best practice frameworks for asset management and, therefore, it is believed that by combining these varied narratives, a new world view pertaining to asset management can be created (together with the generation of novel ideas). As Derntl (2014) explains, subjective knowledge has more substance as it captures the different aspects of reality and if a researcher aims to obtain deep learning about a subject, then the most relevant method is to interact with human respondents and collect different versions of experiences associated with a common issue or concern. By its very nature, constructivism entails social intervention and the co-construction of meanings by human beings as social actors (Long, 2014). Constructivism means that people can congregate and interact with each other, share thoughts and ideas, discuss key challenges, and design effective solutions that prove useful to organisations. Rich information is unravelled, which is embedded in the domain context and it is vetted by a group of people. Positivism and realism do not provide this platform wherein people can converge to create novel worldviews and therefore, they yield knowledge that is devoid of processual richness and context (Johnson, 2012).

3.3 Research Approach

There are two types of research approaches, namely the inductive and deductive approaches to consider for this research. A deductive approach focuses on the need to test study hypotheses (Simonsen & Robertson, 2013), whereas an inductive approach concentrates on forming new theorems (Bhattacherjee, 2012). A deductive approach is fit for a case where a researcher may have previously read about the relationship between female education and low fertility rates but is still interested in proving whether the relationship is valid or not; thus, the researcher will conduct a deductive statistical research approach to test the null and alternative hypotheses of the study. Inductive approaches, on the other hand, will be fit for cases such as where the researcher may want to find new information about how advertising influences the

performance of sales in the UK. An effort to dig for content on this topic may be unsuccessful as there are barely any journal articles, books, or press statements providing this information. The absence of this information, therefore, propels the researcher to perform a research study in a bid to explore more on this issue and gather more data to publish it in peer-reviewed journals.

This study embraces and employs an inductive approach to further explore the challenges facing asset management within the oil and gas industry. Several oil and gas practitioners have reported that despite the fact that asset management assists in maximising the economic lives of their assets, its implementation is straddled with challenges that include poor decision making, poor leadership, and exorbitant compliance fees brought about by a rigid political framework among many others. These challenges are increasingly restricting the oil and gas operators from maximum exploitation of asset management systems, leading to an implementation gap. There is, therefore, a need to conduct in-depth research on these challenges and fathom the root causes. The best way to gain more information on the above-mentioned challenges is via an inductive approach and not a deductive approach. Inductive approaches, as Johnson (2012) explains, enable people to come together to discuss a certain issue at length; they discuss their experiences, positive and negative encounters, thoughts, and attitudes concerning that issue. If there is a perceived problem, various people may even volunteer to teach others on how to implement certain solutions (Øye, Sørensen, & Glasdam, 2016). Embracing an inductive research approach for this present study enabled the researcher to collect people's views and thoughts on asset management and the various challenges hindering its efficient implementation in the oil and gas industry. This way, more data and information shall be made available to the public and will help bridge the literature gap that is currently prevalent in this industry. This shows the value of the contribution that this research will make to this field and topic area.

3.4 Selection of Research Method (First Phase)

3.4.1Research strategy

Research strategy encompasses either quantitative or qualitative data. Øye et al. (2016) define quantitative data as the numerical parts of information that are

collected and tested statistically. Qualitative data, on the other hand, are in a textual, abstract, and narrative format and tend to retrieve a rich, complex exploration of the subject matter from multiple subjective perspectives (Bryman & Bell, 2003). For the present study, it was decided by the researcher that an exploratory qualitative approach was most suitable. This thesis aims to explore the challenges and hindrances preventing effective asset management within the oil and gas industry; therefore, a qualitative methodology will help in sieving more information and thoughts on this topic. This is because a qualitative research strategy engages people and prompts them to talk intuitively about a given topic, the present challenges, and possible solutions.

3.5 Data Collection Method (First Phase)

There are many methods or ways of collecting primary data. These methods are dependent on whether the data is of a qualitative or quantitative nature. Quantitative data collection methods include survey questionnaires, observations, and experimentation; while qualitative data collection methods include interviews, focus groups, grounded theory, action research (AR), role-playing, and ethnography (Sekaran & Bougie, 2013). This study is based on qualitative research methods; thus, it follows that the data collection method shall also be qualitative in nature.

Interviews consist of the researcher posing a series of questions and the interviewees providing their answers to these questions, one by one (Øye et al., 2016). Interviews can be an effective way of collecting data from human participants, especially if the interviewer has set the interview questions in a strategic way to prompt insightful responses from the interviewees. Interviews can be conducted in multiple ways such as face-to-face, via the telephone, Skype, online conferences, and group interviews (Hilal & Alabri, 2013). According to Creswell (2014), even though all these modes of interviews serve the purpose of data collection, the most effective mode is face-to-face interviews. Face-to-face interviews are generally considered the most effective means of interviewing because they bring together the interviewer and the interviewee into the same physical space as opposed to the telephone or Skype-based interviews. When both parties are in the same physical space or vicinity, more details are collected because more details are revealed besides the verbal replies that an interviewee may give during the question-answer session. The interviewer may, for example, pick up on additional non-verbal cues such as body language, facial expressions,

comfort/discomfort of the interviewee, and swiftness in responding to the questions (Bhattacherjee, 2012). These are cues that cannot be detected over the telephone or via Skype-based interviews. These non-verbal cues serve as bonus details for the interviewer as he/she will be able to read the interviewees more thoroughly and evaluate their hidden feelings.

In the present study, the researcher opted to administer face-to-face interviews as they presented an ideal way of observing innuendo and unspoken body language meaning as well as generating subjective data. The interviews were organised in a structured manner, i.e. all the interviews contained similar questions (Saunders et al., 2007). The design of structured interviews is such that the questions therein are in a pre-determined standardised format and the interviewer cannot deviate from this format to ask different questions (Bhattacherjee, 2012). They consist of closed questions that probe specific answers. Their advantage is that because they contain a fixed format, they only require very minimal time hence they are time-saving. Long (2014) also claims that they make it very easy for the researcher to analyse the final data collected. The reason for this is because almost all the answers to each question contain a somewhat identical theme or concept; hence it becomes extremely easy when reading data patterns and interpreting their meanings (Sekaran & Bougie, 2013). The data from structured interviews are also very reliable and easy to test. Appendix D provides an illustration of the interview questions enlisted for this research study.

3.6 Adoption of the Grounded Theory Approach

This study also undertakes a grounded theory approach in interpreting the final data results obtained from the interviews. The grounded theory requirement to undertake research without preconception contributed to its attractiveness for this study. Grounded theory allows a researcher to formulate a new theory from the collected data derived from study participants in the event that there is an absence of theoretical bias in the initial stages of the study. As a consequence, the theory that emerges is the one that best corresponds to the data, rather than corresponding to the researcher's preconception (Evans & Moores, 2013). Additionally, the grounded theory approach is regarded as complementary to organisational studies and research because it helps with supportive decision-making mechanisms.

Concerns stemming from both individual and group behaviour are captured with the grounded theory approach as it can accommodate data of a complex or unconventional nature. Through this approach, a strong link between practice and theory can be established, which may prove of practical value for organisations to gain an insight into their staff perspectives and understand how these influence work-based situations (Øye et al., 2016). Grounded theory differs from other qualitative theoretical approaches in that it emphasises a theory generation by attaching conceptual labels to groups of data to identify relationships, while other methods place an emphasis on describing data rather than interpreting it (Johnson, 2012). Long (2014) argues that adopting a grounded theory approach is the most suitable method by which to capture the intentions of managers and interpret their actions, as well as to understand human behaviour within group settings and social organisations. The researcher fully supports this argument and considers it viable for this research approach.

Grounded theory is a research methodology that is continuous in nature. The process begins by creating some overall questions that guide the research. These questions are, however, neither static nor confining. The research results in the identification of the core theoretical concepts and the development of tentative linkages between the data and theoretical concepts. Grounded theory comprises three analytical strategies. These are coding, memoing, and integrative diagrams. The adaptation of the grounded theory approach is not entirely without precedent. Research that has incorporated aspects of grounded theory within its methodological basis, especially during management and organisational studies, have done so in tandem with other methodologies, particularly qualitative analyses. Additionally, employing grounded theory procedures as part of a range of theoretical perspectives is common within studies spanning social sciences and humanities disciplines (Saunders et al., 2007). Practical reasons are used to justify amending the grounded theory approach to suit studies set in the business or organisational sphere. A compelling case to adjust the approach is found in the existence of the pre-determined issue or specific focus that the study is designed to address. In such cases, it is impractical to ignore the existence of preconceived ideas or directions that the study ought to pursue, therefore the approach's application may be amended specifically to compliment or negate such tendencies.

Another argument justifying theory modification is that it is likely that some studies can anticipate inundation of unstructured data. Instead of being swamped by confusing data, in the interests of efficiently sifting through it to extract useful information, researchers, particularly in the field of organisational and management research, may permit a temporary theory to be accepted to refine, guide, and sort information for further analysis from which a new theory may be extracted. In such cases, the original guiding theory will be subject to modification or will be superseded based on what is extracted from the data (Long, 2014).

For this study, interviewee perceptions and ideas, expressed during the course of the interview were the focus of research. Therefore, coded data relating to specific units of information that may be succinctly expressed in statements ranging from brief phrases through to several paragraphs were obtained. For research purposes, it is paramount to categorise data themes, rather than every single fragment of information. Strauss and Corbin's (1990) proposals have been considered, however, they were determined to be excessive for the present study, as this research needs expressed perceptions and ideas, and not off-topic information.

3.7 Sampling Technique

Sampling entails the procedural approach that is used to select a suitable number of people/subjects to be involved in the data collection process (Saunders et al., 2007). It is always crucial to identify an appropriate sample of research participants to help with data collection and to answer the researcher's questions on particular research problems. For example, a researcher who is investigating a contemporary trend relating to Chinese women's education will most likely obtain this information from Chinese women. They thus serve as the target population for that study.

However, since it would be impractical to research the entire female population of China, the researcher would have to select a smaller group of participants. The act of selecting this smaller participant group from an entire target population is what is referred to as "sampling". To shrink this vast population size, the researcher may pick out a fewer number of participants, say 500 participants, to participate in the exploratory study on behalf of the rest of the population. These 500 women now constitute the sample population and are deemed to be a classical representation of the

larger target population. According to Sekaran and Bougie (2013), sampling entails the selection of a smaller and more compact subset of respondents who are a typical representation of the target population of a given study. Sampling is an extremely crucial step in all research methodologies as it eliminates the stress of having to work with vast population sizes during data collection procedures (Johnson, 2012).

There are two broad categories of sampling. These are probability and non-probability techniques. Probability techniques offer an equal chance of selection to all the population members, whereas the non-probability technique is the opposite. Non-probability techniques rely on various selection criteria such as age, occupation, gender, location, and many more (Saunders et al., 2007). As much as probability sampling is equal and proportionate, it may not always give an ideal set of sample group participants (Cottrell, 2014). The reason for this is because there are no pre-defined criteria when choosing the sample group participants. Take the Chinese women population for example; if all the women were to be given an equal chance of selection, the researcher may end up with a group of participants who may not be well informed about the contemporary trends of women's education in China. Their lack of adequate knowledge on this issue may compromise the quality of the participant responses during data collection; hence ending up with content that is very basic and lacks rich insights (Johnson, 2012).

The aforementioned insufficiency is cancelled out when dealing with non-probability sampling techniques. While it is true that non-probability techniques are sometimes biased because of the subjectivity involved in selecting members of the sample group, they tend to generate content that is rich in context (Bhattacherjee, 2012). The reason for this is because their selection procedures involve pre-defined and calculated criteria that are specially configured to select the most appropriate members for that particular study. Taking the example of the Chinese women again, let us suppose that the researcher selects only those women that have attained education up to college undergraduate level; these members will be better positioned to know more about the contemporary trends of Chinese women's education and provide well-informed responses as opposed to the first group.

Thus, the present study undertakes the non-probability sampling technique in its sampling of human participants. Non-probability techniques are subdivided into other minute segments such as purposive sampling, expert sampling, quota sampling, instance modal sampling, and snowball sampling (Saunders et al., 2007). This study is based on the purposive branch of the non-probability sampling technique. As Creswell (2014) explains, purposive sampling encompasses the situation whereby the researcher selects study participants based on his/her own judgement, taste, and preference. This judgement is subjective to the researcher and is contingent on various factors such as age, occupation, gender, race, ethnicity, religion, social status, geographical location, and educational attainment among many other variables (Cottrell, 2014).

Purposive sampling is ideal for situations where the researcher wants to work with a number of participants who fulfil a particular purpose. In the present study, the author used the purposive sampling method, and this enabled him to single out three oil and gas organisations, A, B, and C, who provided him with a list of their respective employees to interview and obtain their opinions regarding asset management. Two of these organisations are main players in the oil and gas industry; one is actually a subsidiary for trading petroleum products with plans to integrate base oil producing affiliates and establish global base oil product sales. The third company is a major consulting company in the oil and gas industry.

3.8 Interview and Focus Group Procedure

This section outlines the step-by-step procedure followed while conducting the interviews and focus groups. Qualitative research derived from interviews is considered a favourable way to generate subjective data. That is, such data can be derived from asking people to discuss their experiences regarding a given topic (Johnson, 2012). To differentiate qualitative study data from quantitative, Saunders et al. (2007) advocate the “in-depth interview” method. In contrast to quantitative interviews, in-depth interviews are non-directive. They make extensive use of open-ended questions designed to initiate a conversation involving equal parties. These questions are used in preference to the question-and-answer approach that is used for quantitative interviews, and which are typically made up of closed or yes-no questions. In-depth interviews are flexible and dynamic, enabling researchers and informants to

communicate in a relaxed face-to-face manner with the respondent expressing themselves in their own words.

On 1 October 2014, the author sent out interview invitations to the list of employees proposed by the three oil and gas organisations A, B, and C. Although 51 people approved the invitations, only 50 actually attended the interviews. The invitations consisted of three documents: i) Introductory letters (see Appendix A); ii) Consent Form (see Appendix B), and (iii) Research Ethical Guidelines (see Appendix C). Different venues, dates, and times were scheduled as provided by the interviewee companies. The interviews officially began on 3 November 2014 and ended on 18 February 2015. The interviews began with the interviewer introducing himself and providing a brief overview of the project, its aims, objectives, and end goals. The interviewer then proceeded to ask the participants the questions as provided in the interview guide (see Appendix D). The interviews lasted an average of 45 minutes. During the course of the research, participants expressed confidence in the steps taken by the researcher to ensure their anonymity. The interviews were conducted in a well-paced manner to create a tranquil mood and prompt the participants to speak freely without fear of condemnation. The interviewer carefully noted down all the participants' responses underneath the questions in the interview guide, for purposes of future reference and data analysis. After the interviews had concluded, the interview transcripts were compiled together for subsequent data analysis.

The focus groups were conducted with two independent groups of eight persons each, between September 2018 and November 2018. One group was selected from the first phase of this study and another group was selected from willing volunteers in the oil and gas industry at different levels. The researcher mailed the invitation documents to the companies Research and Development coordinator, which consisted of three documents: i) Introductory letters (see Appendix H); ii) Ethical Research Guidelines (see Appendix I), and (iii) Focus Group Discussion Guide (see Appendix J).

Focus groups involve an open and honest discussion that looks to review the framework proposed. The group sessions were conducted in accordance with the guideline, which was shared with participants during the discussions. The guide was a plan that allowed a degree of control and to retain focus and control over the direction of the debate. The focus groups were formed and then conducted utilising the guidelines.

Since a focus group discussion (FGD) is meant to stimulate discussions around a specific topic, the outcomes of these sessions have an impact on the future course of action for the researcher or the sponsoring organisation. Keeping this in mind, it was decided that the composition of the group will be meticulously planned and the discussions would be guided. Also, it was decided to create an environment that would be conducive to a free and candid exchange of ideas. This was deemed to be absolutely crucial as the participants were not only expected to share their opinions, but they were also supposed to respond to the observations made by others. In the beginning itself, the researcher determined that the goal of the FGDs was to validate the findings obtained from the interviews and to ascertain if new knowledge could be obtained pertaining to the subject matter of asset management in oil and gas companies.

Next, it was important to ensure that the researcher had the requisite skills as a leader who could manage such important discussions. In this regard, prior training and experience helped the researcher in gaining confidence and going ahead with the FGDs method of data collection. Also, it helped that the researcher had extensive work experience in the same domain and he could easily relate to the research participants, ask relevant questions and guide the discussion in the desired direction.
In terms of the discussion guide, the researcher prepared the list of topics that would be taken up for discussion. These topics were taken from the literature review as well as from the findings extracted from the first phase of the research (in-depth interviews). Some of the topics planned to be covered during the FGD sessions were – Risk Management, Leadership , Procurement, Strategic Objectives, Asset Management, Business Continuity Plan, Disaster Recovery Plan etc. In addition, the researcher prepared a general format for the questions to be asked (which were later adapted according to each topic.

Once the participants were finalized (recruited), two calls were made to confirm their participation on the day and time specified. In addition, one email was also sent as a gentle reminder. The benefits of participating in the research process were emphasised and a few personal contacts were also used to make sure that the participants agree to come. On the day of FGD sessions, all the arrangements were reviewed – venue readiness, recording instrument, presence of the support person and the availability of the earlier findings.

During the FGD session, the researcher opened up the discussion by making a welcome note and summarising the goal and purpose of the exercise.

Next, participants were asked if they had familiarised themselves with the themes that had been shared with them earlier. In addition, copies of earlier findings were again shared with the participants for the purpose of referencing. After that, the researcher explained the proposed flow of the topics and summarised the rules of engagement. For each topic, the researcher set the tone by summarising the existing research knowledge and asked the participants to start contributing. Also, similar questions were put in different ways so that the participants could respond as they related to different words and fords. The researcher made sure that follow-up questions were asked. Finally, the researcher continually took note of the participation level of each respondent and elicited opinion directly from those who were a bit reticent. This was deemed essential to ensure that the responses were representative of the whole group and not a few extraverted participants.

In terms of the recruitment plan, the researcher relied on a segmentation schema wherein respondents were identified as belonging to different domains such as information technology, procurement, risk management, asset management, human resources management etc. The idea was to strive to get participants who could represent all the domains that were covered during the first phase of the research. Once the set of potential participants was identified, a recruitment screener was applied by the companies' coordinator wherein it was ascertained whether the respondents would hold positions that would give them the right kind of knowledge and understanding; whether they would be available for the FGD sessions, whether they would impose any conditions on participation what would impact the research process. The focus group sample pool was drawn from organisational supervisors/team leaders, manager and general managers within the oil and gas industry, and the discussions lasted an average of 60 minutes on each component of the proposed framework.

3.9 Data Analysis

Data analysis proceeded simultaneously with data collection. Information obtained from the interviews was carefully transcribed and analysed using the NVivo software program, which helps researchers explore qualitative data to unearth

particular themes, points, ideas, suggestions, concepts, or patterns in abstract texts (Hilal & Alabri, 2013). Analysis was undertaken by reading transcripts carefully and identifying terms, themes, or facts, as well as reflecting on the data and analysing it sentence by sentence. Data was organised according to specific categories and in chronological order, and was repeatedly reviewed and coded in accordance with the grounded research approach to facilitate its analysis. Significant ideas that emerged were recorded in special constructs such as nodes in conjunction with the anticipated use of NVivo data management software (see screenshots of the data analysis process in Appendix E). The results of the data analysis are demonstrated in a codebook (see Appendix F). As soon as practical following the interview and focus group discussion, transcription commenced. Some of the completed interviews were transcribed by the researcher while the remaining were completed by a different transcriber.

The focus group dataset was also analysed using the NVivo software program (see Appendix K), which provided a clear differentiator between the interviews and validation of the framework. The approach followed the recommendations of Riessman (1993) in regard to content and presentation to ensure a vibrant data result was presented to each reader.

3.10 Rigour

The term rigour refers to the approaches taken to ensure the reliability and validity of data collection. Rigour is related to the integrity of the data collection process and does not necessarily have anything to do with the outcome of that process. While the data's interpretation may be subject to question the actual data itself should be beyond dispute. Falling within the ambit of rigour is the reliability which is typically demonstrated by replicability of process. Reliable data ought to be proven as such, by being able to be replicated to produce the same outcome. Meanwhile validity which describes the extent to which the data can be regarded as accurately reflecting reality, is related to both the process and the outcome. During any appraisal process, when the outcome is at variance with existing knowledge on the subject this will by necessity bring under scrutiny the research process. As a consequence, it is necessary to ensure rigour is built into methodologies to safeguard the research process. Rigour is designed to ensure methodologies survive any careful examination. In the following sections a discussion of techniques under consideration for the research will follow.

3.11 Selection of Research Method (Second Phase)

The researcher considered that while the interviews would provide datasets for analysis, the research would also require a validation method. The aim of the research is, after all, to provide a solution and a contribution in the form of a framework. To not apply a validation method would ultimately leave a clear research gap and leave the research results open to academic criticism. The researcher considered the advice of Wilkinson (2004) who discussed qualitative research methods, both his and the practice. He offered several robust recommendations regarding the validation of research findings and reducing gaps in the findings. The main method considered suited to the present study was employing focus groups. Wilkinson (2004) argued that focus groups demonstrate another level of transparency of research by literally throwing the research findings and recommendations to the lions (i.e. the focus group participants). Focus groups when correctly selected will provide open and, in some cases, painful feedback to researchers. That pain is, however, worth undertaking as a means to truly validating the findings. This is a way of collecting two datasets as well as providing an open and honest validation of the research framework proposal. Stokes and Bergin (2006) also support the employment of focus groups, particularly when combined with earlier interview sets. Milena, Dainora, and Alin (2008) also considered the value of focus groups when compared to interview sets. The present study considered their findings and decided that by combining and correctly staging the interviews followed by the focus groups it would correctly support the research stages. The focus groups could be employed during the final stages to review the proposed framework. This thesis, therefore, employed two methods of collecting data, interviews and focus groups. These offer data collection for the two different phases of the research and the focus groups will help verify the research findings.

Essentially, Saunders et al. (2007) divide methodological choices into three parts—quantitative, qualitative, and mixed methods. The first and the third choices are eliminated because first, the researcher does not aim to analyse the relationships between variables, which are measured numerically and analysed using a range of statistical and graphical techniques; and second, the researcher does not aim to mix quantitative and qualitative methodologies to validate the framework. Therefore, and with logical coherence, the researcher will adhere to the methodological choice of a qualitative approach that was adopted during the first phase of the research—

development of the asset management framework for the oil and gas industry. The justification for using the qualitative methodology will essentially remain the same; first of all, it is aligned with the interpretive research philosophy. For the first phase of the research, the researcher asserted that interpretivism/constructivism would be the preferred research philosophy as this research is driven by the belief that social actors construct knowledge through experience (Sekaran & Bougie, 2013). Thus, knowledge is produced via the study of a subjective world view (ontology) and obtained by abstract narrative means (epistemology), which include human perception, attitude, reviews, feedback, opinion polls, interview responses, faith, customs, religion, political beliefs, ethics, and logics (Creswell, 2014). Valid and acceptable knowledge is produced through the extraction and synthesis of the main themes, implications, or key insinuations prevalent in these sources (Edmonds & Kennedy, 2013). Subjective knowledge is considered as having more content and enlightenment, and finally, the most insightful way to obtain knowledge about a phenomenon or topic is to engage in in-depth conversation with individuals and obtain their different versions and understandings about that issue (Derntl, 2014).

However, while the first phase of the research adopted a mono-method qualitative methodology because the only data collection method was that of in-depth interviews with the industry professionals, the second phase of this research will be characterised by the adoption of a multi-method qualitative methodology. This is because the next phase of asset management framework validation involves data collection through focus group discussions (FGDs) and the analysis of this data using qualitative procedures (Saunders et al., 2007). Furthermore, a multi-method qualitative research methodology aids in enhancing the validity of the research endeavour. This approach helps in the creation of a descriptive view of the domain under study and, in addition, a prescriptive solution can be derived as to how the world should be (a normative framework of asset management in the oil and gas industry, in the context of this research) (Patton, 2002).

Saunders et al. (2007) suggest that after the decision has been made about the research methodology (multi-method qualitative research for the present study), the next step is to finalise the research approach. There are different distinct options available corresponding to a qualitative research methodology—case study, ethnography, AR,

and grounded theory. The first research strategy, AR, is about research in action and it works through several stages or iterations, and the focus of the question may change as the research develops. Furthermore, at each stage of AR, a process of diagnosing or constructing issues is adopted followed by planning for action, executing that action, and evaluating the action outcomes. Clearly, the evaluation outcome of the actions taken is aimed to extract inputs for the next cycle of the research wherein the same steps are repeated—diagnosing issues, planning for new actions, executing actions, and evaluating action outcomes. It becomes clear that AR is composed of such iterative cycles. In terms of the rationale for using the AR research strategy, Brydon-Miller, Greenwood, and Maguire (2003) suggest that this strategy is compatible with an epistemological belief that knowledge comes from action. Furthermore, AR adopters feel compelled to work upon that knowledge in a collective and collaborative way, and they draw power from a "pragmatist" research paradigm, which places emphasis on knowing through doing rather than knowing through conceptualisation. This commitment to action is amplified by an observation that the difference between AR and other forms of research enquiry lies *"in the commitment of action researchers to bring about change as part of the research act"* (Brydon-Miller, Greenwood & Maguire, 2003, p. 15). Bradbury-Huang (2010) reinforces these notions about AR and suggests that AR is a specific orientation towards knowledge creation that is compatible with the context of practice and, therefore, AR requires that researchers work with practitioners. Furthermore, AR's goal is *"not primarily or solely to understand social arrangements, but also to effect desired change as a path to generating knowledge and empowering stakeholders"* (Bradbury-Huang, 2010, p. 93). The commentary on AR provided above indicates that this research strategy is more aligned with the epistemological stance that is commensurate with the pragmatist philosophy, whereas for the research project under consideration, it has been emphasised that the preferred philosophy is that of interpretivism. In addition, despite the many advantages that AR might hold as a research strategy, the practical implications of its adoption convinced the researcher to not follow this approach. First, the researcher has professional experience in the oil and gas industry and he has worked with the practitioners who handle responsibilities corresponding to the different areas that define the domain of asset management. As a consequence, the part of knowledge creation from observation or participation is partially covered owing to the researcher's experience in the field. However, it is difficult to make this aspect

explicit in this research project. However, this is partially reflected in the researcher's ability to construct relevant interview and focus group questions as well his ability to interpret the data collected. Next, because the process of AR is iterative in nature and requires collaborative action with the practitioners, it was practically not feasible for the researcher to spend time with each of the asset management functions at a stretch and, moreover, the aim of the present study is not to effect and witness change in a specific organisation. Rather, this research is aimed to produce knowledge about the challenges that organisations in the oil and gas industry face currently and to develop a generic, recommendations-based asset management framework, which the organisations may use depending upon their discretion.

In view of these observations, the researcher believes that for the second phase of the research, which involves asset management framework validation, a grounded theory research strategy is both useful and applicable. The justification remains the same as that for the first phase: Grounded theory allows a researcher to formulate a new theory from the collected data derived from study participants in the event that there is an absence of a theoretical bias during the initial stages of the study; the theory that emerges is the one that best corresponds to the data, rather than corresponding to the researcher's preconception (Evans & Moores, 2013). The grounded theory approach is regarded as complementary to organisational studies and research because it helps with supportive decision-making mechanisms.

3.11.1 Data collection method (second phase)

After the methodological choice has been finalised followed the adoption of a single research strategy that fits with the nature of the research, the last decision that the researcher has to make is about the data collection and analysis method (Saunders et al., 2007). For the second phase of the research, which is about the validation of the asset management framework, the researcher decided to adopt the FGD for data collection. Hennink (2014) states that the FGD method falls under qualitative data collection methods and its key characteristics include a focus on specific issues, the participation of a pre-determined group of people, and an interactive discussion. More specifically, this method is described as an *"interactive discussion between six to eight pre-selected participants led by a trained moderator and focusing on a specific set of*

issues" (Hennink, 2014, p. 1). The aim of the FGD method is to gather information about a broad range of topics within a span of 60–90 minutes in an environment in which the participants can freely and comfortably express themselves. This method differs from other qualitative methods in terms of purpose and composition, as well as the group nature of the interactions. FGDs consist of 6 to 8 participants but this can range from 5 to 10 participants depending on the purpose and context of the research. Participants are pre-selected and they share similar backgrounds or experiences that are relevant to the research topic. The discussion is restricted to a limited number of issues and adequate time is spent on discussing each issue in detail. There is an emphasis placed on the discussion and interactions among the members and this aspect is essential for gathering data that is unique to this method. Questions posed by the FGD moderator are carefully designed to stimulate discussions, with the moderator effectively probing the group to uncover broad perspectives and experiences. Finally, a permissive and non-judgemental environment is mandatory so that the participants can freely express themselves without feeling threatened.

Robinson (1999) suggests that the aim of the FGD is not to arrive at a generalised or representative statement of opinions (which other methods such as surveys aim to achieve but where the responses are limited) and, instead, there is an assumption that participants may not be able to readily render opinions when interviewed independently and, therefore, they must be open to influence by other members in a group setting. Watts and Ebbutt (1987) assert that FGDs can generate more critical research outputs compared to individual interviews. Essentially, this method ensures that freewheeling discussions occur wherein participants react to issues and concerns that others raise. Furthermore, in an FGD, sometimes there can be a single dominant person who can prove to be an asset—he or she can bring forth key opinions and play a key role in shaping and sharpening ideas so that the discussion takes off. However, the flip side of this is that a dominant or highly opinionated person can discourage others from participating and expressing their views freely. This can happen when the dominant person is voluble or possesses a sheer force of argument. In addition, there are certain practical problems associated with choosing and implementing FGD as a data collection method—there may not be a problem of recruitment when the groups can congregate naturally; however, in a professional setting, it is not easy to bring all the participants together, especially when they belong to different organisations.

Additionally, recording of data is problematic because there may be too much burden in taking field notes even when two researchers are present as it can become difficult to note all the aspects of what is being discussed. Finally, FGDs suffer from a drawback when it is necessary to discuss intensely personal and detailed experiences and, moreover, group dynamics preclude the possibility of the interviewer asking questions in succession to uncover the perceptions of a particular interviewee. Acocella (2011) confirms the advantages of using FGD as a data collection method. The group is the source or information; therefore, it is possible to collect high-quality knowledge in volume and within the limited time available for discussions. Because experts are invited to take part in these discussions, they are naturally interested in the research topic and, therefore, the collection of detailed and relevant knowledge becomes easier. Since the members are generally homogenous in terms of shared experiences, communication among them tends to be more spontaneous and is not marked by ambiguities that may emerge due to different cognitive and evaluative perspectives, and, finally, the goals of "collectively" are achieved because the participants have shared values, have a developed sense of solidarity, and they feel morally obligated to fulfil their role expectations.

Lastly, it is important to describe how the FGD approach to data collection is in alignment with the research strategy of grounded theory. In this regard, Gray-Vickrey (1993, p.21) asserts that *"Focus groups are well suited for a full range of qualitative studies including grounded theory, ethnography, and phenomenology"*. Specifically, the grounded theory approach suggests that the data collection methods are not fixed, and its use allows for multiple stages and levels of data collection and making interrelationships between the data collected as opposed to one particular data collection method (Creswell, 2011). The researcher is allowed the freedom to determine his/her data collection technique and because data collection from different sources and at multiple stages is the quintessential nature of qualitative studies, this feature was applied in the study process for the present research.

3.12 Use of FGD as a Theory Validation Method

There are various techniques for validating a framework. According to Creswell (2007), the intentions of expert opinion validation are to assess the adequacy and clarity of the developed framework. A framework that is regarded as

comprehensive and clearly understood is robust and likely to be accepted by users (Omolara, 2014). According to Omolara (2014), there are three principal approaches for undertaking the validation process, namely FGDs, interviews, and postal surveys. Lichtenstein and Swatman (2003) suggest that FGDs are useful for data collection because the integration and assimilation of a wide array of opinions from different subject matter experts and stakeholders become possible in a short period of time. Further, these integrated and assembled views can be transformed into a "plausible theory". In their research study, Lichtenstein & Swatman (2003) illustrate the use of FGD as a theory validation method in the context of business research. In specific terms, this business research study pertained to the management of information systems and security issues via organisational business policies. Because the researchers wanted the solution to be comprehensive and holistic, they referred to multiple literature resources (from different disciplines) to identify and incorporate different human, societal, technical, and organisational factors. Using these resources, an initial framework was developed that consisted of models and issues at multiple levels of details. Next, the researchers explored this framework in detail with the use of a multiple case study method—six large organisations were studied for their significant utilisation of the information management as part of their business activities. Specifically, in-depth semi-structured interviews were conducted with managers to leverage their in-depth knowledge about the complexities pertaining to security from an organisational perspective. Further, data was analysed *"using the initial version of the framework as a guide for pattern-matching purposes"* and a *"cross-case analysis [was performed] across the six cases, to determine commonalities, trends, and differences, and to draw conclusions from these for the research project"* (Lichtenstein & Swatman, 2003, p. 214).

However, at this stage, it was recognised that there were insufficiencies in data collected and the solutions developed via the case study method. In addition, limitations were identified pertaining to the data collected through single interviews and the study of documents. In particular, the researchers felt that some issues were not raised during interviews that related to social, human resources, legal, engineering, administration, and organisational culture dimensions. The researchers perceived that some of the questions were not answered satisfactorily due to political correctness and that the interviewees did not feel stimulated enough to suggest potentially useful

solutions. Finally, it was felt that the interviewees were being too agreeable and that the responses provided by them were mostly unidimensional. Owing to these limitations, the researchers chose to adopt the FGD method as they believed that for the validation stage of the research, any solutions arising out of a meeting of diverse experts from different disciplines would be likely to be holistic.

From an operational perspective, the FGDs were conducted with the help of a moderator who was an academic having some background in the domain of information management. Furthermore, there were five participants who had different job roles, and thus they represented different disciplines and perspectives. A document containing information about the research purpose and initial framework was shared with the participants before the FGD session date. After completing the formalities related to introductions and narration of session objectives, the moderator helped the group review the document, which contained topics, issues, framework, and component models. This phase of the FGD resulted in a free flow of ideas and brainstorming, and the moderator steered the discussion to discover support (or lack of it) for the framework and its component models. Finally, suggestions for changes were elicited.

Based on this FGD experience, the researchers were able to devise a set of guidelines for an effective use of focus groups in theory validation. These include the composition of the group should be multi-disciplinary and multi-organisational; the researchers must be aware of the key issues related to the topic under study; the moderator should focus on identifying potential discords that arise due to the multi-disciplinary and multi-organisational composition of the group; the moderator should encourage the group to put forth differing views and to resolve open issues; models that comprise the theory to be validated should be available to participants as documents, both before and during the session; models should be structured and showcased in such a way that the participants can easily move from one component to another; the moderator must carefully explain the theory and models to the group and allow for different perspectives to emerge from participants who may belong to different disciplines and organisations; the moderator must facilitate brainstorming so that new issues emerge and are discussed; and finally, the moderator must seek research relevance—for example, if the research output is expected to be useful for

business organisations, then confirmation about the same must be sought at key junctures of the discussion.

Another example of the use of FGD for framework validation comes from the research undertaken by Dahlberg and Kivijärvi (2006) who developed a new IT governance framework. During the initial phase of the IT governance framework development, the researchers surveyed and analysed theoretical models, models used by practitioners in different organisations, and existing theories. In addition, they used their experiences to review the status of IT governance. After an initial version of the framework was developed, the validation process was carried out using FGDs wherein responses from the participants were used to revise and improve different components of the initial framework. In operational terms, the FGDs were carried out in the form of one-day workshops where group members evaluated the framework questions and the status of each organisation. In addition, the focus group members developed the importance index for the components of the initial framework. As an outcome of these FGD sessions, the researchers were able to develop and validate an integrative framework that was expected to help board members, general managers, business line, and executives to understand, measure, and manage business governance in their respective organisations as part of corporate governance.

Finally, evidence in support of the practice of using FGDs for framework validation comes from the research work of Omolara (2014), as mentioned above, who suggests that there are three ways of accomplishing this goal— by conducting interviews with experts, conducting FGDs, and sending postal surveys to experts. In line with this, Ngwira (2015) validated a framework for asset management by eliciting expert judgement and feedback. Specifically, the author developed a validation questionnaire that covered different aspects and components of the framework that required external validation. During the process of development of the questionnaire, several criteria were considered, which included completeness in terms of inclusion of all the important aspects of asset management, comprehensibility in terms of ease of reading and understanding, and cost-effectiveness in terms of the ease of implementation.

The present study, therefore, adopted the FGD as a validation method of the asset management framework. For the purpose of this discussion, two FGD sessions of eight

participants each were held at two different oil and gas organisations with the researcher acting as the facilitator.

3.13 Chapter Summary

In summary, this chapter has described the steps that the researcher undertook during the collection and analysis of the primary data. These steps encompassed the research philosophy, research approach, research strategy, data collection methods, sampling technique, data collection procedure, and data analysis method. Each of these steps played a part in the gathering of the primary raw data for the present study. The study embraced a constructivism research philosophy because it gives a free avenue to question human respondents, and obtains their views and thoughts about the topic at hand. The study also selected the inductive research approach that enabled further investigations via interview sessions with executive personnel in the oil and gas sector. The study employed FGDs as a validation method. The selected research strategy entailed the qualitative method, as this method enabled the researcher to effectively investigate the challenges and hindrances preventing effective asset management within the selected industry. The study used the NVivo software program to evaluate the raw data and develop meaningful information.

Chapter 4: Results

4.1 Introduction

This chapter documents the final results obtained from the NVivo data analysis process. The evaluation of data using NVivo saw the development of themes and sub-themes whereby specific quotes were grouped together into specific nodes to demonstrate similar data patterns (see Appendix F). Consequently, this chapter's primary objective is the presentation of research findings, supported by interviewees' opinions concerning asset management and accounts of the challenges, issues, and variables, leading to the development of an asset management framework and concluding on how this will lead to a positive contribution to the sector. The finding's report is presented transparently to show the thought processes at work and how concepts progressed to theory. The findings are firmly supported by interviewee quotes that were derived from interview transcripts and that are provided in italics. These quotes endeavour to let the research participants speak in their own words as a way of illustrating the concepts being discussed (Whiteley, 2002). The themes identified by the NVivo based data analysis are shown in Table 4.1.

Table 4. 1 Themes

	Themes
1.	Strategic Objectives
2.	Organizational Structure
3.	Strategic Procurement
4.	Business Continuity Plan
5.	Supply Risk
6.	Asset Management Framework
7.	Integration of systems
8.	Poor Leadership
9.	Human Resources
10.	Poor Regulatory
11.	Communication Management
12.	Unwillingness to change

4.2 Personal Details

Personal details entail basic demographic information that is meant to avail critical data about the study participants such as their age, gender, occupation, and marital status. As Etienne, Johannsen, and Lopez-Salido (2016) assert, it is vital for a researcher to collect demographic information as this helps the researcher know more about the participants, and hence understand their plights better and come up with feasible solutions. This situation is notably true of commercial institutions and governments who need such information to better serve a given population in an amicable manner. In this study, three demographic elements were outlined: job title, job roles and responsibilities, and employment duration.

4.2.1 What is your job title?

The purpose of this question was to determine the exact positions held by the interviewees to gauge their knowledge of organisational processes. As indicated in Appendix F, 23 of the interviewees are Board of Directors while 27 are members of

the Board of Management. This layout hints at a well-coordinated corporate structure within the organisations interviewed. According to Maduenyi, Oke, Fadeyi, and Ajabge (2013), a corporate structure is critical in organisations because it outlines the hierarchical path that should be followed by all employees when reporting official issues. This structure also enables the smooth supervision of employee duties to determine whether staff members are carrying out their roles.

Generally, a corporate structure lays down a well-defined workflow chart whereby roles can be easily monitored, new concepts can be easily implemented or enforced, work progress can be evaluated, issues can be easily escalated, mentoring can be executed, and new positions can be easily added. The availability of a corporate structure in the interviewees' organisations implies that there is operational efficiency and therefore processes ought to run smoothly. If not, then there is a lack of operational efficiency, which is likely a result of poor management or leadership.

4.2.2 What are your job roles?

The purpose of this question was to determine what responsibilities these interviewees fulfil in their pertinent positions. The data analysis for this particular question was composed of two segments, namely the roles of the Board of Directors and the roles of the Board of Management. The Board of Directors aims to ensure that the stakeholders' interests are fulfilled in entirety (Srivastava, Masli, & Sherwood, 2015). Because they are elected into their positions by the organisation's stakeholders, it is the board's mandate to ensure that the stakeholders are acknowledged in all areas, for instance, market profitability, legal issues, and annual income (Knyazeva, Knyazeva, & Masulis, 2013). They must also ascertain that the shareholders, creditors, investors, and suppliers are well represented and that their rights are upheld. To achieve this, the Board of Directors frequently hold meetings to come up with intelligent business strategies that are designed to boost the organisation's performance, business productivity, and profits. They also chair all the ongoing activities within the organisational departments to ensure that the decisions made by the board, the strategy and protocol, the mission and vision, as well as the organisational ethics are implemented as need be. In this study, the Board of Directors were responsible for the following departments: Asset management, Business

continuity, Customer relationship management (CRM), Engineering, HSE, Infrastructure management, Production and operations, Regulatory frameworks, Risk management, Staff training and mentorship, Strategic procurement, and Supplier management.

The Board of Management, on the other hand, are tasked with the role of putting into action the decisions made by the directors. They report to the Board of Directors; thus, they are expected to ensure that all the strategies put across for business development are, in actual fact, implemented. According to Hilb (2012), to ensure effective implementation, the managers set strategic objectives for the organisation to achieve. Setting objectives comprises defining goals and appointing the right people to the right tasks to accomplish. Setting objectives also help communicate job expectations, monitoring and evaluation, staff discipline, key performance indicators, policies, and productivity standards (Rao & Srinivasulu, 2013). Eventually, the aim is to propel the organisation towards achieving its mission and vision by way of mobilising individual activity. Therefore, the management must be well-coordinated, have good leadership skills, and know how to engage with employees effectively so that every arm of the organisation can work as required. In this study, the role of the Board of Management was to implement strategies in the following fields: Asset management, Business development, Communications coordination, Developing business plans, Engineering, IT management, Productions and operations, Project management, Risk management, Supply chain management, and Regulatory compliance. Senior level management, particularly the Chief Executive Officers (CEOs), acts as a representative between the Board of Directors and the Board of Management. They are appointed by members of the Board of Directors to ensure that all decisions made by the board are put into action; hence they serve as the bridge between the two boards (Baldenius, Melumad, & Meng, 2014).

4.2.3 How many years have you worked in a similar role?

The purpose of this question was to find out how long the interviewees had been working in their current positions. Such information is important in a research study as it reflects the knowledge base of the employees in a given organisation. Indeed, the longer an employee has worked in a certain company, the wider their

knowledge base is regarding that company and its day-to-day processes (Gabčanová, 2011). Over the years, long-term employees accumulate considerable knowledge about the company's culture, its corporate structure, vision, mission, goals, and services provided. Additionally, in executing their duties day in, day out, they discover better ways to accomplish their goals, resolve issues within the organisation, and integrate more technological innovations among many other developments. They perceive the business model better and now know what strategy works best and what does not work. This way, they lessen operational inefficiency and in the process increase business productivity.

As indicated in Appendix F, 26 interviewees had worked for as long as 11–15 years within their organisations. This duration bracket comprises the majority of the interviewees. Only three of the interviewees had worked for 16–20 years whereas only seven had worked for 21–25 years. Only 13 interviewees indicated an employment duration of fewer than 10 years. No one, however, indicated that they had worked for less than 5 years. These statistics show that the study's population was long-term employees who had served in their respective organisations for more than 5 years. It is thus expected that these interviewees have a very wide knowledge base about most, if not all, of their organisational processes and can, therefore, give very intellectual insights about their organisations, their roles, and the challenges they experience from day-to-day.

4.3 About the Organisation

4.3.1 What are the strategic objectives of your organisation?

The purpose of this question was to investigate the type of strategic objectives that the organisations have set to accomplish after a given time-frame. In this study, there was a wide array of strategic objectives set by the interviewees' organisations. These consist of better HSE compliance, enhanced quality of products and services, enhanced workforce development culture, improved internal organisational setup, increased brand promotion and global presence, increased business alliances, increased profits and revenue, increased technology innovation, and to exceed stakeholder expectations.

4.3.1.1 Improved HSE compliance

One of the interviewees asserted: *"Currently, our company also has developed and implemented a Risk Mitigation Plan as well which is in accordance with its ability to achieve organisational efficiency keeping in view the volatile business environment".*

A second interviewee said: *"Let me start by acknowledging that we are a green company and we do our best to sustain our environment. We ensure compliance with local and global environmental laws and safety standards and regulation". "We work hard to develop the best methods in a way that helps us grow in the market by increasing safety of workers as well as ensuring environmentally friendly aspects being applied".*

4.3.1.2 Enhanced quality of products and services

Other interviewees said that their organisation's strategic objectives centred on enhancing the quality of their products and services. They announced that their companies ensured that they provided excellent services, high-quality practices, and unmatched quality for the levels of services provided by the company, and that this initiative by the organisation was driven on the need for a strong client servicing industry.

One of the interviewees said: *"The strategic objective of the Group ensures to enable its customers with strategic management planning. The company has been known for its range of service and its capability to sustainable growth in the local and global market for Oil & Gas". "The company has ensured that the company offers unmatched quality for the levels of services provided by the company. This initiative by the organisation has been driven on the need for strong clients servicing industry".*

Another interviewee said: *"We pride ourselves on producing high-quality products and premium services through our total quality management practices. We are one of very few companies in the Kingdom to implement TQM practices to highest standards".*

4.3.1.3 Enhanced workforce development culture

Some interviewees said that their organisation's strategic objectives are focused on enhancing their workforce development culture. They claimed that their companies have re-focused their strategy for workforce development and introduced a number of initiatives to ensure that employment of Saudi Arabia citizens has grown, and that they have also become one of the leaders in the service industry. Their interest lies in growing talent (business leaders and professionals) and creating meaningful employment within Saudi Arabia:

One of the interviewees said: *"The company re-focused their strategy for workforce development and introduced a number of initiatives to ensure that employment of Saudi Arabia citizens is grown, they also become one of the leaders in the service industry". "The company success's is 100% dependable on its employees. We have built great faith on our employees whom the key success number one for us". "Our people and culture create value on continuous improvement that to perform at our best. We are preparing for the future to lead it".*

4.3.1.4 Improved internal organisational setup

Two interviewees said that their organisation's strategic objectives centre on improving their internal organisational setup by promoting a healthy ethical climate supported by the internal operational control to achieve the integrity of their company's operations:

One of these interviewees said: *"The company promote healthy ethical climate supported by our internal operational control in order to achieve the integrity of our operation".*

The other interviewee said: *"We achieve this through strategical management on wide array of levels. For instance, our communication Management is Improved through continual internal communications".*

4.3.1.5 Increased brand promotion and global presence

Some interviewees said that their organisation's strategic objectives are focused on increasing brand promotion and global presence in local and international

markets. Their focal objective is aimed at making their companies a pioneer in the market and a leader in the oil and gas industry as well as in the chemical and plastic manufacturing industry. Some claimed that their managements have an overarching objective to be able to retain and sustain a leadership position across the Asian oil and gas market and establish their companies as a brand of choice for customers:

One of the interviewees stated: *"I have been working for this company for last twelve years. This company is one of the leading companies dealing with Gas in Saudi Arabian Oil & Gas market. The company service provider is one of the leading solutions providers for Oil and Gas in totality present in the Kingdom of Saudi Arabia, in the fields of integrated services for oil, chemical, petrochemical, and other allied industries. This company is one of the major shareholders in Oil & Gas market in Kingdom of Saudi Arabia which is a well-sought supplier of a number of world-class products from its partner corporations around the world"*.

Another interviewee said: *"Currently, the organisation is one of the leading organisations that has success in the Gulf region ranked as one of the top 100 companies running under Ministry of Oil & Gas in the Kingdom of Saudi Arabia. corporate headquarters in the eastern province of Dammam linking it back to the regional sales of the country also providing services to various locations across the Kingdom of Saudi Arabia having a network of asset management and procurement offices across the world with regional offices in Asia, Europe and America. This company has built its enterprise significance in the Kingdom of the Saudi Arabia. The group has its headquarters in the eastern province of Kingdom of Saudi Arabia called Dammam, it is the capital this province which has its boundaries extending out and beyond. This company has its global business presence"*.

Yet another interviewee asserted: *"This company is the leading player for Enterprise-wide Oil and Gas Company in Saudi Arabia. The Company is a nationwide company and has global presence in the Oil & Gas sector in Saudi Arabia. The primary objective of the Company was to become the industry leader when it came to the Exploration and Production Company for Oil & Gas and natural resources in Saudi Arabia. This will allow the company to work towards enhancing their production profile and reserves in turn"*.

4.3.1.6 Increased business alliances

Some interviewees reported that their objective was to increase business alliances. They said that they intend to forge good policies for partnerships between their companies and others, and welcome any other entities that would like to join the organisation. They reported that they would also like their companies to be major stakeholders with other companies and business partners outside Saudi Arabia through long-term financial partnerships, as well having various collaborations with other oil and gas companies to shine in the industry.

One interviewee said: *"Our objective is to progress and build up on the achievement that we made as of today, especially by leveraging the initiative and our partnership that we have in place"*.

Another interviewee claimed: *"... the company has been able to develop strong relationships among the government and high officials. The company's clientele has got some key contacts, which are of paramount importance for the business specifically in the jurisdiction where the company's operations lie"*.
A third interviewee replied thus: *"Our management team do a great work establishing one new strategic alliance annually. Finally, our channel Management always works on improving distributor and/or supplier relationships"*.

4.3.1.7 Increased production and exploration

Some interviewees said that their organisation's strategic objectives are focused on increasing production and exploration operations. They divulged that their organisation's main vision is to acquire major interests in deep-water exploration and to maintain their production and enhance operational processes to execute business strategies. In addition, their companies have great focus around primarily the expansion of oil and gas resources and reservoirs worldwide while ensuring that every well they drill prepares them for the future.

One of the interviewees claimed: *"The Company has established its presence in Saudi Arabia, since the year 1988 as one the passive operator. At present, the company has five Oil & Gas fields in its acquisition, providing agricultural support. The fields have their licenses until 2023, which leaves them with 8 years from now. It has also been*

ensured that the production for Oil and Gas should have continued to maximise the profit and exceeding the expectations of the users in turn contributing to the overall production of the Group".

Another interviewee said: *"The company has grown its strategic objectives and operational plans which allows the company to follow a business strategy. At the moment the company has business strategy in place to acquire lands for exploration and production. The business strategy is such that the organisation is given meaningful acreage for the leaseholds which is that the organisation in the KSA has onshore basins for hydrocarbon containing significant reserves for the areas of untapped oil and gas".*

A third interviewee said: *"Our business has higher chances of exposing to opportunities for the production and exploration of oil and gas. It is imperative that the leading oil and gas plants should be able to create the abundance of gas resources, through the positioning of adequate and appropriate infrastructure causing the demand for LNG to increase and so is the case with the sales figures and establishing huge portfolios".*

4.3.1.8 Increased profits and revenue

Another interviewee said that their organisation's strategic objectives are focused on increasing profits and revenue. They disclosed that their main strategy is to generate stable cash flows by increasing profits and reducing costs, hence allowing them to make monthly distributions to their unit holders.

One interviewee claimed: *"Our main strategy is that to meet the business objective and generate stable cash flows allowing us to make monthly distribution to our unit holders".*

Another interviewee responded: *"Our strategic objective in the financial side is to exceed SAR200 million in the coming ten years". "We focus on our financial growth by increasing revenue, decreasing our expenses and increasing our net profitability by 10% per annum".*

4.3.1.9 Increased technology innovations

Some interviewees said that their organisations' strategic objectives are focused on increasing technology innovations, and that they intend to become the world leaders in this industry by providing the finest and effective technology to their customers.

One interviewee claimed: *"Our main objective is to become the world leader in this industry by providing the finest technology to our customers*".

Another interviewee replied: *"It has got various venture capitals through establishing effective technology"*.

Yet another interviewee said: *"Moving swiftly to another point, we adopt some internal and operational strategies. This system is mainly concerned about increasing efficiencies through use of latest technologies available in the market"*.

4.3.1.10 To exceed the expectations of stakeholders

The last eight interviewees said that their organisation's strategic objectives are focused on exceeding the expectations of their stakeholders. Their companies strive to lead innovative explorations in the market to increase the shareholders' values by increasing their net asset values, as well as providing continuous support to their customers.

One of the interviewees said: *"Our main objective is to become the world leader in this industry by providing the finest technology to our customers*".
Another interviewee claimed: *"It has got various venture capitals through establishing effective technology*".

A third interviewee said: *"Moving swiftly to another point, we adopt some internal and operational strategies. This system is mainly concerned about increasing efficiencies through use of latest technologies available in the market"*.

4.3.2 Organisational structure

The purpose of asking this question was to find out the workflow composition of the interviewees' organisations. In this study, the resulting organisational structure, as reported by the study interviewees, follows a hierarchy from the Board of Directors to the Board of Management, and down to the subordinate departments and staff. There are 22 Board of Directors who are responsible for the formulation of the organisations' strategic objectives as discussed above. After this, there are two Board of Management members who are responsible for the supervision of the day-to-day organisational processes in a bid to make sure that these processes fulfil the set strategic objectives. Then, there are several subordinate departments, including the Accounting, Administrations, Assets integrity, Automation Department, Brand management, Business Development, Communications, Compliance, Consultancy, Corrosion control, CRM, Drilling, Engineering, Finance, HSE analysis, HR, IT, Infrastructure development, Internal audit, Labours, Legal department, Logistics, Manufacturing, Marketing, Operations, Piping and static, Process and plants, Production and exploration, Project management, Quality control, Refinery, Research and development, Risk management, Supply chain management, Training, and the Treasury. Each of these departments is matched with a relevant objective, function, and target that they need to achieve within a given time-frame.

4.3.3 Do you have an existing asset management framework in your organisation?

The purpose of asking this question was to find out whether the organisations at which the interviewees were employed had in place a functional asset management framework. All 50 interviewees responded in the affirmative—yes, they had an existing asset management framework in their organisations. Furthermore, it was determined that three of the interviewees had in place the Google Drive – SharePoint framework, while 27 had the in-house Enterprise Asset Management Portals.

4.3.4 Can you please explain further?

The purpose of asking this question was to prompt the interviewees to provide more explanation to the answers they offered in the above question regarding the asset management frameworks in their organisations. Below are their responses:

4.3.4.1 Google Drive – SharePoint framework

❖ **Advantages**

The interviewees remarked that Google Drive was ideal for inventory control. One of them asserted: *"Well, as operational company, we do have many assets that we must keep record of in terms of its maintenance, repair, procurement spare parts, schedule, obsolesces etc. These records are maintained through the portal SharePoint where we keep the records of assets that being maintained by operational team"*.

Another participant claimed: *"The asset management tracking tool is being used by the company for the maintenance and management of assets including property, infrastructure, oil reservoirs control system, plants, and other public infrastructure"*.

❖ **Disadvantages**

The disadvantages of it were that it does not simplify work and lacks leadership from above.

One interviewee pointed out: *"This framework does not simplify work. It is very ineffective, and needs to be both easy to use and understandable without having to do some major training course*".

Another interviewee agreed: *"This is not the best system though. Reason being that we are currently using this system is because of the lack of leadership decision's making as well as insufficient employee engagement. Frankly, we need to look into this very seriously. The company and its leadership need to be very supportive to this discipline. In order to be genuinely supportive of us, asset management leadership needs to be innovative, creative and needs to be done differently"*.

4.3.4.2 In-house enterprise asset management (EAM) portals

Apparently, the EAM portals are ideal for inventory control. They are used to schedule the operations of maintenance, repair and overhaul of assets, spares and inventory management control. Most companies have been using them for monitoring the life cycle of their physical assets, scheduling maintenance, and ensuring the provision of detailed analysis of asset management in a holistic manner.

One interviewee asserted: *"The MS tool is used in our business throughout the enterprise portal, as it is the system that is used by the organisation to ensure that the organisation has the systems managed under the control of asset repository and monthly reports created by the system. The company manages all of these reports, which is asset intensive. This provides a holistic approach for the management, procurement, disposal, repair, maintenance and various other activities related to the asset in the life cycle of asset management".*

Another interviewee said: *"The company has an asset management framework which ensures that the firm has a proven track of all the assets, when the assets have been maintained, expired etc., The asset management framework is re-visited by the organisation every 5 years to ensure that the records management related to assets have been reviewed time to time".*

Yet another interviewee claimed: *"The current asset management framework had been developed in-house to suit our needs. This modification, creation and customisation follows a manual process where we keep our assets tracking on a log-sheets. The log-sheet includes the asset tracking maintenance schedule, asset tracking data information, asset details and all other required information that should be maintained".*

- **Disadvantages**

Its benefits notwithstanding, a number of interviewees explained that the EAM portals still have several drawbacks. One interviewee specifically said that such frameworks do not simplify work. In fact, they are very ineffective and need to be both easy to use and understandable without having to undertake a major training course. Three others claimed that their portals were old-fashioned, and thus very basic.

One interviewee said: *"Our current asset management framework is quite basic and simple … We are currently not using a cutting-edge system which we should. Our current asset management framework being used in our business need to be re-visited seriously in order to match our needs. We know this is a fact".*

Most interviewees, however, seemed disappointed by the lack of system integration for their portals. For example, one interviewee said: *"I shouldn't need to say this, but*

managing information is extremely important, yet frequently overlooked. Presently, we are looking into ways we can manage our information more efficiently. The organisation recognises it needs a new vision, so we are seeking to improve all aspects of our strategic business continuity. Part of this is our business continuity plan which is effectively our Disaster Recovery Plan which needs to be in place to ensure we can meet our strategic objectives in the event of a significant unplanned event. In order for us to proceed smoothly, we recognise the need to integrate our systems so as to achieve better information management, more effectively than we have in the past. We all know systems integration is very important…yet our present system continues to not support multiple integration of the business's many divisions…yet nothing is being done. We need to define our own evaluation process before we can deliver superior services to customers and other divisions. It's necessary to identify".

Another interviewee said: *"The company is currently using its own manual framework which had been enhanced in-house. The system is not quite comprehensive, but it does meet day-to-day operation. You know, the fact that we have disintegrated systems is causing our information to be considered as unreliable. In our company we actually have three different systems and none of them are integrated with any of the others. Despite the fact ...we all agree that a fully integrated system is important...we still have a situation in place…where data migration cannot take place as the current software is not integrated. Some of the important parameters that are monitored and improved through the implementing of integrated system: To ensure an improvement in performance of assets; To improve the need to utilise workforce for asset management; To decrease the cost for maintenance of assets".*

4.3.5 Would you be able to align the strategic objectives of your organisation with strategic procurement policies in your department?

All the organisations have linked their strategic policies with their strategic procurement policies. Any organisation that operates in the oil and gas sector should always have their procurement policies aligned with its strategic policies if the business aims to fulfil its target expectations. As outlined earlier, strategic objectives are the goals and targets that an organisation would like to achieve within a given time-frame. Strategic procurement policies, on the other hand, are systematic arrangements

or procedures crafted to help the organisation achieve its strategic procurement (Hallgrim et al., 2014). Therefore, strategic objectives and procurement policies work in tandem, that is, they both need each other to work effectively and one cannot work without the other.

Some of the interviewees talked about the benefits of having their organisations' strategic objectives and procurement policies aligned with each other. They said that the strategic objectives and strategic procurement policies should go hand-in-hand because they will enhance the selection and evaluation processes of the suppliers, their performance, the agreement of the service, and business value. Most agreed that procurement is one of the main pillars of their organisations' strategic dimensions as it brings about a strong sense of stability as well as a perfectly designed supply chain that ensures all the supply chain goals are achieved before every fiscal year for capital and revenue items. Procurement is also seen to reduce organisations' bottom line as well as reduce the cost of raw materials. Having a comprehensive procurement alignment with the company's objective adds value contribution to optimise the external spend in our operations.

The strategic procurement policy holds granular details on adopting a proactive approach to develop examples for leading improved procurement outcomes; hence helping to establish sustainable and ethical policies from which the organisation can benefit. More often than not, procurement policies are designed in line with the day-to-day operations. Therefore, it makes it easy for businesses to make informed decisions as well as ensure that the business accomplishes its mission and vision. If the strategic procurement policies of the organisations do not align with the strategic objectives, then the organisation would not follow the lean processes. The lean processes reinforce the need for procuring assets just in time, and this is in line with the concepts of TQM. The strategic procurement policies of a company, therefore, need to align with the strategic goals of the organisation so that the organisation can audit its processes and ensure that constructive feedback has been considered while devising processes.

One interviewee specifically stated: *"The Strategic Procurement policies of the company are created and written in complete synchronisation with the strategic*

objectives of the organisation. Not only that but also the Executive Committee of the organisation is there to ensure that the organisation sticks with its vision and adhere to the mission statement in order to be able to achieve its strategic goals".

A second interviewee said: *"If I were to develop the strategic procurement policies of my organisation, then I would prefer that the strategic procurement policy of Oil & Gas Company is developed in line with the strategic objectives of the organisation. The strategic objective of an organisation is the sum of its goals for not only that year but also for years to follow. In my opinion, if an organisation has identified its strategic goals then it must have also identified what it needs to achieve in order to align its goal with the strategy. Therefore, the procurement function helps the organisation identify how it should achieve what it wants to achieve".*

A third interviewee added: *"The strategic procurement of the company deals with the strategy development for the procurement of the assets. In my opinion, the strategic objectives of the organisation must be aligned with procurement policies. If the strategic procurement policy of the organisation does not meet with the strategic objectives of the organisation, then it would not follow the lean processes. The lean processes reinforce the need of procuring asset just in time and not managing the maintenance of assets which is in line with the concepts of total quality management".*

4.3.6 Would you be able to align the strategic objectives of your organisation with the asset management policies in your department or organisation?

4.3.6.1 No

Eight of the interviewees replied that they were unable to align their strategic objectives with their asset management policies, with the reasons being that their asset management function was either outdated or it was still a new concept and had not been fully internalised. Others gave the reason that their companies did not have an asset management framework in the first place, whereas the rest answered that the asset management policies were still under development and that they had a poor capacity management.

One of the interviewees said: *"However, I have said earlier the asset management framework is quite simple and is not fully integrated with the company's objectives yet"*. Another interviewee claimed: *"The company does not have traditional practices for asset management*".

A third interviewee added: *"These policies are yet not completed and still under process. I strongly believe that we should pay more attention to asset management system"*.

4.3.6.2 Yes

A total of 22 interviewees replied that they had aligned their strategic objectives with their asset management policies. The asset management policies of the organisation should align with the strategic objectives of the organisation. These strategic plans reinforce the need to create operational plans and tactical goals so that the asset management and planning process for assets is achieved within the performance benchmarks set by the organisation. Strategic objectives also play a significant role in providing advisory services when the oversight committee plans the asset management framework for the organisation, keeping in view all objectives of that organisation's individual business units.

Indeed, asset management frameworks are achieved in line with the strategic objectives of the organisation. They help ensure that the policies and procedures that are created for managing asset life cycles contain detailed information such as when the scheduled maintenance should occur, how often it is required by the organisation, what hours the outages should be planned for the organisation, and whether the organisation has achieved its level of maintenance updates and triggers. They also help in determining what assets have been procured, what assets can and have been updated, and if the asset can be repaired or if they need to be replaced. All of this is possible if the strategic objectives of the organisation have been considered before detailing the asset management policies and procedures for the organisation.

4.4 Strategic Procurement

This section reflects upon strategic procurement policies and particularly investigates whether the oil and gas organisations have installed any well-established

and documented policies. The aspects discussed herein include how these policies have been developed; whether they have been related to asset management, and if not, what were the challenges, and how were these challenges solved; and how often the strategic procurement department communicates with the asset management.

4.4.1 Does your company have well-established and documented strategic procurement policies?

4.4.1.1 Yes

All 50 interviewees reported having well-established and documented strategic procurement policies in place.

One interviewee replied, *"Yes, we have all the strategies in place developed to ensure that the organisation understands that it needs to comply with the standard processes as outlined by the PPRA (Public Procurement Regulatory Authority) and advocated by the Ministry of Oil and Gas"*.

Another interviewee stated: *"Yes, the company has well-established documentation for Strategic Procurement Policies and a handbook of all relevant details"*.

A third interviewee claimed: *"Yes, we have detailed documentation available on the Strategic Procurement processes within the organisation since the compliance processes within the organisation are quite strict"*.

At the time of writing, the Ministry of Oil and Gas in the Kingdom of Saudi Arabia has placed a lot of emphasis on all organisations to document their procurement policies. It is, therefore, considered very important for companies to maintain these policies, because they are held accountable for the procurement under the procurement authority. Thus, companies always try to keep in line with the standard procurement manuals, documents, and policies that are important to ensure that all organisational processes are prepared using the standard conditions and requirements. Strategic objectives also benefit organisations in so many ways. For instance, organisations now have a well-documented procedure for defining how procurement functions should be run based on the strategies advised by the management of the organisation.

Most of the interviewees agreed that the policies represent the lifeblood of the business as they are the baseline documents that guide the operability of the businesses. They also provide an overview of the governance framework, which is used as a roadmap for determining the way in which the organisation conducts its procurement activity. DiMatteo (2014) argues that it is important to ensure that the procurement strategy of a company always aligns with the organisation's tactical framework and business strategy, because they underline the policies that will achieve the objective of any company.

4.4.2 If yes, how are these strategic procurement policies developed?

4.4.2.1 In-house development strategy

Some interviewees replied that their organisation's strategic procurement policies had been developed in-house by the organisation's stakeholders themselves. Usually, the procurement policies are led by the Chief Procurement Officer, who then delegates the procurement management department to meet with other departments and devise a detailed comprehensive policy. This policy is like a manual that has all the necessary information related to suppliers and procurement processes. Therefore, many departments (including, but not limited to, the legal department) are usually involved in procurement, quality, inventory management, asset management, procurement handbook and practices, and the risk assessment wing of the organisation. The legal department, especially, cooperates with the procurement department to ensure adherence with the local regulations. This consultation with other departments has so far brewed smooth coordination and ensured that the representatives from all business units get together to solve current problems and provide the procurement departments with their requirements for annual planning. It has also helped take into consideration the requirements of individual business units. Thereafter, final approval of the procurement documentations is sought from key members of the Executive Committee.

The interviewees testify that the in-house development strategy is very autonomous as their managements are in direct charge of the strategic procurement policies. They also say that the policies are developed through years of experience, as well as market research, to ensure that the best possible assets are sourced at the best possible price.

They are developed in relation to the organisations' vision, mission, and objectives. This allows the organisations to autonomously develop their fiscal plans and expenses for the following year, as well as manage their relationships with suppliers. These sentiments are best expressed in comments made by interviewees such as the following:

"The company has strategic procurement policies written in synchronisation alongside the strategic objectives of our company. The procurement management department meets with other departments to ensure that the other departments have provided the procurement departments with their requirements for annual planning. This is important that the organisation has taken into consideration the requirements of individual business units. This will allow the organisation to develop its fiscal plans and expenses for the next year".

Another interviewee said: *"Corporation has devised a detailed comprehensive policy, which is like a manual that has all necessary information related to suppliers and procurement processes. The Corporation also has a handbook that aims to provide information on procurement processes and appropriate accountability mechanisms".*

Also, one interviewee claimed*: "The company has its strategic procurement policy, which defines how the organisation should run its procurement function based on the strategies advised by the management of the organisation. These policies provide an overview of the governance framework, which is used as a roadmap determining the way in which the organisation conducts their procurement activity. It is important to ensure that the procurement strategy of a company always aligns with the organisation's tactical framework and business strategy".*

4.4.2.2 State administration

Other interviewee claimed that the strategic procurement policies practised within their organisations have been imposed onto them by the state, or rather the Ministry of Oil and Gas of the Kingdom of Saudi Arabia. They allege that most of these policies are developed with the government as this is a requirement. Usually,

these policies are written in accordance with the directions and clauses set by the government authorities.

One interviewee stated: *"At the moment the organisation keeps its focus on the standard policies that are highlighted by the Department of Oil & Gas and the ministry that looks after natural resources. Since the company operates in KSA therefore the company has access to the strategic procurement policies"*.

Another interviewee stated: *"Currently, all our procurement policies and documents are developed and based on the Ministry of Oil and Gas. These policies need to be in line and agreement with the government body"*.

A third interviewee concluded, *"In my understanding, the strategic procurement policies of the organisation leave a long run on the strategic objectives of the organisation therefore the company has decided that the strategic procurement policies of the organisation are of paramount importance to them and that's why they decided on the compliance framework given to them by the Ministry of Oil & Gas-Kingdom of Saudi Arabia"*.

4.4.3 Are these policies developed in relation to asset management?

4.4.3.1 Yes

One of the interviewees expressly stated: *"All of these strategic procurement policies are developed in relation with the Asset management framework"*.

Another interviewee added, *"Yes, all the strategic procurement policies have been developed in relation to Asset management"*. *"Yes, all the policies and procedures that have been put together in the organisation have been developed such that the Company has managed establishing its asset management framework, which is aligned with the strategic procurement policies of the organisation. It is important to ensure that the organisation has its programs and processes that are created based on the recognisable asset management policies. The company is proactively addressing the risk through the regulations and thereby company's Executive*

Committee has decided that there is a need to develop all the policies in line with the asset management of the organisation".

4.4.3.2 No

A total of 29 interviewees replied that no, their strategic procurement policies are not developed in relation to asset management. When probed further, one of these interviewees claimed: "*In my opinion, at the moment the organisation does have well-versed policies related to strategic procurement but when it comes to asset management, I am aware that the organisation has created forms that go along. This information is referenced to every now and then at the time of annual or periodic audits by the compliance team. So, it would not be right to say that the procurement policies of the organisation are developed in relation to asset management".*

Another interviewee said: *"Strategic procurement and asset management policies are not correlated to each other as both are totally two different functions".*

4.4.4 If not, why not – Were there any challenges, difficulties?

4.4.4.1 Asset-related challenges

Interviewees acknowledged that there have been challenges related to assets. These include the asset management framework not being comprehensive, the non-integration of systems, and a lack of clear asset management policies.

One interviewee claimed: *"Of course, there are issues. We actually have several issues, to name a few, asset management concept and framework is quite new in this industry and it is by the way a shortcoming and there is a gap we need as oil and gas operators to fulfil. Our company's practices are generally outdated. While this is true, in recent years, technology and standard practices have been included into the company's business processes. As a result, asset management has also been adopted. But because it is such a new field for the company, no one really understands it, so it has been outsourced to firms of consultants, so it isn't in line with the organisation's strategic objectives".*

Another interviewee added: *"Well, yet we have no strong connection due to lack of asset management system integration between departments. This presents a real challenge in managing assets and increased supply chain complexity". "You know, many of the barriers we encountered were because we didn't really know what was expected of us. What they expected of us, wasn't clarified as it should have been. There were also no clearly documented set of targets that was expected of us, nor any standards by which we were to be judged by, in meeting these standards; they were all non-existent. How can you achieve goals when you aren't told what is expected of you?"*

4.4.4.2 Coordination

The interviewees talked about coordination issues between the two departments, namely strategic procurement and asset management. Apparently, the organisations do not see a need to have asset management functions integrate with the strategic procurement of the organisation because these are two independent functions; they have different objectives, and are responsible for different services and functions, hence they are managed separately. Generally, the two departments work in silos, thus creating a gap.

One interviewee claimed: *"There no real difficulties. But the way I see it is that asset management department is operating independently. Procurement department on the other hand has other responsibilities that not related to asset management policies. Again, as said, there is slight relation but not in terms of policies".*

Another interviewee added, *"The organisation does feel the need of having Asset Management policies established but since the organisation uses the standard asset management framework hence companies only follow these frameworks in isolation". "The Asset management function has been developed keeping in view the operational level agreements of the organisation. The organisation has set up an enterprise asset management for the management of assets and its maintenance. This also provides the organisation with monitoring of assets. But the organisation does not see a need to have asset management function integrate with the strategic procurement of the organisation since these are two independent functions … according to the strategic*

objectives of the organisation, the two departments are responsible for different services and function hence managed separately".

4.4.4.3 Poor procurement regulations

Interviewees remarked on the poor procurement regulations prevalent in their organisations. They identified the factors that caused these poor regulations. These factors include ambiguity in regulatory policies, the lack of autonomy in certain regulations, the inability to accurately estimate procurement needs, as well as the need for international standards.

One interviewee stated: *"The only challenge is that the Ministry of Oil & Gas-Kingdom of Saudi Arabia manages and administers the policies used by the companies working in Oil & Gas sector KSA. In this way the organisations such as Private Limited under these regulatory bodies working in Oil & Gas sector cannot manage their policies. There is no autonomy for policing at the moment. Therefore, these challenges need to be worked in order to have improved system".*
Another interviewee claimed: *"It is beyond doubt that there are no actual applicable regulations and guidance governing asset management areas which we as employees can directly apply to our operations. In our day-to-day asset management responsibilities, there is an almost total lack of common regulations and applicable guidelines which we can see clearly applying to our operations".*

A third interviewee remarked: *"The company certainly acknowledges the need of developing the Asset Management policies which has been established for managing and administering the asset for the organisation but since the organisation uses the standard asset management framework provided by the Ministry of Oil and Gas of under which the asset management framework for Oil and Gas company falls. Since the Ministry of Oil and Gas would like to command and control of this function so that the individual oil and gas exploration and production companies do not get to autonomously execute these functions hence companies only follow these frameworks in isolation".*

4.4.4.4 Shortage of skilled staff

The interviewees acknowledged that the shortage of skilled staff and inadequate training for their employees was a major challenge for them. For example, one interviewee said: *"Yes, there is currently a shortage of skilled staff so unfortunately, we have had to rely on our own in-house team who are struggling as they have not had enough experience, particularly in delivering the right procurements. Our processes need fixing"*.

Another interviewee added: *"The most commonly noted challenge was providing proper training"*.

A third interviewee said: *"They haven't thought about matching the job that needs to be done, with the actual person doing that job and using that system"*.

4.4.4.5 Confidentiality issues

The interviewees identified confidentiality issues as among the many challenges they have been facing: One of them expressly stated: *"We always struggle with confidentiality issues"*. Another added: *"I would have to say confidentiality"*. A third interviewee said: *"This is a very important focal point since we can put our confidential data at jeopardy since suppliers require access to a lot of these data"*.

4.4.5 If yes, can you please provide more details?

The purpose of this question was to prompt the interviewees to provide more details regarding how their strategic procurement policies are developed in relation to asset management. In response to this question, the interviewees admitted that linking their strategic procurement policies with asset management helps ensure that the assets are well maintained and that they have the best service delivery. They said that the policies helped ensure that the physical assets are of prime value to achieve their company strategic objectives. As stated earlier, these policies are crucial to asset life cycles and maintenance. Thus, aligning them together helps achieve the desired level of business improvement as well as the decision-making process, which in turn strengthens the process. For most organisations, because the two policies and procedures are already in place, the only thing required was for the Cross Functional

Team, who had expertise in both areas, to carefully assess the systems, monitor various cost controls, and incorporate the quality assurance element to ensure safe and reliable operations within the company's facilities and beyond.

One of the interviewees stated: *"The strategic procurement policies are developed with Asset management because in order to achieve the strategic objectives it is important to align company's goals and strategies. There is a need to ensure that there is appropriate and adequate preparation and monitor various cost control and coordinate with executives".*

Another interviewee claimed: *"Yes. The asset management framework of the organisation is in line with the strategic procurement of the organisation. The asset management framework provides the prospective rules of agreements providing the final approval for the policies and the processes. The asset management department ensures the ability to cater for a number of assets in time. The asset management framework of the organisation is a part of the organisation's standards and manuals used with strategic vision".*

A third interviewee added: *"It is common sense that if you are going to buy any assets this should have at least a procurement policy involvement. This is put in order to protect our company if we face any complications with suppliers' assets as we as any quality issues. Procurement team gets inveigled at the beginning and then we circulate them afterwards if we are needed".*

4.4.6 If any difficulties were experienced, how were they solved?

4.4.6.1 Increased communications and dialogue

One interviewee claimed: *"Through proper communication and transparent dialogue between all departments".*

Another interviewee added: *"Yes, we do have deliverables not arriving on time, the way this issue is solved is by doing an investigation as to what led to the delay. In most cases it would a border patrol issue. If that delay has direct effect on the operation the client is notified immediately".*

A third interviewee remarked: *"Development of a communication strategy to have better suppliers' engagement"*.

4.4.6.2 Increased consultation

One of the interviewees commented: *"All the challenges are solved through getting people on the table; it is important to pause, step back, consult and reflect"*.

Another interviewee added: *"The Corporation has a committee that has people from different parts of the organisation to consult on matters that are arising and may affect the organisation as a whole"*.

A third interviewee claimed: *"All these have been addressed through mutual consultation with the key stakeholders that manage the asset-based drilling program"*.

4.4.6.3 Systems integration

One interviewee suggested: *"These challenges can be solved by integrative system. Risks in our business can be very significant and they can be managed with efficient handling of information…this is because our software is not entirely integrative. Without a systems integration framework specifically earmarked to the development and management of an asset management framework program, then all you have is just a meaningless plan"*.

Another interviewee claimed: *"In my opinion, this problem could be solved when we have integrated system"*.

A third interviewee claimed: *"Implement a friendly user asset management framework"*.

4.4.6.4 Embracing change

One interviewee expressly stated: *"Change cannot take place unless there is a group of people that are convinced that change affects them positively"*.

Another interviewee claimed: *"One of the many challenges faced by the organisation was embracing change initiative. It is nearly impossible to convince people to move from their traditional way of recording information and start recording information in an electronic system. You also need easy framework that will do the job. When staff see that the framework actually makes their jobs easier, it will be used. Therefore, it needs to have the process easier which will make the job of staff easier. To do this, it needs to provide information that they actually need and that is genuinely useful in doing their job"*.

A third interviewee said: *"In summary, I would say that technology enabled the change. Technology made us re-evaluate our processes. When the technology arrived, we had to re-design the way we did things and as a result we gave a lot of consideration to how things were done, which actually improved it as some of our processes were pretty outdated"*.

4.4.7 Do you think strategic procurement adds significant value to asset management?

The purpose of this question was to gauge the interviewees' views and outlook on the two policies of strategic procurement and asset management and see whether they appreciate how they influence each other. Seven interviewees said no, while forty-two said yes.

One of the interviewees expressly stated: *"To a certain extent, the Strategic procurement function for an organisation could be one of the most important processes for procurement and vendor management in the organisation therefore it is important to continuously monitor the needs of business units and also to have asset management monitor available for the Executive Committee and make decisions based on information provided to them"*.

Another interviewee claimed: *"In my personal opinion, it is important to ensure that the production environment for the organisation benefit from the strategic procurement in turn allowing the organisation to impact the asset management which is ultimately organisation's supply chain management"*.

A third interviewee added: *"I believe, the strategic procurement policies of the company could be in line with the processes for sourcing. The asset management framework for the company need to be developed in line with the strategic procurement policies. It is important to have re-evaluation of the policies that are created in line with the management frameworks".*

4.4.8 If yes, to what extent? If no, can you please explain why?

4.4.8.1 If yes

i. Better record maintenance

One interviewee replied: *"Once all that information has been sorted then the organisation can deal with the specific asset management schedules. It is of due importance and criticality to ensure that the organisation has managed to maintain sufficient records and adequate logs related to the availability of assets … to record the downtime of assets operating within the organisation. The Company also records the scheduled and unscheduled maintenance in form of the logs, which should also be maintained by the organisation".*

Another interviewee added: *"Yes, since at the moment the information in the asset management framework is stored in manually but this information is not being utilised as we have not linked other divisions with the asset management, which does not provide reports as it is expected to. For the asset management framework to actually support us it needs to be innovative, imaginative and different from what we currently have. It's a foundation and when the foundation is right, everyone else can fall into place".*

ii. Better monitoring of asset life cycle

One interviewee expressly stated: *"It should be ensured that the asset management policies of the organisation are developed in relation with the strategic procurement policies to a greater extent in order to ensure that the organisation can actually monitor the entire life cycle for asset which is extremely important to take into consideration for observing asset reliability".*

Another interviewee added: *"... provides edifice for the effective and continuous monitoring of assets throughout the life cycle of the assets".*

A third participant added, *"It would be good to have a relation between strategic procurement and asset management because it would create some sort of accountability for the use of asset throughout the asset life cycle".*

iii. Better inventory control

One interviewee stated: *"In my opinion, the organisation has strategic procurement policy has the responsibility to ensure that the organisation has thoughtfully planned the asset management of the organisation. This asset management framework of the organisation focuses on the maintenance, scheduling of outages, planned and unplanned downtime and unavailability of assets and the contracts for maintenance with external vendors. When the organisation has worked out its agreement, the agreements are passed on to the operations department from procurement department".*

Another interviewee asserted: *"This allows the Company to have significant procurement processes, which causes the organisation to continually improve its processes through the optimisation of resources". "Any organisation that operates in an Oil and Gas industry, require strong procurement policy in order to protect your assets for the long run".*

iv. Better regulatory compliance

One of the interviewees agreed: *"Yes. I believe that there is an extreme to ensure that the organisation has planned through the regulatory framework for developing its asset management policies in line with the strategic procurement of the organisation. This is based on the production of the exploration of oil and gas enhancing the supply chain management for the organisation. The strategy of the organisation is such that the organisation can reap benefits from the strategic procurement and asset management assisting the organisation with some of the internal controls and external audits thereby ensuring regulatory examinations".*

Another interviewee expressly stated: *"In my view, the strategic procurement policies of the company might impact the asset management framework. The company has gotten the risk policy, which ensures to deal with the risk mitigation plan in the best possible manner"*.

A third interviewee claimed: *"As well as laws and regulations to follow in certain situations"*.

v. Enhanced risk management

One of the interviewees stated: *"I believe Procurement and Asset Management are strongly connected and one cannot be achieved without the other. In my role for instance, the safe operation of company's sea terminals will be exposed to higher risk if chartered vessels were not in line with procurement policies in terms of compliance as well as quality"*.

Another interviewee claimed: *"The company has been creating its policies such that the recommended policies creating the establishment of the company are Key Risk Indicators (KRI)"*.

vi. Improved relationships with suppliers

One interviewee said: *"... procurement is part of asset management anyhow in a certain way especially when it comes to the agreement between the supplier of these assets and the maintaining activities in the long run. All of these are part of the procurement deal which I believe these are overlapped activities all the time"*.

Another interviewee said: *"It can protect your assets by having a firm policy in place that forces suppliers to comply with"*.

vii. Increased cost-effectiveness

One interviewee said: *"The company for the exploration and production of Oil and Gas being a component of the entire group needs to plan its asset management activities a year ahead. This will allow the company to plan for the capital expenditure and operational expenditure and also that the company can then budget for the procurement of its assets in various regions of the world"*.

Another interviewee added: *"It allows us also to avoid unnecessary purchases which improves our cost reduction process"*. *"Purchasing the required raw material with the required specs and standards is essential for cost-effectiveness"*.

viii. Reduced tendency to work in silos

One of the interviewees expressly stated: *"Yes. In my personal opinion, given the nature of the Company, it is of paramount importance to have the asset management policy of the organisation to be created in line with the strategic procurement policies and in this way the company will save itself from operating in silos and will have an integrated approach presented to the organisation"*.

Another replied: *"Yes. In my opinion, it has immensely impacted the overall productivity for the organisation since all function related to asset life cycle has been aggregated in one spot by the organisation. For the oil and gas sector procurement strategies are a significant determinant of effective asset management"*.

A third interviewee agreed: *"Yes. The company should have its asset management in line with the strategic procurement policies and in this way the company will save itself from operating in silos and will have an integrated approach presented to the organisation"*.

4.4.8.2 If no

Only seven interviewees reported thinking that strategic procurement policies do not really add value to asset management. One of these interviewees expressly stated: *"... these two functions are different and are managed for different purposes"*.

The second of these interviewees said: *"There is no need to have the connection between the strategic procurement policies and the asset management as the two functions are management by different departments and also the procurement policies are made in line with the finances and the feasibility of procuring assets whereas the asset management is outsourced"*.

Another interviewee replied: *"No, as the two systems are working perfectly fine and under different departments"*.

4.4.9 In terms of inter-department communications – How often do asset management personnel communicate with the strategic procurement department and vice versa?

4.4.9.1 Very frequently

A total of 25 interviewees reported having a very frequent amount of communication between the strategic procurement and asset management departments. They explained that their organisations encourage an open policy in terms of communications between the two departments. It is these policies that advocate for regular meetings (either weekly or monthly) between the two departments to enable them to review and amend strategies or apply new courses of action as required, thus ensuring that both departments are on the same page. Additionally, both departments are also involved in case studies and incident investigations in an attempt to avoid risk reoccurrences by enforcing new or amended rules while considering the lessons learned. The commercial teams are also consulted to ensure consistency with the company's objective.

4.4.9.2 Rarely

Twenty-two interviewees confessed that these two departments rarely communicate. They all acknowledged that it was very unfortunate that they currently had very little communication with the procurement department; and then explained that this was almost entirely because they have no integrated communication system. One interviewee specifically stated: *"It is very unfortunate that we have very little communication with the procurement department. This is almost entirely because we have no integrated communication system. I believe if we put in place an effective communication process, this would dramatically improve the reporting process"*.

Another interviewee said: *"Well, currently the communication is to a minimum. Usually, the operation team referees back to procurement throughout the project managers whenever they encounter issues. If I were about to change this, I will definitely change it to have frequent visibility and communication. Remember also that there is not a good system connecting the two functions together"*.

A third interviewee claimed: *"The communication between both departments occur on the need only. There is no scheduled frequent communication that I am aware of"*.

4.4.10 Can you please explain if there were any challenges or issues in communication?

4.4.10.1 Tendency of both departments to work in silos

The interviewees conceded that their organisational departments had a very high tendency to work in silos or isolation, and this was dampening all efforts of interactions between the departments. The main reason for this is because both departments have different operational goals and different underpinning contracts for providing services. For this reason, they have not deemed it necessary to come together and develop strategic procurement policies in relation to asset management. The interviewees stressed that the two departments had entirely different visions, schedules, operational plans, strategic directions, and approaches for accomplishing certain tasks to the extent that they found it very difficult in the beginning to find common ground between them.

One interviewee said: *"The biggest challenge between the two departments is that both departments have different operational goals and different underpinning contracts for providing services"*.
Another interviewee replied: *"In my opinion, the two departments have entirely different vision and strategic direction, therefore I can't see any scope of amalgamation"*.

A third interviewee commented: *"The departments have different schedules, different operational plans, and different approaches of doing the work"*.

4.4.10.2 Geographical distance

Interviewees remarked that the communications between their strategic procurement department and asset management department may be hindered by geographical distance. These two departments are physically and geographically distant in the sense that the Ministry of Oil and Gas has its asset management office in the main city, whereas the company has its procurement team based in another industrial city. This distance has made it difficult for the teams to work their policies and strategies together.

One of the interviewees claimed: *"The biggest issue is that these two departments are physically and geographically distant in the sense that the Ministry of Oil and Gas has its Asset Management office in Jubail while the company has its procurement team sit in Dammam, which makes it difficult for the teams to work their policies and strategies together"*.

Another interviewee remarked: *"... on top of everything, both the departments are located in geographically dispersed locations"*.

A third interviewee claimed: *"The two departments involved in these activities not only belong to different geographical location but also different organisation"*.

4.4.10.3 Non-integration of systems

Communication between the two departments has also been hindered by the poor integration of the system networks. One of the interviewees expressly stated: *"It is very unfortunate that we have very little communication with the procurement department. This is almost entirely because we have no integrated communication system. I believe if we put in place an effective communication process, this would dramatically improve the reporting process"*.

Another interviewee replied: *"Sometimes both departments face issues especially if the system is different and not integrated"*. *"Due to the fact that both entity works in silos. We also do not have one system that could communicate together"*.

4.5 BCP

This section examines whether the interviewees' organisations have a decent BCP. As discussed in the Literature Review chapter, having a decent business continuity strategy is necessary to ensure that the day-to-day operations can still continue during and after a crisis (Bronson & MacDonald, 2014).

4.5.1 Are strategic procurement policies linked with the business continuity strategy?

The purpose of asking this question was to find out whether the interviewees' organisations have deemed it necessary to align the strategic procurement policies to

their business continuity strategy. Procurement policies are the base documentations for all organisations; therefore, it is always prudent to link these policies to all other departments. From the results obtained, only 13 interviewees stated that their strategic procurement policies were linked with the business continuity strategy. The rest of the interviewees have not yet linked them together.

4.5.2 If yes

4.5.2.1 Enhanced quality engineering

One interviewee said that their business had been able to enhance their quality engineering: "*The assets we buy for our business need to be of the highest standard as our equipment operates in subsea environments. Our procurement policies are aligned with quality engineering department to ensure the correct tool and or equipment is purchased. This leads to business continuity and enhanced quality engineering*".

4.5.2.2 Enhanced risk mitigation

Another benefit is that it has enhanced risk mitigation procedures. One interviewee said: "*Any policies in our organisation are linked to business continuity and risk management policies as precaution measure"*.

Another interviewee reported: *"Business continuity plan always help us to have proper risk mitigation practice in place so that in any project we conduct we have some risk mitigation sessions, which will help us minimising the risks on our assets and improve on our operations*".

4.5.2.3 Improved asset procurement procedures

Linking the policies has also helped the organisations improve their asset procurement procedures. One of the interviewees expressly stated: "*The Business Continuity strategy has been created in the organisation to ensure that complete business assessment has been accounted for, this allows the organisation to plan their strategic procurement, which also allows the procurement of assets based on the need for the priority for an asset to be available*".

4.5.2.4 Enhanced business sustainability

The remaining interviewees acknowledged the advantage of linking their strategic procurement policies with their BCPs. They claimed that this linkage has helped create more sustainability in their businesses and helped ensure simplicity in supply chains.

4.5.3 If no – can you please explain why?

4.5.3.1 The BCP is still new

Five of the interviewees reported that the BCP is still a very new concept, and thus is yet to be well understood and implemented. One of the interviewees expressly stated: *"The concept of Business continuity planning is really new and in its inception stage in Saudi Arabia and other Middle Eastern countries"*.
Another interviewee replied: *"BCP is being a new concept used in this industry but yet we do not have it"*.

A third interviewee claimed: *"The concept of Business continuity planning is contemporary and also that the company did not have it as part of its strategic objectives therefore the company has not accounted for the policy"*.

4.5.3.2 The BCP is not significant

Some interviewees reported that the BCP has not really been significant for their organisation's operations; that is, their organisation does not see the BCP as being important, and therefore they have not incorporated it into their structure.

One of the interviewees claimed: *"No BCP strategy. Business continuity plan is not taken as one of the important requirements by company"*.

Another stated: *"No, Business Continuity is not critical to the transparent and continuous operation to our department and business"*.

A third interviewee claimed: *"The business continuity plan is not considered significant for the organisation therefore the strategic procurement policies are not linked to it"*.

4.5.3.3 There are other strategies in place

Twenty other interviewees said that the reason why they have not linked the policies together is that they already have other strategies in place. These strategies include the Risk Management Policy, the Disaster Recovery Plan, and an Emergency and Contingency Plan. All of these strategies act as a substitute for the BCP.

One of the interviewees replied: *"Corporation does not consider the need for a business continuity plan because the organisation has already gotten a risk plan"*.

Another answered: *"There is no need to have a business continuity plan since the has an Emergency and a Contingency Plan in the event that the organisation faces any problem or natural calamity to ensure that the operations do not suffer. This falls under the jurisdiction of the Operations department"*.

A third interviewee claimed: *"Our business does not have this concept in place. We do have extensive risk management policy that is in place we follow. Risk management function is being outsourced to a third party to manage"*.

4.5.4 Do you see a BCP as important in your organisation?

4.5.4.1 No

The first 20 interviewees stated that they find the BCP to be redundant as their organisations already have a Disaster Recovery Plan and Risk Management Policy in place, which manage the risks related to asset management and supply of the products in case there is an event or natural calamity. One of these interviewees said: *"The Business Continuity Plan is redundant for the organisation already has a Disaster Recovery Plan in place which manages the risk related to asset management and supply of the products in the event that there is an event or natural calamity takes place"*.

Another interviewee stated: *"I do not see the need of a business continuity planning, as it is redundant for Company. The company already has a risk management plan"*.

4.5.4.2 Yes

Only 17 interviewees confirmed that they see a BCP as an important aspect in organisations. For example, four interviewees explained that the BCP helps to analyse and assess the possibility of the occurrence of risks, as well as form risk mitigation processes that will protect assets and increase their lifespans. Others said that a BCP enables a better disaster recovery as it aligns with the organisations' visions and strategic frameworks, hence allowing organisations to progress through and deal with any calamity having all its information available at all times. Two interviewees said that the establishment of a BCP is favourable because it helps enhance job security and offers relief to employees who need to see a strong BCP in place to feel some sense of security. Another interviewee asserted that their BCP has, so far, helped to keep the share price of the company at a desired level and establish growth in a new market. Additionally, a BCP helps ensure that the deliverables of raw material arrive on time, thus maintaining a solid supply chain.

4.5.5 What role can you foresee a BCP playing in asset management?

4.5.5.1 It plays no significant role

Twenty interviewees said that a BCP has no significant role in the practice of asset management. When asked why, some said that the BCP's function was as an external function to their organisation. Others said there was simply no relationship between asset management and business continuity.

One interviewee expressly stated: *"I do not see Business Continuity playing a major role in Asset Management of the company since it is an external function to the organisation"*.

Another interviewee replied: *"I can't see business continuity playing an important role in Asset Management since these two functions are mutually exclusive and being independent functions, these two have different objectives for the organisation"*.

Yet another interviewee added: "*Again, business continuity does not play a major role with asset management. Nevertheless, Risk management does play a significant role in asset management, especially for ageing assets"*.

4.5.5.2 It plays a significant role

Only 16 interviewees rightfully acknowledged BCP as having a highly significant role in asset management. One interviewee stated: *"In my opinion, business continuity plan is important for an organisation since the asset management policies of the organisation need to have its physical infrastructure in place for organisation's asset and infrastructure. Therefore, Corporation will deem it important for IT infrastructure, as it is the core of any oil and gas organisation"*.

Another interviewee claimed: *"I think it plays vital role in prioritising the critical risk"*.

"In my humble opinion, I think that business continuity management or risk management should be part of any asset management, this is due the fact that it helps improving the relationship with potential suppliers". *"The Business continuity plan for the organisation ensures that the organisation has asset management … and procurement planning allowing the organisation to plan for the entire fiscal year"*.

4.6 Asset Management

This section discusses matters specifically relating to asset management. These include the people in charge of asset management, the risks associated with these job allocations, asset reliability, and the challenges involved with asset monitoring activities.

4.6.1 Who manages the asset management–maintenance program?

This question sought to find out the personnel who are in charge of the asset management function and whether they possess the right skills to undertake this role. The answers obtained are as follows: Compliance and Regulatory Department (two interviewees), Engineering Support Department (six interviewees), Facilities Asset Department (two interviewees), Maintenance Department (nine interviewees), Operations Department (eighteen interviewees), Outsourced (Third-part) company (two interviewees), Procurement Department (one interviewees), Quality Control Department (three interviewees), and Risk Management Department (one interviewee). The Operations Department appears to be the one that is in charge of asset management the most, followed by the Maintenance Department, the Engineering Support Department, and finally the Quality Control Department.

4.6.2 Can you please explain if there are any specific reasons for that role?

4.6.2.1 No reasons

When asked if there was a specific reason for assigning the aforementioned departments with carrying out the role of asset management, 27 interviewees said that they had no special reasons for this. They merely responded that this was only a reporting structure and part of their organisation's hierarchical framework. They said that the allocation of that asset management role was just in accordance with the reporting line.

One interviewee expressly stated: "*No. The only reason for this is the hierarchical and reporting structures, which have been put together in place by the management"*.

Another interviewee concurred: *"No. This has been a result of restructuring that took place when the Procurement and Inventory Management department was disintegrated and formed Procurement Services department and the inventory control function fell under the Operations department and now expanded to be called Asset Management"*.

A third interviewee added: *"No. This is just based on the organisation's hierarchical structure"*.

4.6.2.2 Yes, there are certain reasons

i. Compliance and Regulatory Department

Interviewees said that the Compliance and Regulatory Department is the most skilled workforce to deal with the issue of asset management. They said that the Compliance Department is well-versed in scheduling the procurement, administration, and disposal of assets, and recording these tagging asset life cycles at all times. They also said that the Compliance Department is responsible for the management of obsolescence of assets in addition to ensuring that the assets are audited periodically and replaced before they become obsolete.

ii. Engineering Support Department

The Engineering Support Department was said to be the best to deal with asset management programs because they are mobilised on site and they are fully aware of the physical conditions of the assets. This helps to keep assets healthy and up to speed, in addition to reducing the maintenance costs over time. One of the interviewees specifically stated: *"This function should be always with the engineering department since this is their bread and butter"*.

iii. Facilities Asset Department

The Facilities Asset Department, on the other hand, was regarded as the most ideal to manage asset maintenance programs because they are the service delivery owners of these assets. The main benefit of this is that the service delivery owners are the most accountable for these assets in front of the proponents, and that this helps in analysing the organisation' capital plan.

iv. Maintenance Department

The Maintenance Department are ideal because asset maintenance is their area of expertise, and thus they are aware of the required number of materials to be utilised during maintenance activities. In addition, they are always in charge of keeping all assets maintained by sticking to a precise maintenance schedule. This ensures that physical assets are maintained in an adequate manner to achieve the best outcome and reduce maintenance costs over time.

v. Operations Department

The Operations Department was the most preferred department to handle asset management. The reason for this was mostly because this department possesses the skill set and experience to preside over asset management activities and yield excellent utilisation of the available resources. The Operations Department workforce are experts who understand the operational life cycle of assets and requirements for frequent maintenance and can therefore manage risks associated with the life cycle of an asset and play it beforehand. They can handle asset management smoothly, without any confusion. Furthermore, the Operations Department workforce are usually actively involved in the installation of the asset. They are also involved not only in the maintenance of that asset, but also in recording logs related to the asset's activity,

maintenance, and performance in the main office and other sub-sites that are part of various projects inter-state or at a regional level.

vi. Third-party Consultants

Third-party Consultants were purposely outsourced and mandated with the task of handling asset management programs because the organisations lacked sufficient in-house capabilities and dexterity to deal with asset management themselves. One interviewee said: *"Frankly speaking, yes, our current asset management control department does not have the required skilled set. We outsource this to a third party"*.

vii. Procurement Department

Other interviewees replied that the Procurement Department helps to improve correspondence with suppliers during asset procurement. For example, one interviewee stated: *"The only reason is that it falls under the procurement office. It is because they are strongly aware of the terms and conditions of the contract agreement with prospective suppliers"*.

Another interviewee said: *"One of the biggest benefits of it all is dealing with assets suppliers is taken care of, from warranties to ordering materials"*.

A third interviewee added: *"Yes. The responsibility of procuring, maintaining and managing assets fall under Procurement and Vendor Management Department"*.

viii. Quality Control Department

The Quality Control Department has been shown to help with asset life longevity: One interviewee said: *"We try our best to always engage our QA & QC team when we manage our assets in order to expand its life cycle time"*.

4.6.3 Are there any risks associated with that role?

4.6.3.1 No

When questioned whether there were any potential risks in assigning asset management programs to the various aforementioned departments, 30 interviewees

said that there were no associated risks. In fact, they said that it was the most suitable and thought-out method of addressing asset management.

4.6.3.2 Yes

i. Maintenance Department

There are risks of staff injuring themselves. There is a fair amount of lifting involved; therefore, there is always a risk of a back injury. Another risk is that assets may be used incorrectly out in the field, which will result in numerous repair complications.

ii. Operations Department

The most profound risk associated with the Operations Department is that the department appears to only rely on the asset management policies administered by the Ministry of Oil and Gas in an overbearing way. Because the Operations Department is amalgamated with the state, through the Public Procurement Regulatory Authority‘s Memorandum of Understanding, it is obligated to strictly follow its policies, which then compromise its autonomy and control over the organisation. Such circumstances are very dangerous because the company does not have access to the policies, procedures, and strategies developed. Therefore, if anything happens to the Ministry of Oil and Gas in the Kingdom of Saudi Arabia, the department would not be able to sustain the asset management function.

Six interviewees said that their Operations Department was fond of working in isolation, meaning that there are many aspects of the asset management system that might be missed by them. In addition, it rarely teams up with other departments to discuss, review, and develop new strategies for asset management. Therefore, there has been a lack of input from other units. Lastly, there has been an increased dependency on the Operations Department by other business units. This dependency is such that if anything goes wrong within the Operations Department, all the other organisational functions are compromised.

iii. Third-party Consultants

The associated risks with involving Third-party Consultants in asset management programs include exposure of confidential information, higher risk costs, delivery time, and quality control, and an increasing over-dependency on the outsourced company. The outsourced companies monitor and control assets, and all other logic information associated with these. This leaves the organisations' confidential data exposed to external parties. This, in turn, exposes these organisations to data security risks. Other than that, it endears the organisation to be over-reliant on the outsourced firms to the extent that if the operations of the outsourced company suffer a shutdown or downtime because of any reason, then it will directly influence the functions of the company. This downtime causes delays in asset availability.

One of the interviewees expressly stated: *"If the operations of the outsourced company suffer shutdown or downtime because of any reason then it will directly impact the operations of the Company, which will continue to have its business operating, but the downtime causes wait for the asset availability"*.

Another interviewee claimed: *"Our company is dependent on outsourced companies who supply so many essential services to us. We have not given any real thought to what happens when those companies themselves experience a shut down. The impact could be really bad for us and bring out operations to a stop until they resume. Our asset availability is at risk of them. Our company needs to analyse its capacity requirements and to plan which kinds of assets are going to be needed and what support it will need, so as we can increase operational efficiency"*.

iv. Procurement Department

The Procurement Department is also associated with the risk of over-dependency. One interviewee said: *"The Procurement department is a central spot for managing strategic procurement and asset management which means if something goes wrong with one of the functions, the other function will also be compromised"*.

4.6.4 In terms of asset reliability, how reliable are the current physical assets?

4.6.4.1 They are not so reliable

i. Fast ageing of assets

Some interviewees attributed poor asset reliability to the fast ageing of their assets, saying that it is difficult to record the expiry and look for the replacement of assets. One of the interviewees stated, *"Some of the challenging metrics were the aging and expiry timeframes for different types of asset within the organisation and also the assets that are used in various parts of organisation".*

Another interviewee said: *"Considering the vast amount of assets oil and gas operators use, it is not easy to coordinate the expiry of all parts and decide on replacing assets, but it does have to be done. When this occurs, obsolete or superfluous assets are usually sold or decommissioned near their expiry or scheduled maintenance dates".*

ii. Poor asset disposal

Other interviewees explained that their asset reliability had declined because their organisations had poor asset disposal measures thanks to following the standards and regulations that require the organisations to dispose of assets that have exceeded their lifespan already. Poor asset disposal has occurred because of the high overheads related to asset stocking warehouse maintenance. One interviewee observed, *"The current physical assets are not very reliable since the organisation follows standards and regulation requires the organisation to dispose of assets that have exceeded their lifetime already".*

iii. Poor asset maintenance

Three more interviewees also spoke about poor asset maintenance and explained how this also affects asset reliability. One interviewee observed: *"Recently, we really haven't been paying attention to maintenance planning at all. From my perspective though, as a production manager, I can tell you that we recognise the importance of maintenance planning across all levels. I see it as an important business driver particularly as a demand on our physical assets as they continue to grow".*

Another interviewee said: *"Lack of asset data maintenance, Lack of planning".*

Yet another interviewee remarked: *"Maintenance processes need to be considered seriously. But presently our company is facing serious problems maintaining its assets"*.

iv. Reluctance to change

Interviewees spoke about their organisations increasing reluctance to change. They discussed the poor status of the reliability of their assets and said how much everybody keeps speaking about change, but no one actually puts this into practicality. One interviewee said: *"As a leader, I would love to see more improved results that will create more opportunities. We have had discussions about implementing and developing an asset management framework based on what all the other industry participants have experienced. We need to bring all their expertise together. If we want to improve we really need to go through a change in culture before we can see a change in the way we operate. But I do not think most departments want to change"*.

"We all know that our business needs to make some major changes if it is ever going to improve its finances. We all know that. But each department wants change for other departments but not for themselves, such as the finance department, the materials department, asset management department, operations, procurement, and logistics. And even the project managers and human resources departments who speak of change the most. The truth is they are the ones who resist change the most in their own areas. People seem to like change in the abstract more than in reality".

"We are routinely told that we need to do more with less resources and that change is needed, without exactly saying what these changes need to be. The managers think 'change' will solve everything, but they are unwilling to change themselves".

"Asset management should be a good instrument of change. We are always told that it can be used as a tool to improve our business operations, but other than these slogans, I do not see any of the managers actually making any changes regarding asset management. They speak of change, but just keep doing it the same way".

v. Inadequate demand forecasting

Interviewees mentioned demand forecasting and how this affects the reliability of assets if it is undertaken inadequately. One of them expressly stated: *"It is clear that the accuracy of data relating to the condition of the assets isn't reliable and this is because there either isn't any demand forecasting or if there is, it is done very inadequately"*.

Another interviewee said: *"There also needs to be improvements made to the demand forecasting"*.

4.6.4.2 They are very reliable

A few interviewees said that the asset reliability in their organisations is in very good shape. Elaborating further, they said that their asset management frameworks are visionary tools that are environmentally friendly, are in line with the compliance processes given by the Ministry of Oil and Gas, and have actual physical mechanisms to ensure the reliability of the physical infrastructure and assets in the organisation.

These interviewees also said that their asset reliability status was highly enhanced by their regular maintenance schedules. For example, one interviewee remarked: *"The maintenance schedule is an extremely critical function of the asset management program hosted and conducted by the maintenance department, which ensures that the assets remain reliable and that the operations do not suffer due to the malfunction of assets or poor health of assets"*.

The above-mentioned interviewees concluded by saying that they have been able to maintain their high asset reliability because they have effective communication and reporting systems, regular audits and inspections, assigned improvement lead teams to monitor all assets within the supply chain, implemented asset reliability management systems. One of the interviewees expressly stated: *"We try to minimise and avoid the frequency of assets failures. In our plant we introduce a reliability plan which helps us increasing the efficiency of our assets"*.

Another one claimed: *"Our company has lots of reliability management that we seriously practice, such as time and speed performance as well as quality*

performance. The operational and maintenance departments should have these measurements in place in order to understand the reliability of our assets".

4.6.5 Are there any monitoring activities of these assets?

The purpose of asking this question was to see whether the organisations practised adequate asset monitoring. As established previously, adequate asset monitoring is an important step in pinpointing any faults within the asset management framework that would otherwise not have been detected (Davis, 2014). Nine of the interviewees answered in terms of how frequent the monitoring activities were performed. Four said annually, one said bi-monthly, two said daily, one said monthly, and one said quarterly. Conversely, the other 38 interviewees replied in terms of the types of tools used in asset monitoring within their organisations. One interviewee said they used barcoding, thirty-five said they used the EAM portal spreadsheets, and five said they used the Google Drive SharePoint.

4.6.6 Are there any issues and challenges in this monitoring process?

This question sought to determine whether the interviewees were experiencing, or had experienced, any sort of challenges or issues while carrying out asset monitoring activities. Forty-four interviewees said yes, they had experienced various challenges related to poor leadership, inadequate regulations, supplier issues, non-integration of systems, usage of manual tools, and workforce issues.

4.6.6.1 Poor leadership

One of the most profound challenges observed during asset monitoring was the aspect of poor leadership. The organisations already acknowledge that their asset reliability status requires improvement; however, the leaders have not provided the support and mobilisation required for these changes. One interviewee said that their leadership is not supportive of cutting-edge software, which will, without a doubt, help the business grow. He said that they are currently using manual spreadsheets to monitor assets yet that is not the proper method to use. Unfortunately, the leaders are not taking further measures to evaluate this and implement new technologies.

Undoubtedly, leadership support is actually the cornerstone of an organisation.

Without a strong cornerstone in place, everything else might fall apart. Additionally, to a certain degree, company leaders can really drive the business forward, particularly if they are well liked. Well-liked leaders have great influence as staff enjoy working for them. Instead, many organisational leaders are failing in their role by not being committed and not engaging with their employees appropriately.

To illustrate the above point, one interviewee stated: *"Our leadership is not supportive of cutting-edge software which will help our business without a doubt. I ask you, how difficult it is when there is not a developed asset management program created with expert people supported by strong leadership of the organisation? By the leadership, I am talking about the senior management in the company. They need to show strong support of the asset management program by appointing the right managers to support people trying to do it. The managers also need to be held accountable rather than blame the low-level workers"*.

Another interviewee said: *"Yes, the challenges that we have is that the current leadership framework does not have enough influence on the employees. When you have good leadership in the company it is a great morale booster and has an effect throughout the entire organisation. Well, there are a lot of managers who think they think outside the box, but the reality is they need to think far beyond present boundaries with regards to establishing the best asset management framework. Instead of just catching up with what others are doing, if we want to lead, we really need to show some imagination and genuinely think outside the box"*.

A third interviewee remarked: *"We have already highlighted these concerns to our leadership team which they have great influence on the board management committee. So, in a nutshell, there definitely is an issue of poor leadership that is continuously affecting employees' performance. Leadership is more than just management and it needs to come right from the very top, otherwise it's just talk and slogans"*.

4.6.6.2 Insufficient regulations

Some interviewees complained about the inadequacy of regulations surrounding asset management. One interviewee said: *"We already have a lot of very*

basic laws and policies relating to asset management areas but they are mostly too general". Others complained that the laws are relatively complex, and the managers are under a lot of pressure to interpret the new regulations. Because of major events overseas, and for political reasons, both federal and state governments have introduced new regulations for the oil and gas, and petrochemical sectors, which operators are obliged to comply with. In reality, though, managers do not necessarily apply all the regulations, all the time, because of how these regulations contradict each other. Instead, managers apply the rules in the guidelines and regulations as they see fit. This, in turn, results in the erroneous application of legislations.

One interviewee stated: *"One of the biggest challenges that we face nowadays is the lack of understanding of the asset management policies that is produced by the government … On many occasions, we have been unable to apply the regulations because we possess insufficient knowledge about how they should be carried out. I have many years of experience in western countries like Australia and New Zealand. I can say that in those countries they are equipped with asset management guidance which are actual tools in designing specific processes and which actually shape practices. Furthermore, they are regularly supplemented by updates, which is something we could do with here as there is no such regulation to standardise industry-wide frameworks, which could be very helpful*".

Another interviewee claimed: *"Yes, on many occasions we have been unable to apply the regulations because we possess insufficient knowledge about how they should be carried out. I have many years of experience in western countries like Australia and New Zealand. I can say that in those countries they are equipped with asset management guidance which are actual tools in designing specific processes and which actually shape practices. Furthermore, they are regularly supplemented by updates which is something we could do with here as there is no such regulation to standardise industry-wide frameworks, which could be very helpful"*.

4.6.6.3 Difficult supplier selection

Another challenge observed was supplier issues such as difficulties in supplier selection, as well as difficulties in maintaining long-lasting relationships with suppliers. One of the interviewees said: *"Building and maintaining good relationships*

with external suppliers is not as easy as you might think, as often they may not deliver on time, but you also need to remain nice to them as they can hold you as a sort of hostage".

Another interviewee commented, *"Secondly, many of our assets are monitored by the supplier and we must extend our relationship with them in order to ensure that our assets are being properly monitored. It's really important to maintain favourable relationships with our external providers as they will be responsible for maintaining our operations really".*
A third interviewee said: *"We outsource supplier to inspect and audit our assets. It is always a challenge to source reliable and available suppliers. Our industry is highly specialised and complex which means that selecting the right provider is never an easy task*".

4.6.6.4 Non-integration of systems

During the monitoring of assets, it was noted that there were a lot of cases of non-integration of systems. To begin with, the systems are decentralised because of a lack of common IT systems shared by departments. Because of this, maintenance data is kept separately to the point where the maintenance staff members are unable to conduct proper maintenance planning across operations; hence, the monitoring activities are not systematic and are not aligned with other departments. It also becomes impossible for managers to quickly review the performance of assets; therefore, underperforming components can go unnoticed for some time, contributing to the poorer outcomes all round.

One interviewee stated: *"The main challenge is that it came to my attention the fact that we do not have data accuracy. This is because of the lack of asset management technology in place. We are still using our tracking log as other organisations, but this is not efficient way of doing if I am being honest with you".*

A second interviewee stated: *"Accessing asset data is a real struggle. It's easier to get an appointment with the pope than to get the data we need. I believe we need to develop within the framework easy and speedy access to information which will help*

us all to further enhance the quality of our decision-making process. Sometimes we do not even believe the data we eventually receive. If we had more faith in the data, and it was instantly available, this would genuinely make us more productive. The fact I am even saying this shows there is something wrong with the current availability. I get the distinct impression that ERP SAP is an amazingly powerful system which should be capable of integrating our company's departments, so they need to seriously consider it".

A third interviewee said: *"Multiple systems is being used. Eventually, will cause serious consequences on the reliability excellence of our assets. Using detached systems is not user-friendly at all. Instead, it is very tiresome as I have to log onto almost 10 different sites just to retrieve one data item. This decentralisation is actually causing data items to be repeated in many different sites, something that is increasing our data redundancy".*

4.6.6.5 Usage of manual tools

The organisations have been using manual tools to monitor assets, and this has subsequently decreased the asset reliability rates of the organisation. Manual tools are not fit for asset monitoring as per the views of the interviewees. They simply do not work in favour of the company as they are decentralised and therefore cause major gaps in the monitoring and maintenance schedule. Normally, every asset has a different monitoring cycle. Therefore, depending on the asset, some should have a performance review every six months, annually, two, five, or seven years. However, usage of manual tools uses physical monitoring, which is, more or less, on a random basis, hence creating gaps in the systematic schedules.

In addition, manual tools are not user-friendly. One interviewee specifically stated: "*Yes, there are challenges I myself encountered as a director. I actually use the framework in my job, and as one of the employees I can tell you it is not user-friendly. If it were changed to become user-friendly then that would give me some indication that the company actually knows what is really going on, and is actually seeking to improve the way they do things. As it is they do not seem to know, or care that staff do not like their own framework".*

To avoid these shortcomings, many operators nowadays are opting to outsource the asset management monitoring function to third-party entities to achieve better outcomes. However, outsourcing is quite expensive, and therefore a major disadvantage to the asset reliability status of the organisations. One interviewee claimed: *"There are major challenges for this process as being manual and not systematic. We have many upcoming projects and it keeps on increasing and increasing. This method is being old-fashioned for such a large instituting. Due to recent increases in demand there are many asset projects underway which we routinely outsource to consultant firms to carry out the entire project. Outsourcing in this manner ultimately increases costs for our company beyond what they would be if we did it in-house"*.

Another interviewee declared: *"We need to keep into consideration that if we continue to outsource this function, then the risk will be there. As you might know, we cannot continue forever outsourcing this since it does attract high cost and shirking our cash flow. Therefore, we must increase our skill sets personnel"*.

To overcome these challenges, organisations should switch over to automated frameworks that function intravenously, without human intervention, to improve asset reliability, integrity, monitoring frequency, and regular information updates. It is very important to manage the information correctly and protect its integrity. Asset management is based on interpreting information about assets; therefore, there is a need to focus on improving the quality of that information. Some interviewees also suggested the introduction of hand-held PCs, suggesting that it would be a good idea if their companies would provide their maintenance staff with ready-to-use hand-held PCs so that they could enter data electronically even when they are away from the office.

4.6.6.6 Workforce issues

The last challenge, as far as asset monitoring and reliability go, is workforce issues such as poor employee engagement, poor role allocation, and shortage of skilled manpower. One interviewee remarked: *"Our main challenge is the fact that we do not encourage our employees to be more engaged, creative and active. There definitely is*

an inadequate employee engagement. The employees just keep on going in the same old way and with the same performance … To add to the issue, our organisation rarely includes junior employees in decision-making processes and I think this has contributed to the minimised worker performance. Recently, we had a workshop seminar, and one of the junior staffs chimed in that the management should do more consultation in making decisions that involve the employees, such as working hours, and bonus perks".

Another interviewee added: *"Employee engagement should be developed further as it actually does help us to be more productive and therefore helps us meet objectives. From the perspective of employees, management and leadership skills have a direct bearing on employee engagement. Engaged employees are enthusiastic employees so give the company a competitive edge. Levels of employee engagement are often a reflection of performance and, furthermore there is a lot of evidence which shows that improved engagement equals improved performance".*

A third interviewee claimed: *"Absolutely. we have several issues here. First and foremost, to monitor these assets properly, you do require full skill set of the employee that is competent. If our corporation was strongly committed to asset management, they would permanently establish a team of highly skilled dedicated resources to focus solely on this aspect of the business, which would eventually deliver the greater outcomes managers constantly speak of. We have the highly skilled staff to do it already, but they are not assigned to asset management specifically".*

"The current challenge we face that lack of the skilled people. I think there is a real need to form a group of highly skilled team members who enjoy the trust of staff to oversee this aspect as the ones currently trying to do the job do not really have the skills or credibility to do their jobs properly".

4.7 Supply Risks

This section explores how oil and gas organisations tackle supply risks. The section specifically discusses questions such as how the interviewees view supply risk policies, how critical they are, how often supply risks should be forecasted, and whether the organisations have aligned their supply risk protocols with their strategic

procurement policies.

4.7.1 How do you view supply risk for older assets?

The purpose of asking this question was to determine the views of interviewees regarding how older assets should be cared for to minimise risks that arise during the purchase, supply, and utilisation of assets. The interviewees, in response, claimed that the assets should be regularly monitored, that there should a proper asset maintenance plan, and a proper asset disposal.

One interviewee expressly stated: *"The supply risk associated with the organisation keep into consideration the need for the organisation to deal with its older assets and continually monitor its assets to be able to determine, which asset has aged and gotten obsoleted"*.

Another interviewee claimed: *"The supply risks are managed related to the management of obsolete assets. The company find it of paramount importance that assets tend to increase their age with time. It is therefore significant to keep under consideration processes related to the replace of assets, and also the ability to maintain, overhaul and replace the assets"*.

A third interviewee added: *"There is a disposal policy in place, which deals with older assets, and therefore it has been taken care of. The policy is comprehensive enough to take into consideration supply risks in order to yield Just-In-Time delivery of the assets that have been procured by the organisation"*.

Other interviewees reported, though, that it is difficult to control supply risks for older assets, partly because as assets come of age, the main concern is centred around the suppliers being able to honour their part of the deal in helping the companies with the required spare parts or will they call it quits and start preaching their later models. This becomes quite a strain on the company's liquid assets. Therefore, there is the risk that suppliers may not be able to follow through with the necessary service delivery as required. There is also the risk of recording assets' expiry dates and looking for new replacements.

4.7.2 How critical do you think supply risk is in your organisation?

4.7.2.1 Very critical/ important

Twenty-two interviewees said that supply risks are critical in their organisations. These interviewees explained that these supply risks can make or break of the company, because they protect against common bottlenecks found along the supply chain. Therefore, they serve as the company's backbone in times of crises, and are thus an integral part of the organisation.

One interviewee said: *"The nature of our business exposes the company to a variety of risks. Therefore, I believe that supply risk is essential and relevant to us"*.

Another interviewee claimed: *"... like any other Oil and Gas company, this is considering as critical. At the moment the biggest threat the asset of this company has is because of geographical scalability"*.

A third interviewee added: *"It is important to ensure that the risks associated with the supply chain function are thoroughly researched, managed and mitigated for the Vendor Management department. Sometimes when we are faced with a tight deadline it becomes impossible to find the right asset provider, so there is the risk we end up getting one who isn't actually best for the job, but we have no real choice"*.

4.7.2.2 Not critical/ important

Nineteen interviewees seemed to overlook supply risks and said that they are not at all critical for their organisations. When asked why, they said that they do not really need supply risks because all the assets they obtain are new, and thus cannot possibly be susceptible to any faults including ageing, obsolescence, or expiry. These interviewees also explained that they are continuously receiving new technology, and thus are constantly updated on this technology. Thus, they felt that nothing could go wrong.

4.7.3 Can you please explain a bit about your organisation's supply risk policies?

4.7.3.1 Well-established supply risk policies

When asked to explain further about their organisation's supply risk policies,

only five interviewees replied that they have well-established policies in place that are being used and implemented by every department. They specifically stressed that the supply risk policies focus mainly on managing suppliers and ensuring that they maintain the best service delivery. For example, one interviewee claimed: "*The policy we have at the moment is all about keeping the relationship without suppliers well intact. We have procurement review new suppliers' all the time to safeguard against supply risk. That way we get informed right away if there is any shortage in the parts. We communicate with them on a consistent basis".*

Another interviewee stated*: "Our suppliers also have to be able to prove to us that they are capable of delivering on time and on demand. They also have to be insured in order to cover any losses experienced from our end due to their mismanagement"*.

Interviewees also emphasised that the supply risk policies are in compliance with the Ministry of Oil and Gas, and ensure that the supply strategy of the company is shared with shareholders, investors, and other project stakeholders so that they can identify their input.

4.7.3.2 There are no supply risk policies in place

Forty-four other interviewees announced that their organisations do not have any supply risk policies in place, and that they have a risk management policy instead. These interviewees clarified, however, that the risk management handbook is quite comprehensive as it contains a section specifically for supply risks. The handbook is one centralised risk management policy manual (called Strategies for Risk Management) for dealing with risk assessment, risk mitigation, and any other supply risks. The handbook ensures that the organisation does not become negatively influenced in the event of natural disasters. In addition, the handbook enables the organisation to plan for disaster recovery.

Therefore, this manual is responsible for safeguarding the supply chain department altogether and the Executive Committee does not appreciate the need for creating redundant policies. One interviewee remarked: *"The risk management policies are so quite sought after that there are strong clauses in place for the management of issues*

such as obsolescence. The company also has definite metrics in place which sheds light on how a company deals with issues such as assets' aging which needs to be controlled by the operations department and recorded by the compliance department in order to ensure that the health of assets is not compromised …".

Another interviewee claimed*: "We do not currently have risk management policies in place specifically to be able to handle the repercussion of natural disasters".*

A third interviewee asserted: *"… At the moment has not created a supply risk policy. However, the company definitely has developed a comprehensive manual for dealing with risk assessment and risk mitigation called Strategies for Risk Management. This manual for the risk management will help the organisation to manage the risk that is associated with different functions in the organisation and one of which is the risk associated with the supply chain function in the organisation". "The organisation has one centralised Risk Management Policy and does not hold any further documentation related to supply risk. The company already has a risk management policy and the Executive Committee does not appreciate the need for creating redundant policies. Therefore, the housekeeping of risk strategies becomes the responsibility of supply chain department altogether". "The company does not have a supply risk policy instead the company has a handbook called "Risk Management Strategies". This handbook is a guide to how the organisation manages risk associated with different functions in the organisation and one of which is the risk associated with the supply chain function in the organisation".*

4.7.4 If you do not have such a policy, are there plans to establish one?

When asked this question, only seven interviewees confirmed that they were soon going to establish supply risks within their organisational structures. The other 43 interviews said that there were no plans whatsoever to establish any new supply risk policies. When asked why, these interviewees replied that their organisations already had a risk management policy manual, and that this manual was sufficient.

4.7.5 How would you go about establishing a new supply risk policy?

4.7.5.1 By encouraging change preparedness

Two participants declared that endorsing change preparedness is vital in establishing and successfully applying any new policies. It does not matter if new strategies have been listed down and plans made to execute them; if people are not ready to actually change and apply these new strategies, no new developments will be realised. One interviewee expressly stated: *"Based on my observations and experience, a major factor is the organisation's actual desire to change the framework governing asset management. Everyone says they believe in change, yet seemingly are not necessarily willing to change, until something goes wrong"*.

Another interviewee added: *"We have thought about designing a risk policy and strategy and know that some of its key components are staff requirements to embrace change, needing to embrace a collaborative approach etc. However, the risk strategy doesn't go far enough. There needs to be a preparedness to change thinking, as the framework is not just an accounting tool, which many treat it as"*.

4.7.5.2 Teamwork and consultation

Ten interviewees argued that the best way to establish any new policy in an organisation is to encourage teamwork and ensure participation from all organisational departments so that every business unit is well represented in the policy formulation. They said that they would encourage contribution from everyone in the organisation so that the activity would be a team effort. Most importantly, members from all departments—especially the Procurement Department, Operations Department, risk management experts and procurement officers, Logistics Department, and Engineering Planning Department with representatives from the Legal Department—should contribute to specific articles in that document.

One interviewee stated: *"The organisation would have to create teams that action out details related to areas that need to be included in supply chain planning"*.

Another interviewee claimed: *"But if I were to develop a supply risk policy for the company, then I would focus on getting the asset management function together with*

the strategic procurement all with the procurement department and will call out the operations department and compliance department as and when required. This will allow one to analyse asset management before devising a policy that deals with the risks associated with supply for the organisation".

A third interviewee added: *"In my opinion, if I were to recommend the development of the supply risk policy, I would have asked the Executive Committee to develop a cross-functional team and have personnel come on board from different departments of the organisation in order to take responsibility of the policy and to have supply chain department become its custodian".*

Other interviewees said that they would first consider all scenarios susceptible to risks, and then formulate policies that would safeguard their continuity. One interviewee stated: *"It isn't possible to over-emphasise the need for supply risk planning to our company. As an organisation, we needed to consider every possible scenario and develop a plan to mitigate its associated risk by conducting a feasible study on them, then later incorporate this into our overall strategic plan. This is something we really need to develop even more".*

4.7.6 Would you relate these policies to asset management and strategic procurement?

This question sought to find out whether the interviewees' organisations deem the relationship among the supply risk policies, asset management, and strategic procurement important enough to align them together to achieve maximum benefits from them. When asked this, only 30 interviewees could relate the supply risk policies to asset management as well as strategic procurement policies. In their opinion, every organisation should relate all three policies together as they are all part of the process and fall under one cycle to meet the company's objective. One cannot be achieved without the other. They are all in the same pool and you cannot get away without the three of them. If not, then it becomes extremely difficult to have insight into the operation of the organisation. The other 20 interviewees, however, seemed not to be in favour of linking them together.

4.7.7 If yes – please explain more?

4.7.7.1 Better accountability structure

Findings show that linking supply risk policies, strategic procurement, and asset management will necessitate a better accountability structure. One interviewee stated: "*Our company has gotten an Executive Committee which approves of all the roles and responsibilities for their staff; there is a need to develop an accountability structure due to which th*e *organisation ensures that the asset management of the organisation should reflect upon the strategic procurement of the organisation".*

Another interviewee said: *"I would agree with that fact that there is a need to relate asset management framework of the organisation but having these policies in association with the supply risk of the organisation requires that the company along with the Ministry of Oil and Gas- Kingdom of Saudi Arabia work together. It is important to have an alliance to meet all regulatory requirements …".*

A third interviewee claimed: *"Yes. It is important to relate all of these policies so that a list of alliance or members who oversee the project provide their buy-ins to meet with the regulatory requirements provided by the Ministry of Oil and Gas- Kingdom of Saudi Arabia".*

4.7.7.2 Better risk management and safety

It also ensures solid risk management. One interviewee stated: *"Well, risk is always there. Without having risk management policy, the operation will be always at risk. We have a fully dedicated function in our enterprise that follows strict practice and policy".*

Another interviewee added: *"In order to increase our safety measures, we always should have our risk management practices being implemented. This will always ensure to increase our performance, safety and increase our growth value of the assets".*

Yet another interviewee said: *"I think that the risk management process needs to be part of any practice in our company. This is for the fact that it does help you to mitigate and plan your project risk-free"*.

4.7.7.3 Enables better business planning

There is a need to strongly relate the asset management policies of organisations with the long-term objectives, strategies, and supply risks. This will enable organisations to achieve better planning and remain abreast of new information. The asset management framework for corporations may have indirect impacts on the evaluation and assessment of risks related to supply. Hence, it helps the organisation in planning ahead if there is a need to replace a specific asset and procure another one without influencing business and having standbys available in the event that anything goes wrong.

One interviewee claimed: *"It will help the organisation in planning ahead if there is a need to replace a specific asset, procure another one without impacting business and having hit standbys available as well in the event anything goes wrong"*.

Another interviewee argued: *"In my opinion, it is important for an organisation to know what's its asset up to, when the asset has been procured, when is it being maintained, what are the overhauling schedules, if there is a need to retain or dispose of asset, if there is a need to dispose of asset then is the organisation replacing asset; if the organisation replaces assets then are we procuring new assets"*.

A third interviewee claimed: *"In my opinion, we should work towards getting more information and hold of their asset management function. Once the organisation has achieved that, they can then work towards developing a strategic procurement policy, which is in line with the standard asset management practices for the organisation"*.

4.7.7.4 Improved monitoring of finances

The interviewees acknowledged that organisations are also able to monitor their finances in a better capacity because of the increased transparency in operations. One interviewee remarked, *"Yes. In my opinion, the asset-intensive industries should*

ensure creating their asset management framework but not only that but also the strategic procurement policies of an organisation help the organisation monitor its finances and based on the information for assets make an informed decision for procurement".

Another interviewee claimed: *"… it will provide further help for cost reduction, lead time"*.

Yet another interviewee remarked, *"In order to protect our assets, and reduce the cost of your procured equipment and increase efficiency you should have risk management practices in your business"*.

4.7.8 If not, why not?

In response to this question, five interviewees said that one of the reasons why they would not align them is because their asset management and supply risk policies exist in isolation of each other, that is, they do not have the same objectives, and thus should not be related together. One interviewee, for example, said: *"In my opinion, all three policies i.e., the strategic procurement policy, asset management policy and supply risk policies are independent of one another therefore there is no need to integrate the policies since the functions provided by each has been properly managed"*.

Another interviewee claimed: *"I do not a need of relating everything. It works very well for the organisation working in standalone mode and having ownership of their own areas instead of shared responsibilities, which causes problem to be managed, by the organisation*".

A third interviewee asserted: *"The two functions are managed adequately and appropriately by the two departments therefore it reduces the need for the two functions to be managed within the same umbrella"*.

A fourth interviewee remarked that their company does not have a dedicated skilled management team; however, they are outsourcing risk management consultants to perform risk management practices.

4.7.9 How often do you think is best to forecast supply risk?

The purpose of this question was to ascertain how frequent supply risks should be estimated and predicted based on the views of the interviewees. Fourteen interviewees recommended that supply risks should be forecasted at least every year; eleven said every quarter of a year; eight said every half a year; another eight said it should on an ad-hoc basis, or every now and then; five said monthly; one said bi-monthly; and another one said every three years. Only three were uncertain of the frequency with which it should be done.

4.8 Chapter Summary

This chapter discussed the findings of the major categories concerning asset management within the private and public sectors. The chapter identified themes and their sub-themes from interviews with the participants, with particular attention paid to challenges specific to asset management within the oil and gas sector, together with issues that are unique to operators due to their status as either public or private enterprises. These themes will be discussed in greater detail in the following chapter.

This chapter identified 12 themes, and these were illustrated with supporting interviewee quotes. Many of the findings were shared among multiple oil and gas enterprises with common issues including IT, management of asset data, capacity management, supply chain complexity, and asset maintenance. Some of these issues were also discussed in the literature that were cited in earlier chapters, and that will be discussed further in Chapter Five.

Chapter 5: Discussion

5.1 Introduction

The aim of this chapter was to bring the discussions within the thesis together to form a central summarising perspective. Grounded theory comes into play in this chapter as it assists in the construction of new knowledge based on the responses given by the study interviewees (Evans & Moores, 2013). The grounded theory principle of emergence lends further weight to the information obtained from Chapter Four and reaches conclusions via various modes of evaluation. Through this process, the key objective of grounded theory was maintained by the researcher as the continued production of analysis in a manner that is innovative but formal (Evans, 2013). Guided by grounded theory, the researcher elected to conduct measured evaluation and processing of information, and the organising and handling of the anecdotal answers from the participants in relation to their interaction with an asset management framework within the context of the oil and gas industry. The key problems were identified and analysed in light of the present and possible problems that are present in the oil and gas industry in relation to asset structuring and handling. Furthermore, the developments in Chapter Four relating to asset management framework problems encountered by organisations are re-affirmed in this chapter.

According to Evans (2013), grounded theory should be made evident through theoretical presentation and illustrations, confirmed with data extracts, or live examples drawn from actual study settings, and accompanied by detailed accurate descriptions. These would enable readers to realistically visualise the scenario for themselves. Because grounded theory results from data indicating the theory, O'Reilly, Paper, and Marx (2012) argued that the researcher is not obliged to describe how each concept was arrived at, but is only required to provide an example of the method used to show how the data related to the theory. The qualitative analysis process is, essentially, data reduction to allow for its interpretation. The process involves researchers reducing potentially voluminous amounts of data into useful segments characterised by discernible identifiable patterns, categories, or themes. This information allows for interpretation via the use of specific schema; a process which Øye et al. (2016) described as de-contextualisation that allows for more in-depth analysis. While the ultimate objective of this analysis is the emergence of the 'big

picture' under consideration, being able to see the big picture requires deconstructing the data into smaller components, which can be codified by their essential elements

To aid the reader's understanding of the data, Øye et al. (2016) advocate visually displaying the information in a spatial format in tabular illustrations. Such tables can emphasise the links among categories by their sources, location, demographic factors, data collection time frames, role ordering, or other characteristics evident in the information. In this thesis, such tables have been constructed to emphasise the themes and sub-themes, and highlight both similarities and differences pertinent to the research (see Appendix F).

The coding process (which is essential in transforming data into categories and themes) is not governed by inflexible rules that determine how best to sort interview transcripts, observation notes, visual materials, or other documents. On a case-by-case basis, information categories and codes are developed to suit the needs and purposes of the study. The initial categorisation and coding of data eventually provide the way forward for the qualitative researcher to interpret what the information is actually indicating. This process involves dividing the informational data through a process of "segmenting", leading to "coding categories" (Azeem & Salfi, 2012), which enables the researcher to "generate categories, themes, or patterns". This chapter picks up the various emergent themes displayed in the findings above and explains them thoroughly.

5.2 Strategic objectives

Strategic objectives are crucial for the growth and success of a business or company. They map out the company's mission, vision, and ultimate goals (Nikols, 2016). It is compulsory for all organisations to have strategic objectives in place as these are what define the business strategies, direction, and purpose of the organisation's existence. Furthermore, strategic objectives help improve operational and production efficiency as they make it easier for employees to understand the purpose of the organisation and what goals must be achieved (Nikols, 2016). Organisations can collapse because of the lack of clear objectives in a certain department or division. To avoid such scenarios, it is vital to establish strategic objectives for the organisation and to ensure that these objectives are clear,

measurable, and realistic. Simply put**,** objectives need to be SMART, i.e., Specific, Measurable, Achievable, Relevant, and Time-oriented (Trinity College Dublin, 2017).

Specific objectives provide clear definition and clarification on the goals and targets that the organisation is trying to attain (Trinity College Dublin, 2017). They also enumerate which department or division has been tasked with what role, and specify how those roles should be executed. Additionally, specific objectives demonstrate the expected end results of these tasks, so that once one has completed a task, one can check and see whether the expected end results have been achieved (Lawlor & Hornyak, 2012).

'Measurable' defines the terms of assessment used to evaluate objectives (Trinity College Dublin, 2017). It answers the question: "Do the operational processes, roles, and tasks completed meet the anticipated expectations?" As Lawlor and Hornyak (2012) assert, there are many terms of assessment such as quality, deadlines, frequency, and quantity. Quality measures include accuracy, precision, and articulation, while quantity measures include percentages and volumes. 'Frequency', on the other hand, refers to how often a certain task should be executed (for example, daily, every fortnight, or monthly).

'Achievable' makes certain that the objectives set are actually attainable (Trinity College Dublin, 2017). It addresses questions such as "Can this objective be realised?" and "Do these personnel possess the right skills and abilities to accomplish this objective and fulfil these specific expectations?" Factoring in this 'achievable' factor is very crucial to setting a company's objectives as it guarantees the company's stakeholders that the set objectives will be attained and not dismissed. Another advantage is that it establishes the necessary skills, aptitude, and level of competency required to achieve a particular objective (Lawlor & Hornyak, 2012).

'Relevant' addresses questions such as "What is the essence of this particular objective?", "Is it suitable or worth it?", "What are the benefits likely to be achieved when this objective is applied?", "What are the risks of this objective, challenges, costs, and efforts required?", and "What will be the consequences?" (Trinity College Dublin, 2017).

‘Time-oriented’ addresses questions such as “How long will it take to have this objective accomplished?” and “What are the end-points of this objective?” According to Lawlor and Hornyak (2012), end-points refer to measures used to assess whether a given objective has been carried out as ordered and whether it should be declared satisfactory or not. Organisations set various end-points to establish a sense of urgency in accomplishing a given objective. It is prudent to set end-points for company objectives to ensure that the company fulfils its vision and mission within a given time-frame.

All the organisational objectives in this study appear to be SMART. They are very specific and detailed, and they let one know what the organisations want to achieve. The institutors of these objectives have set a number of benchmarks that they shall use (or already use) to gauge the execution of these objectives. They comprise HSE codes, Risk Mitigation Plans, TQM practices, and Corporate Social Responsibilities, among many other examples; hence they are measurable. They are also achievable and within reason. They are relevant, too, as fulfilling these objectives will guarantee that these organisations achieve success in accomplishing their goals and targets. The objectives are both long-term and short-term; thus, they are time-oriented as well. Despite these strategic objectives fulfilling the SMART requirements, none of them touches on asset management practices. None of the study interviewees mentioned any strategic objective related to asset management. This can only be interpreted as either total disinterest in mapping out asset management practices or an absolute absence of asset management practices in these organisations. Both these interpretations demonstrate that most oil and gas organisations seldom revere to making asset management plans, which is disastrous. Asset management is complex and, in this regard, it requires the utmost planning and shrewd objectives to ensure that everything runs smoothly. A failure to plan and set appropriate objectives means planning to fail.

Nonetheless, none of the oil and gas organisations in this study have a structure for asset management practices. The only mention that was made regarding asset management was by one interviewee who said that their organisation had in place an ‘Asset Integrity’ Department. One mention is not enough. More needs to be done regarding the enforcement of asset management as a fully functional department on its own, with its own managers, directors, supervisors, and other experts.

Implementing this will help the organisations to better manage and care for their assets. The asset management framework is a visionary tool, and, therefore, at the very least, must have a clear vision and provide clarity of strategic purpose rather than be a set of vague assertions. It requires a set of objectives that are realistic and balanced, and it must be obvious how the process improves the business and is ultimately benefiting everyone.

5.3 Strategic procurement

Procurement processes adopted by organisations typically include the following common characteristics: the manufacture of capital items according to design features specified by the purchasing organisation; agreed date and delivery time of completed capital item, product, or service; delivery in compliance with the quality specified by the buying organisation; and the development of a review and evaluation process of the delivered product or service, not only to ensure the suitability of the purchase itself but also to assess the supplier with a view to decide their suitability for further procurement purchases (Jeeva & Baswaid, 2014). Nevertheless, it is realistic to ground the procurement process on an accurate assessment of the true capabilities of the supplier within the context of the area of operations that the procurements are made in, and the supplier's usual area of business operations. The Commodity Council sees a set of conceptual issues, which require addressing in relation to strategic procurement. Nguyen et al. (2014) list these as seen from the perspective of the oil and gas sector. They include:

- How does the oil and gas sector's management of assets apply strategic procurement policies?
- What are the differences between the oil and gas sector's concepts of strategic procurement application and the traditional conception of managing purchases and supplies?
- In the context of external resource management, what are the benefits of developing a proactive decision-making approach towards procurement decisions rather than a reactive approach?

- What connection exists between the development of appropriate theory building, conceptualisation, and practical operation of strategic relationships employed by oil and gas sector organisations?

The process of answering these questions serves to prompt oil and gas sector operators to evaluate their asset management frameworks, particularly for compliance with the requirements of statutory bodies. The establishment and documentation of strategic procurement policies is not an issue because all organisations have them. The only issue is how these policies have been developed. Twenty of the interviewees said that their strategic procurement policies were developed and imposed on them by the Ministry of Oil and Gas. Apparently, they are not so pleased with this administration because the legislations are not autonomous and they are unable to access the policies because they are managed by the states.

In addition, the majority of these policies are not developed in relation to asset management. The reasons for this include poor interdepartmental coordination, difficult supplier selection, shortage of skilled staff, poor procurement regulations, non-integration of systems, and the lack of clear, standard asset management policies. The majority of the population even disregard the connection between strategic procurement policies and asset management. They claim that there is really no need to connect the two departments as they are two different entities that serve different purposes. This explains the poor interdepartmental communication between the strategic procurement policies and asset management, with many interviewees saying that there are rare and minimal communications between the two departments.

This lack of a relationship between the strategic procurement policies and asset management is a worrying concern for all organisations. It is crucial that asset-intensive industries, such as the oil and gas industry, align their asset management policies with their strategic objectives. This way, they lay down a solid framework for assets in terms of how effectively they should be cared for, how often maintenance should be carried out on the assets, how quickly the assets should be replaced, what criteria should be looked out for when purchasing a new asset, what determines the best buy, and what aspects determine the value of the asset five or ten years in the future (DiMatteo, 2014). With these considerations put in place, organisations will be

able to take better care of their assets and maximise their economic lives. Actually, it should be mandated by the state that all oil and gas organisations should develop their strategic procurement in relation to asset management via collaboration and excessive planning between all organisational departments. This could lead to increased interdepartmental communications, increased dialogue, consultation, and change embracement. Additionally, the board leaders should make better decisions when it comes to asset management to ensure that the organisations have a better system in place for adequate information distribution as well as a centralised system.

Within the oil and gas industry, a recurring challenge is adapting to fluctuating marketplace conditions. When combined with the inevitable delays between identified needs and being able to meet these requirements in relation to physical assets, not to mention the complexity of the nature of production, controlling procurement requirements is challenging. Businesses must therefore conduct comprehensive analyses of their procurement necessities to ensure that the data upon which they are founding their projections are correct, and to predict market conditions and make adjustments accordingly. The swift delivery of data to key parties within the production capability is a recent phenomenon, facilitated by the ever-changing environment for technological advancement, and combined with the internationalisation of the marketplace and the emergence of rivals. Even prior to this recent period, analysts proposed that the incorporation of expert information regarding cooperating production partners is a principal factor in determining a company's success (Nikols, 2016).

Businesses undertaking an assimilation of their production sources have an enhanced ability to participate equally in the production of information and other resources to deliver enhanced outcomes for stakeholders (Obinger et al., 2014). It is also imperative that administrators and bureaucrats are incorporated into the process of projecting future market conditions. Such enhancement of outcomes and maximisation of returns can only be achieved by close coordination with stakeholders, including comprehension of their limitations and potential. Opening and developing lines of communication between businesses and stakeholders is thus imperative to the maximisation of such capacities, including the collaborative nature of distributing expertise and other resources.

5.4 Business continuity

Bronson and MacDonald (2014) define "business continuity" as the practices outlined within an organisational setting that aim to ensure that the day-to-day operations can still continue during and after a crisis. It is an extension of supply risk strategies as it helps develop a recovery plan for a business after experiencing incidents that threaten to disrupt normal operations (Gallagher, 2013). With a robust BCP in place, businesses can now be sure that mission-critical functions shall carry on as usual, even in the face of disasters. These disasters may range from natural calamities, e.g. fires and earthquakes, civil unrest, terrorism, technological malfunctions, supplier insolvency, credit crunches, poor communication, cyber insecurity, and industrial strikes. They may occur at any time, and without prior warning. Hence, it is imperative for organisations to develop strategic BCPs to avoid business losses. BCPs are especially critical for the endurance and stability of asset management functions. Typical catastrophes may emerge during the facilitation of asset management processes, for example, machine breakdown, obsolescence, corrosion, poor field development, defective servers, harsh weather climates, data loss, or even wrongful asset disposal (Griffith University, 2013). Thus, the application of BCPs may help oil and gas operators to survive through these crises and circumvent bad reputations, asset damages, and business losses.

A number of organisations recognise the importance of BCPs and attest how they enhance business operations and procurement planning. The majority of the population appear, though, to overlook the value of a BCP, assuming that they are secondary to risk management strategies, disaster recovery plans, and emergency and contingency plans. They assume that these three strategies are superior to BCPs and, therefore, since they have already incorporated them, then there is no need to incorporate BCPs as well. This explains why many organisations have not developed their strategic procurement policies in relation to BCPs as they simply do not see their relevance or the role they play.

In as much as BCPs, risk management strategies, disaster recovery plans, and emergency and contingency plans are applied interchangeably and appear to overlap each other, they are actually different and serve different purposes. BCPs focus on how to ensure a continuum of operations even when a business is faced with a crisis,

whereas the three latter forms tend to concentrate on how to get a business back on its feet after it has already suffered a crisis (Bronson & MacDonald, 2014). BCPs are more of a forecasting tactic that analyse all possible risks in advance, then maps out a strategy with which to avoid the collapse of business operations so that normal day-to-day activities can still run even in the face of that crisis. Risk management strategies, disaster recovery plans, and emergency and contingency plans, on the other hand, are remedial tactics that are applied following a crisis (Gallagher, 2013). Thus, the notion that BCPs are irrelevant is highly incorrect and businesses should refrain from this school of thought.

5.5 Supply risk – supplier chain complexity

Interviewees listed supply chain complexity as one of the leading challenges facing their industry. They particularly identified vendor availability, their competency, and procurement as issues. Private operators within the oil and gas sector regard the procurement and selection of vendors as aiding in the streamlining processes, reducing costs for raw materials, and identifying superior supply sources. Overcoming supply chain complexity is regarded as a means to help the company's bottom line. From interviewee responses, three sub-themes emerged: procurement and delivery process, supplier selection, and supplier risk. According to Cross and Bonin (2010), one of the most significant and least appreciated inputs associated with conducting business with international suppliers is the degree of risk. This theory is quite evident in the responses of the interviewees. Although some organisations appreciate the essence of supply risk policies, many appear to, once again, dismiss them. Out of the 50 interviewees, 44 commented that their organisations were yet to establish supply risk policies and, instead, say that they were doing just fine with risk management policies instead.

However, the aforementioned interviewees were quick to add that their organisations had specific clauses for supply risks in their risk management policies, which were quite comprehensive. Such a policy forms the basis for the organisation to plan their risk identification, risk assessment, and risk mitigation strategy related to the organisation's supply chain. For the six interviewees who had incorporated these policies, they were yet to develop them in line with asset management as they alleged that strategic procurement policies, asset management policies, and supply risk

policies were independent of one another (meaning that there was no need to integrate them). In as much as supply risk policies and risk management policies appear similar, they have many differences. Risk management policies are, more or less, focused on financial matters and less on the supply chain. Vilko and Ritala (2014) showed that risk management policies involve the identification, evaluation, and mitigation of risks in the financial sphere such as investment losses and credit risks.

Conversely, supply risk policies focus on monitoring, evaluating, and mitigating risks that specifically threaten the supply chain (Viator, 2015). They protect against supply shortages, cost volatility, service deliveries, asset obsolescence, and asset disposal. Thus, it is incorrect to substitute supply risk policies with risk management policies as they work in totally different segments. Thus, companies should endeavour to develop supply risk policies and ensure contribution from all organisational departments in this new exercise. Companies should also acknowledge that other supply considerations are given less attention despite their importance, such as the lead time required to ensure the availability of certain capital items, particularly where demand for such an item is either very high (potentially exceeding supply) or very low. This results in non-availability from the inventory.

Following an investigation of the available information, what clearly emerges is that both supplier and buying organisations ought to place an overriding emphasis on improving operational efficiency by undertaking measures to reduce the cost of supplying goods. Both suppliers and buyers should conduct business in the belief that operational efficiency will be achieved by implementing measures that will reduce the supplier's costs and improve operational efficiency. This will benefit the buyer through shorter lead times, and it will give the buyer some control over the supply of their purchase, particularly in regards to maintaining delivery schedules.

Customer loyalty should also play a part in aiding the delivery of scarce items; however, loyalty can backfire. For example, suppliers may take loyal customers for granted, and thus not reward them. On other occasions, loyalty may place the buyer at the top of a supply queue. Alternatively, loyal customers occasionally may not receive the discounts that are available to new customers. Loyalty is a difficult quality to accurately measure or quantify (Walker & Jones, 2012). Wei and Xiang (2013)

advance the proposition that contemporary business practice does not see organisations fully evaluating the risks associated with disruptions to supply and procurement chain continuity. They believe that the lack of a full evaluation of the impact of a supply chain breakdown results from an overemphasis on cost reduction, to the exclusion of less measurable considerations.

Reducing costs has always been one of the principal concerns for buying organisations. Consequently, buyers typically devote considerable time and effort into researching suppliers who are capable of offering superior quality or priced products within the necessary time-frame, together with a requirement to meet the organisation's other operational guidelines. While a range of risks are present for every organisation, which can potentially disrupt the supply chain during their strategic procurement process, there is a tendency for organisations to not address these problems before they occur. Problems can result in increased lengths of time for suppliers to fulfil their customer's orders, and this can detrimentally influence business operations and damage the long-term working relationship between supplier and buyer. Consequently, both parties in the transaction have an incentive to assess the possibility of risks, their likelihood of occurring, and preparing for the consequences through a combination of preventative and contingency strategies. Where organisations undertake these measures, their relationships will be more realistic, and consequently, they will find themselves in a better position to improve efficiencies and design contingencies in the event of a supply disruption occurring (Wei & Xiang, 2013).

To avoid, or at least minimise, supplier chain complexities, an understanding of supplier relationships is required before long-term partnerships that reap benefits can be realised. Such relationships are worth the time and effort of investing in because they can deliver innovative products or technologies at more favourable prices than that of regular suppliers, which can lead to buyers winning a competitive advantage. In the event of a supplier's under-performance, the buyer can potentially intervene to request that they improve, possibly through newer innovative technology or superior processes. This is done in the interests of promoting and even further developing the long-term and sustainable relationship with suppliers.

However, relationships with suppliers typically require careful management by the buying organisation because, depending on their purchase, they may have several options open to them. Ultimately, the buyer may potentially benefit by ending a contract or understanding with a supplier and conducting the work itself in-house by acquiring the necessary skill set or capacity to fulfil the supply itself. Alternatively, the buyer may split a purchase up among multiple suppliers or it may place the business with a (different) single source supplier. After consideration of the available approaches to buyers, however, researchers have advocated the advantage of developing favourable relationships with strategic suppliers, which typically pay off by delivering customised service or products, instead of being sold a standardised or in-stock service provided to customers with whom they lack a cooperative relationship (Amue & Ozuru, 2014).

Risks are present in every procurement policy decision, such as relying on a single source supplier, experimenting with new suppliers, or using multi-source suppliers. Nevertheless, regardless of the procurement strategy that is being pursued, consistently working with the same supplier or set of suppliers provides the buying organisation with a degree of certainty derived from the relationship's track record of delivery, which can be reassuring. In scenarios where an organisation relies on a single supplier, the ongoing relationship risks casualisation, which can possess both benefits and risks. However, the maintenance of stringent operational conditions, which both parties agreed to at the commencement of their business relationship, will protect the purchaser to varying degrees from adverse effects should the supplier not fulfil their expectations.

The supply original equipment manufacturer should be relationship-based, whether established on a single source or multiple-source supplier. Risk management strategies should also be applied to the management of obsolete parts. The building and sustaining of long-term business relationships require bilateral cooperation and an ongoing investment of both time and effort; however, the benefits for both parties justify such undertakings. Developing mutually beneficial supplier and buyer relationships founded on track records or delivery experience is ideally a two-way transaction, with both parties needing to maintain favourable contacts. From the perspective of the supplier, the relationship development process begins with the

original selection of the supplier and is sustained by the ongoing monitoring and review of their work. It may necessitate the development of training initiatives. Additionally, buyers may deem it advantageous to provide incentives to suppliers designed to cultivate a process where continuous improvement is fostered, manifesting itself in superior infrastructure and skill sets of workers. If implemented correctly, this should deliver improved quality products and improve the integration of the supplier with the buyer organisation (Birasnav, 2013).

A primary objective of supplier relationship development is a reduced cycle time within the constraints of available engineering, together with inventory reduction, producing improved customer satisfaction, and retention (Dashore & Sohani, 2013). Where mutually beneficial relationships are successfully formed, this permits the purchasing organisation to also reduce their number of suppliers. Companies across the business spectrum, who maximise outsourcing, begin to reflect on the quality of products and services that they receive from their partners. Simultaneously, for the buyer, the cost of outsourcing is a major driver towards greater utilisation of technology. When correctly utilised, technology can prove to be a source of innovation, delivering benefits in terms of products and services supplied to the buyer.

However, a key component in benefiting from outsourcing is vested in determining the original supplier via an evaluation process (Gopalakrishnan et al., 2012). A recurring theme of academic literature concerning supplier development is the improved performance resulting from development, and its material improvement in the quality and performance of the equipment or services supplied. This may have an identifiable impact on the operations of the buyer's business. Thus, international and local supplier original equipment manufacturer is linked to the supplier's performance optimisation. Research that focuses on the key to improved quality of products and/or services delivered to suppliers is not restricted to the management of potential bottlenecks in an organisation's supply processes. Instead, this research encompasses the supplier's complete supply chain management.

5.6 Asset management frameworks

The researcher noticed that the majority of the participants in the present study failed to link up their asset management sector with other related sectors, that is,

strategic objectives, strategic procurement policies, BCPs, and supply risk policies. The asset management frameworks are mostly fragmented and isolated from all other departments. This creates a very delusional working environment for the oil and gas industries as the assets are poorly managed and cared for. As emphasised in the Literature Review chapter, such asset-intensive industries require strong and stable structures for managing and maintaining their physical assets.

Earlier, it was assumed that oil and gas organisations have firm asset management structures to properly care for their assets and ensure longevity. The situation on the ground, however, is quite different. Most of the interviewees divulged that their strategic procurement policies and objectives were not developed with asset management in mind. One then wonders how they are able to achieve proper asset care if they do not have well-established tactics to procure them, commission, and dispose of them rightfully. How does an entire organisation perform asset maintenance and repair without proper documentation? Does the organisation not have goals or visions that it would like to achieve in its asset management procedures? One can only conclude that the asset management department is run very haphazardly, since there are no set objectives, no supply risk policies, no business continuity strategies, and no procurement protocols. Indeed, most of the organisations do not even have supply risk policies and BCPs in place as they believe risk management policies are adequate enough.

Furthermore, the majority of the organisations use the Google Drive SharePoint as their central asset management framework. Google Drive can be used as a platform to store inventory lists but only at a very basic level. As Hilb (2012) asserts, Google Drive is not a visually inspiring platform like a DAM platform (for example EAM portals) is. It is rather basic and contains endless spreadsheet-like cells that can only store basic data entries such as numbers and texts. Google Drive cannot hold videos, pictures, or catalogue presentations. In addition, who wants to sift through a library of numeric registers only to pull out only one record, whereas with the EAM portals, you can easily sort through the attached images? To this end, more digital platforms should be embraced to cease the use of manual tools and encourage more collaborative and interactive platforms.

Generally, organisations ought to make their current asset management more intuitive

and steadier by aligning them with the aforementioned key aspects, most importantly, the strategic objectives and strategic procurement policies. Not only will this improve the acquisition, planning, supply, and commissioning of assets, but it will also see to it that the overall organisational leadership is improved, that there is more change preparedness by the help of the management, and that the systems are integrated. There is also increased employee engagement, as well as increased training programs.

Organisations that own, operate, and maintain their physical assets ought to take it upon themselves to ensure that the asset's performance meets the needs and expectations of customers and contributes towards meeting stakeholder's aims. In recognition of this, responsible organisations ought to be continuously seeking to utilise their assets in the service of their organisation. Motivation to maximise value from physical assets stems from improving customer satisfaction, increasing productivity, improving output or service quality, minimising environmental impact, or any of a range of other performance indicators related to the operations of the specific physical asset. For asset management to demonstrate its value-adding role within the organisation, it must be seen to fulfil a specific strategic function. To achieve this, instead of being reactive, it must be proactive and essentially respond to issues before they become problems, which will disrupt the objectives of the organisation (Graham et al., 2013).

Asset management needs to forecast the organisation's needs to develop forward plans that complement the future objectives of the organisations, without potentially disrupting them. Consequently, asset management encompasses far more than the maintenance needs of operational infrastructure. Regarding asset management as an essential strategic component of the organisation's operations is both important and requires adopting a long-term view of the enterprise's performance. Hilb (2012) describes strategy as matching the organisation's internal set of skills and resources with the opportunities and risks presented in the external environment.

Strategic asset management also encompasses determining long-term organisational objectives and goals, and designing a course of action to accomplish them, while ensuring the allocation of necessary resources is made to realistically accomplish these goals (Horn & Granger, 2013). Consequently, strategic asset management seeks to effectively incorporate the organisation's long-term asset management needs into the

organisation's overarching plans as an essential element of meeting customer's evolving needs. A component of this is the requirement to predict future asset needs and to develop plans that ensure their timely provision.

Approaching physical asset management from a strategic perspective enables a comprehensive understanding of how aligning the organisation's asset portfolio enables service delivery, which actually meets present and future customer needs (Islami, 2015). The strategic process is holistic, as seen in the requirement for corporate objectives to coordinate the operations of asset owners, managers, and service providers. Consequently, the driving force shaping the policy objectives and goals of asset management is the performance and sustainability of assets in the service of organisational objectives. Therefore, adopting a strategic approach requires establishing asset management goals that are based on a need to support the business's strategic goals.

5.7 Integration of systems

Based on the responses of the participants, one of the most significant challenges facing the management of oil and gas assets in the private sector is the absence of integrated IT systems and databases. Data loss is a genuine issue that requires planning for, as it can have major and dire consequences on operations. Additionally, interviewees discussed the inadequacies of prevailing remote access tools, which they generally labelled as inflexible and not suited to supporting business data. These inadequacies resulted in users devising alternative approaches to working remotely including emailing documents to their personal accounts to permit working off-site or at home. For organisations to effectively manage the performances of their assets, IT systems must facilitate interdepartmental communication. They also remarked about unreliable data and information. The availability of detailed, accurate, and current information concerning organisational assets operating within the oil and gas sector is of concern to the entire industry.

Decision making relating to both the long term and daily functioning of assets depends on reliable and efficient data. Consequently, the unreliability of information leads to poor decision making, which adversely affects efficiency. A note was also made on how the existing frameworks were not user-friendly in terms of the platforms not

matching user needs, thus making the functions harder to perform. Interviewees generally believed that their organisation's management framework needed to be designed to ensure it provided advantages to their enterprise.

An operational and reliable asset handling database is critical to the adequate handling of assets more generally, and thus is key to improving asset handling. It is crucial that such a database allows timely access to correct information, to facilitate the speedy evaluation of assets pertaining to a particular company. This can, in turn, assist with making informed choices regarding the nature and results of assets, including descriptions of the methodology used to determine value, and indicators of choices that are immediately pressing (Kusumawardhani, 2016). Therefore, a well maintained and updated database can be critical to the provision of information, provides a solid foundation for the quality organisation of assets, and can be useful across many levels of a company. These include the planning and system results stage (which affirms that systems are completed successfully) and the asset make-up stage (which affirms the ongoing success of specific assets within a greater plan). Information access and distribution between entities are highly prominent in relation to the key goal of underlining assets and implementation of plans, including at the bureaucratic level (Kusumawardhani & Markeset, 2015).

Despite the usefulness of the information, analysts such as Lipaj and Davidavičienė (2013) state that the majority of companies have an insufficient understanding of the circumstances in which their assets are located, including their access or ongoing status. This lack of understanding often creates problems along the line, especially through poor utilisation, and influences both the company itself and its various stakeholders. Some of the possible impacts can be lowering capability, creating dangers for individuals, decreasing asset values, higher costs associated with sustaining assets, and poor planning in sustaining the assets.

Furthermore, there are instances where a lack of information will cause problems in categorising the asset according to legal requirements, for example, under whose area of authority it is placed (central, regional, or other territorial authority). The cause of this has been identified as poor cohesiveness and deficient recording of assets, and it has exacerbated the obscurity of asset possession. Such a lack of understanding can

also create poor practices within the entity, inducing additional costs for capabilities already within the scope of the organisation after some relatively simple adjustments. Therefore, it is absolutely critical that an organisation obtains useful information regarding the assets they hold.

Recent studies have exposed and underlined these significant flaws in companies' handling of asset information. Generally, the data retained includes details, value, fund resource, amount, place, possession, information, structure, status, code, title, and variety. However, recent rigorous evaluations have outlined deficiencies in the data collated and retained in databases. This is the case in the context of planning, as standard procedure, and allowing for irregularities or modifications such as the impact of global warming. Therefore, collating such information for the purposes of obtaining a detailed understanding of assets is an important problem for companies to address, and generates pressure for companies to update their methods. Only half the public institutions had adequately updated and digitised their databases in 2013–2014, with an absence of a current database on public land ownership. Further deficiencies were found in relation to the significance and usefulness of the information retained, and this has a knock-on effect on the outcomes of choices made in relation to asset management across the board. Income and loss generated from physical asset ownership are not linked with individual assets, principally because of a lack of coordination with financial planning.

Lillis and Szwejczewski (2012) suggest means by which such an asset repository might be developed or enhanced within the resources sector. Together with the research findings of this study, these may include the following:

- **i.** The creation of suitable processes and knowledge among employees.
- **ii.** The development of economic instruments, which may help to provide a basis for database expansion.
- **iii.** Incorporation of technological innovation to enhance access and stability of asset databases.
- **iv.** Offer the relevant establishment support for software development, funding, and expertise.

v. Distribution of relevant data between suitable entities, with an aim of improving the running of publicly available provisions.

vi. Offer a regulatory environment that will adhere to the objective of enhancing processes in asset management.

The enhancement of asset databases necessitates the appropriation of high-quality methods by companies from those nations with current high standards—incorporating some suitable adaptations for local conditions. For example, Canadian methods to limit and expand the organisation and coordination of assets is considered to be from a rich background of development, which privileged information is a key tool to be distributed among relevant parties to enhance informed choices, availability, individual empowerment, and communication. According to Mitchell and Mitchell (2012), such foundations may involve the following:

i. On the level of public administration, data distribution among various associated entities is imperative in ensuring coordination. Defending data should be considered only when such data is of concern with regard to safety or stability.

ii. Data should be compiled across multiple parties (which share responsibility and are adequately trained for this task) with those at the top of their sector, thus confirming that the data is being handled well. The obligations in handling the data should be made clear to employees.

iii. It is important to make data available to relevant parties, and that it is in a form suitable for the task and type of user. This includes availability and accessibility for the public, administrators, and within government.

iv. Data should be in a form that is coherent, direct, and comprehensible.

v. The potential for later merging into other processes should be considered, as well as a single formation and distribution process.

vi. Such processes as those outlined above should be integrated through initially specifying the capacity of the pre-existent database to operate in a manner that fulfils these requirements. Secondary to this are the opportunities to ensure that such elements as data correctness, efficiency, form suitability, and availability of information are to a contemporary standard, with monitored and public methods of access.

In general, the origin of any plan for asset information collation should be a method of correctly locating and allocating assets—methods which, at present, require improvement. As well as being deficient in requirements for informed choices, the present methods of asset locating and allocation do not acquire enough information in connection with environmental consequences, and the impact of global warming on the asset. These should be compiled and updated regularly, and should be integrated with current methods.

5.8 Poor leadership

There was a general acknowledgement that most organisations have poor leadership. Within this theme, some sub-themes emerged: 1) the absence of operational clarity; 2) inadequate employee engagement; 3) ineffective management; and 4) poor business planning. Without direction, employees are aimless. They do not know what the company's goals are and they do not know why they are working with specific processes. Interviewees pointed out that their productivity receives the biggest hit as they are directed less in an ambiguous work environment. Interviewees acknowledged that this industry currently suffers from a major redundancy in top management due to the downturn in current oil prices. Poor leadership also leads to frustration in employees, as decision making is either crippled or biased. This leads to employee dissatisfaction and (in a few cases) attrition. Participants considered that the asset management framework development is part of building a track record and of making sound investments. There can be no improvement or development of the asset management framework until it is directed from senior management, because without truly great leaders, you cannot have a truly successful physical asset management process.

The interviewees also repeatedly commented on poor planning and lack of a clear strategic vision resulting from poor leadership, hence leading to an inadequately designed asset management framework. Interviewees described poor planning with a variety of similar adjectives, such as inadequate planning, poor planning, bad planning, or non-forward planning. Irrespective of the precise words used to describe the phenomenon, poor planning was linked with ageing assets, which study participants identified as in need of prioritisation of planning due to their potential for failure. Similarly, poor leadership also triggers inadequate capacity management,

which entails the entire process of delivering optimal physical asset performance (Varner, 2013).

Poor capacity management, on the other hand, elicits reduced effectiveness, less productivity, and limited operational efficiency. Effectiveness in capacity management results from a process that leads to asset owners and stakeholders maximising the investment's value. In the pursuit of maximising investment returns, assets must be operated effectively and at their optimal performance. Thus, capacity management would seemingly suggest that organisations are required to ensure a) assets are highly utilised, and b) assets are used to support business operations. Both of these prerequisites are recognised as important factors in contributing to business output by improving operational efficiency, partly through improved maintenance efficiency, which can be one way of improving output, rather than the more expensive course of additional capital investments.

5.9 Human resources

Inadequate or insufficient resources required to manage organisational resources were reoccurring themes described by interviewees. Many interviewees reported that their organisation owned and managed far more assets than dedicated staff could realistically manage and had inadequately skilled team members. Furthermore, many interviewees described situations where their operations lacked suitably qualified personnel necessary for asset management, including lawyers, engineers, IT professionals, and accountants. They asserted the need for their organisations to form a group of highly skilled team members who enjoy the trust of staff to oversee this aspect as the ones currently trying to do the job did not really have the skills or credibility to do their jobs properly. Due to labour shortages for technical staff, many organisations are obliged to secure the services of outsourced providers to supply infrastructural assets. Interviewee responses provide evidence that innovative procurement approaches are being adopted in the form of external partners due to the compelling requirement to cut time to completion, enhance economic competitiveness, mitigate project complexity, and up-skill staff through complementing teams with specialist expertise.

The structure of labour and other company elements that are pivotal for asset coordination must be sensitive to core capacities and intra-company management styles, with long-term administrative centres and capable employees taking care of asset management. Asset handling falls into both categories of budgeting and domestic strategising. Because of this, an effective team working in asset management will necessarily combine the targets of enhancement and cohesion between groups. A key issue regarding labour in the gas and oil production industries is the monetary level at which companies can set wages for staff, so that positions in asset management will attract workers with the demanded skill set (Nanjundeswaraswamy & Swamy, 2014). Furthermore, companies also suffer from deficiencies in offering rewards to staff for high performance, poor staff confidence, and re-skilling and training. Generally, within such companies, the management of capital is looked after well, whereas the management of people may leave something to be desired.

The problem of adequate staffing among oil and gas companies is not limited to the amount of staff available, but also to the standard of those staff members. Nassazi (2013) suggests looking for skilled workers from other businesses, or seeking those with potential from inside the company itself. For each instance, imparting additional skills to staff is required; therefore, companies must ensure that their means for training staff are to an adequate level, as these will be required to ensure that staff members operating in asset management are doing so at a level demanded by the occupation of asset management. Some companies demonstrate an urgent need for skill development to meet even relatively fundamental targets. Within public and private organisations, the assistance of a wide array of government infrastructure may be sought, or alternatively, they may ask for advice from large global organisations or significant asset management businesses. The labour force within an organisation may be enhanced through various methods, with assisted training and services possible for any human-based interactions. According to Nassazi (2013), such elements might include:

i. Company strategy, and implementation of projects:
    a. Incorporating objectives, problem-solving, corporate identity, and hierarchical problems.

ii. Self-analysis procedures:

b. A system to evaluate a business and locate areas that may be bettered.
c. May incorporate collective exercises, specification of problems, brainstorming, and surveys.

iii. Future strategising:

d. Systems that may entice or encourage new employees to join the company, filling problem regions.
e. Identifying the deficiencies from removing expertise will be pivotal in the level of success within regional politics.

iv. Adequate skill building platforms:

f. Specifying and ranking areas for development.
g. Identifying the difference between operations and management.
h. Confirming the implication of senior administrators and regional staff.
i. Finding the appropriate teachers and building thorough teaching models.

Although it is often beneficial to begin with a company analysis to identify any problems and target them early (Joe, 2008), the quadrant of processes has an in-built flexibility. This means that businesses can customise it to their needs. The initial company analysis period facilitates a business gaining new perspective, which often naturally leads to them developing a long-term strategy. Holding this pair of activities first allows any inadequacies among labour skills to be identified, and planned for in the subsequent strategic discussion and staff skilling. Success in enhancing the company may be centred on a clear perception of the company, together with building a pathway for the business towards the enhanced level striven for. Quantifying the abilities of the public or private company successfully then permits a thorough and methodical analysis of other elements, in terms of their importance to the company.

5.10 Poor regulatory

The interviewees stated that they believed that the regulatory and legislative environment governing the oil and gas sector is ambiguous. Interviewees stated regulations were generally vague and, due to their lack of precision, they were not easy to implement in practice. Consequently, interviewees could not refer to specific guidance relating to asset management practice that they could point to as the starting point for any framework. Practically, all interviewees working in the public and

private sector oil and gas organisations negatively mentioned the absence of precise regulations applying to guidelines governing their practices. This theme was further broken into three sub-themes: 1) inadequate or non-existent asset guidance; 2) misunderstanding of regulations; and 3) non-conformity of regulation application. They remarked how they were unable to apply the regulations because they possessed insufficient knowledge regarding how they should be carried out owing to the total lack of common regulations and applicable guidelines for asset management operations.

It is clear that the present regulatory environment does not meet the requirements of businesses, and there is a pressing need for increased monitoring and guidelines in relation to their handling of assets. Over- or double-regulating should be avoided within the guidelines structure, and the relevant legal basis on each level of the regulations structure, given the broad nature of the structure at the top. It is also critical that the legal and regulatory framework is comprehensive and coordinated, so that there are no activities or potential actions that are not covered, and no sections where the guidelines are obscure or misleading, with new propositions to remove such discrepancies.

In response to this poor regulatory framework, companies operating domestically and from a bureaucracy viewpoint must have a framework of limitations and governance, together with an agreed basis in law, to guide the nature of control of assets (Tuyucu, 2013). This inevitably necessitates a parallel founding of systems that will aid and support the regulation of assets in a commercial context. Ideally, such a legal framework should (together with any regulation or recommendations) be made in support of business in the objective of asset management (Office of the Queensland Parliamentary Counsel, 2014). In practice, however, such recommendations tend to be inadaptable and inflexible; despite various specific possibilities, the make-up of the legal framework tends to be similar. What specific, localised conditions do exist tend to be developed by regional councils, but even then these are only through communications with similar government entities and are limited to simple gestures. This situation ensures that guidance remains undeveloped and homogenous, despite the clear arguments otherwise. Furthermore, some parts of the legal framework and regulatory measures are ill-formed or obscure, leading to their partial or reluctant

implementation by regional governing bodies, and may lead to a negative approach to asset management within such entities (Schane, 2012).

5.11 Communication management

Sharing information and keeping each other constantly updated allows for a sense of stability in capital costs and budgeting, as the requirements of all parties are considered. Extensive collaboration with partners, investors, and the like make for an increased openness to offering assistance to the development of resource infrastructure. Trust and relationships are crucial to the distribution and sharing of information among production partners. The development of cooperative partnerships allows procedures to be undertaken concurrently, and has as its foundation a group integration of expertise and information. This, in turn, offers businesses the capacity to cooperate in their actions and utilisation of assets (Varner, 2013).

Furthermore, an emphasis is placed on communication with, and understanding of, stakeholders, as this determines to a large extent the ability to maximise the outcomes for stakeholders through the coordination of activities. Acknowledging the restrictions and conditions upon stakeholders (who may include clients, investors, or employees) is key to utilising assets effectively. Businesses that can maximise their asset organisational capacity via the integration of production partners will see better results in their outcomes. As mentioned earlier, a key point of maximisation for the resources sector is in the capacity of reacting swiftly to changes in market conditions (Viator, 2015), which is a focus of the research conducted in this study.

Just as conventional wisdom dictates that operating with a sense of separation with external entities may be positive for the company involved, and that competitive relationships with such external suppliers are necessary to achieve the maximum benefit for the firm involved (Smith, 2014), it is also true that the separation between expertise among core and non-core functions in terms of assets and services will have as its effective outcome a division in the operations of the business in relation to assets. Effectively, management and the provision of assets become exclusive procedures, and this contains certain risks for the business—namely, that the latter takes precedence and affects the success of the company in undertaking the former. Because of this, there are significant advantages in a closer integration of the provision of management procedures, with the effect of muddying this distinction somewhat.

Therefore, a contemporary partnership with an external partner will ideally be structured so that the connection is closer.

Today, it is commonly accepted among theorists that the outcomes of a business and the existence of close relationships with external partners go hand-in-hand (Tamzidul, 2012). Quantifiable studies have shown that such relationships assist in building the capacity of a business and that those sources existing outside a company itself are crucial to providing the company with key data. Such closeness is developed through a supportive and cooperative environment between partners, which offers an environment of conviviality and shared responsibility (Westall, 2014). Such positive connections are categorised as being formed in the long term, and are characterised by a sense of common objectives and a division of benefits and costs. Such a sense of mutuality is pivotal to generating situations in which all parties can benefit, for example, more detailed comprehension of customers and producers, and a more thorough idea of what is necessary for the projected outcomes of the company. This is a view reinforced by feedback from individuals. Shared resources accessible to partners within a framework of agreed cooperation are also seen as pivotal to determining the future of the partnership itself (Woodhouse, 2014).

The procedure involved in evaluating a potential new partner when considering a closer relationship within a production process is key to making correct decisions. Therefore, a certain amount of determination is necessarily retained by the business to guarantee that the outcomes and demands of a contract are met, and that the associated benefits in the connections between businesses are established. This situation necessitates both an attitude of coordination with partners outside the company, and affording them a degree of autonomy in their activities to ensure that potential improvements can be capitalised upon. Furthermore, the business must meet the demands of the agreement it has made, with a mutual acceptance of some managerial activity on the part of the business. This requires effective communication and accounting of processes, a point reinforced by various managers. In a general sense, businesses that provide infrastructure benefit from close ties to other entities via the development of a selection of expertise at their disposal. Such partners may emerge as important suppliers of the facilities required for the functioning of the company itself.

5.12 Technology as a change facilitator

Several interviewees saw the significant need for change within their organisations, which they believed were capable of delivering benefits in their operations' finances, operational management, assets management, project management, and human resources functions, all resulting from the implementation of functioning asset management processes. According to the interviewees, the organisation's asset management framework was regarded as an instrument of cultural operations as well as an ongoing change that was capable of leading to the breakdown of boundaries and barriers within their organisation's traditionally siloed business units. In a general overview, there must be preparedness to change thinking, as the framework is not just an accounting tool, but rather a good instrument of change and better performance. One of the best ways to facilitate these much-needed changes is through technology, as this is innovative and re-evaluates processes and ways of doing things altogether.

The synergy of IT resources with existing company practices and expertise is one of the critical prerequisites for a business to achieve its outcomes (Perrons & Jensen, 2015; Samara, 2015). Just as technology has its capacity defined by the users, so do the assets within the IT category function in a manner interrelated with other assets within the business. This is a process that Patil et al. (2014) describe as being able to "fit together". However, benefits are presented to companies that insert IT capability within areas of certain strategic significance to the business. The insertion of IT capability can only build capacity within the organisation if it integrates well with the prior elements established in the organisation. According to Lin et al. (2015), the outcomes of such a manoeuvre are contingent on the level of assimilation with assets from the commercial and technological side of the organisation.

Regardless, the intricate nature of technology's careful application within the existing processes of a business is largely established, particularly given the inevitably scarce nature of IT resources and plethora of potential for applications within the organisation. Within this environment, there is an argument for focusing on labour as a guideline for IT integration to achieve the maximum benefit for the organisation. An evaluation of information gathered from enquiries suggests that the maximum benefit

in terms of asset management is inevitably created through the assimilation of IT with existing asset management procedures (Marakas & O'brien, 2013).

The positive influence of IT implementation has the expertise as a necessary precursor. The human focus of any implementation is reaffirmed by Narayanamurthy and Arora (2013), who stated that placing human capacities at the forefront of technological implementation was imperative to their subsequent successful oversight and employment. It has been suggested that the most effective situation in which implementation occurs is in the midst of a rich variety of IT skills and information, which can have the effect of successful synergy between those responsible for technological and human resources, thereby aiding its capability in adopting technologies. The communication between such human and technological resource managers is seen as pivotal by Marakas and O'brien (2013). These researchers proposed that the collective and shared IT information between such entities (for example, IT knows the operations of asset managers, and asset managers knowing the possibilities of IT) was pivotal to adopting capability. If such a communication and information-sharing network is established, general progress is seen on the asset management level. Such an outcome enables the development of customised IT solutions suited to the task of the organisation, contingent upon the IT knowledge developed by managers, and leading to general progress in outcomes. From such an analysis, successful implementation of IT solutions is contingent on cooperation between IT managers and other specialised areas of asset management. The potential outcome is a series of skills that are shared by both areas in crossover and that support the adoption of new technological innovations.

5.13 Proposed Asset Management Framework

By drawing upon the findings of the earlier sections and chapters, this section culminates in the development of an asset management framework.

5.13.1 Challenges hindering the facilitation of asset management in the oil and gas industry

This section addresses the first research objective, whose main aim was to determine the key managerial challenges hindering the smooth application of asset

management systems in the oil and gas industry. Relying on this study's empirical evidence, together with theoretical explanations, this thesis has identified the principle challenges hindering effective physical asset management. A reoccurring theme in this study's findings is the lack of a symbiotic connection linking asset management frameworks/goals with corporate strategic objectives, strategic procurement policies, supply risk policies, and business continuity strategies. Demonstrating a link between these entities is the most feasible solution as it will help draw the attention of the organisation's corporate decision makers to the strategic role asset management can play within their operations. Demonstrating this link will also help demonstrate how management concepts contribute to the competitiveness of oil and gas organisations. The disconnection has, thus far, caused numerous bottlenecks. These include:

i. **Asset obsolescence:** There is insufficient knowledge on the management of ageing assets that have reached the end of their economic lives, as well as funding concerns over the substantial costs required to renew or replace ageing and obsolete capital assets.
ii. **Insufficient planning for risk and maintenance:** Failure to priorities equipment risk inspections, servicing, and plant reliability.
iii. **Poor decision making**: Decision making in certain key asset areas is conducted with only limited information.
iv. **Too much political interference:** Owing to excessive political/government interference, businesses lose focus and miss out on long-term planning. Most organisations are forced by the states to abide by the general asset management regulations, documented by the Public Procurement Regulatory Authority, which are very constricting and incomprehensible. This government involvement interferes with company policies, regulations, financial controls and, in some cases, the actual delivery of specific asset services, and thus businesses end up performing poorly. Governmental interference also weakens managerial authority over financial and operational aspects of these businesses and imposes contradictory objectives in addition to politicising investment decisions, labour relations, prices, and the choices of technology used.
v. **Poor managerial leadership**: Poor leadership weakens business coordination and disrupts the flow of processes.

vi. **Decentralised systems:** Lack of integration within subsystems in an organisation leads to systemic weaknesses and an obvious lack of communication, as well as information sharing. Many participants pointed out that most of their subsystems were not integrated and not interconnected to each other. This has apparently brought many complications, including difficulties in data access, data mismanagement, and poor data integrity. In addition, disintegrated systems are not user-friendly because of the overlapping of information and the redundancy of data.

vii. **Lack of recognition for asset management:** The lack of understanding of how valuable infrastructural asset management is has made businesses dismiss establishing proper asset care/maintenance.

viii. **Strained supplier relationships:** Most of the organisations apparently have difficult relationships with suppliers, and this is disrupting the supply chain processes as there is a shortage of material supply. There have also been several supplier chain complexities such as difficulties in procurement and delivery processes as well as poor supplier selection, which have reportedly strained asset management in the oil and gas industry.

ix. **Usage of manual tools:** When asked what type of asset management tools they used for asset management activities, more than half of the participants responded that they were currently using the Google Drive SharePoint functionality for tracking assets. Google Drive is not the best tool for managing and tracking assets. DAM tools are better because they are more collaborative.

x. **Poor employee management:** Apparently, there have been several workforce issues such as employee engagement, shortage of skilled labour, and a lack of commitment towards the improvement of asset management. All these issues have further complicated the application of asset management in the oil and gas sector.

xi. **Poor leadership:** Numerous interviewees claimed that their managerial team had poor leadership skills, which have reportedly frustrated asset management operations. Poor leadership has been manifested through poor

business planning, insufficient employee engagement, and poor decision making.

xii. **Ambiguous regulations:** Several interviewees raised complaints regarding ambiguity in asset management regulations, and how they are having difficulties interpreting them. Sometimes, the regulations are even non-existent, which leave the industry operators uncertain about what procedures to follow when managing their assets.

xiii. **Asset maintenance:** Poor data maintenance, inefficient maintenance planning, and non-compliance with maintenance regulations were also mentioned as obtrusive challenges in asset management application.

5.13.2 How can these challenges be reduced, or better yet, completely resolved?

Below is a list of viable solutions that the oil and gas industry operators can use to overcome the aforementioned challenges.

i. **Asset obsolescence:** Organisations should, first and foremost, develop their asset management objectives in relation to supply risk policies. This will help curb against asset obsolescence as it optimises inventory tracking systems. These systems will trial the inventories and report about their current health conditions (to see whether they are functioning okay or have almost reached their obsolete status). Additionally, organisations should install an auto-replenishment system within their asset management framework that will notify the management when new assets need to be purchased to replace the older ones, as well as when older assets need to be sold off before they are completely obsolete.

ii. **Insufficient planning for risk and maintenance**: To prioritise equipment failure and plant reliability, by placing a strategic procurement model that is developed specifically from the perspective of supply risk and business continuity.

iii. **Poor decision making***:* Can be solved through increasing consultation and developing asset management activities in line with strategic procurement

policies. These two are beneficial in business planning and formulation of strategic decisions that sketch out the future projection of the company.

iv. **Too much political interference***:* Organisations are urged to keep out of the political arena and avoid political risks as much as possible. They can achieve this by procuring a political risk insurance cover or hiring a director of political affairs to notify them of oncoming political risks.

v. **Poor (managerial) leadership***:* Poor leadership can be solved by linking asset management objectives with the organisational structure. The organisational structure provides a clear path of the organisation's hierarchy that demonstrates different job roles and management positions so that tracking down a poorly-performing individual is easier. The organisational structure will also enable easy/regular monitoring and evaluation programs to verify whether the strategic objectives are being met. The monitoring and evaluation program will spot insufficient employee engagement and then solve them through creating more group discussion, more team building platforms, encouraging people to spur healthy workplace politics, more work delegation, and target achievements.

vi. **Decentralised systems*:*** All organisations should try as much as they can to consolidate their information systems to enable better data access and improved data management. The integration of systems can be achieved in three ways, namely, horizontal integration, vertical integration, and star integration.

vii. **Lack of recognition for asset management:** For asset managers to fully appreciate the value that effective asset management contributes to business operations, it is imperative for them to incorporate asset management strategies into wider organisational goals. When top echelon oil and gas organisational managers appreciate the importance that asset management plays in their operations, this can initiate a paradigm shift in priorities. When a managerial understanding of the potential contribution of asset management to business objectives has been achieved, asset managers must be able to articulate the strategic capabilities their current

assets possess. This will typically require an itemised cataloguing of asset capability together with an assessment concerning the capabilities each asset possesses, which necessitates the challenging task of mapping the parameters of specific strategies. Many resource sector businesses are actually unaware of their organisation's current strategic parameters, which include factors such as strategic partner relationships and relations with stakeholders and customers. The task that asset managers have in familiarising themselves with their current operational parameters is, however, likely to be beneficial in educating them in how the asset management framework can be applied.

viii. **Strained supplier relationships**: Developing asset management goals in relation to supply risk policies and BCPs will also greatly improve strained supplier relations. Supply risk policies, on the one hand, will help develop more tactical supplier selection processes and quality supplier management. BCPs, on the other hand, will ensure that the normal day-to-day operations still continue, despite certain supplier risks such as supply shortages, poor service deliveries, and faulty products.

ix. **Usage of manual tools**: Organisations still using spreadsheets and Google Drive to track and manage assets are strongly urged to switch to DAM platforms, e.g. PAM technologies, CMMS, IDMS software, CMMS, ERP SAP, Asset Labs Streamline, A1 Tracker, Asset Track, Asset VUE Inventory, or Remedy Asset Management software.

x. **Ambiguous regulations**: Regulations, nowadays, are very vague and use confusing terminologies that may have two or more meanings. Lawmakers, among other legislators, are urged to be more lucid in their grammar and sentence formation, to avoid all instances of confusion.

xi. **Workforce issues**: The most obtrusive workforce issues were poor employee engagement and a shortage of skilled labour. These can be absolved by increasing employee training workshops, seminars, and conferences; improving the quality and intellectual value of training

classes; encouraging newer employees to learn hands-on skills from older employees; incorporating more asset management courses in higher learning institutions; and reinforcing the importance of asset management via a strong learning culture at the workplace to instil a stronger commitment to asset management.

5.13.3 Development of an asset management framework

This section addresses the second research objective, which was to develop a framework that would demonstrate a better implementation of asset management systems to eliminate the above-mentioned challenges. Through the integration of all research findings and discussions, it was possible to develop an interpretive framework that outlines the approaches that oil and gas organisations can take to improve their asset performance by implementing processes to maximise asset capabilities.

The framework in Figure 5.1 illustrates how the different themes contribute to the overall value of an organisation. Themes discussed in Chapters Four and Five—for example, the strategic procurement policies, supply risk policies, BCPs, and strategic objectives—support the capabilities of the enterprise and optimise sustained asset performance. These findings make a twofold contribution. First, the framework in Figure 5.1 provides a holistic framework that is specific to the oil and gas sector asset management managers and researchers. Second, these findings possess managerial implications on ways the framework can be applied to the real-world improvement of asset performance. These implications justify the allocation of company resources to enable framework implementation.

For instance, the framework demonstrates that asset management is comprised of four critical themes: strategic objectives, strategic procurement, supply risk policies, and BCPs. The tier that is situated immediately above the themes demonstrates the impacts on the oil and gas industry of the four strategies. For example, the objectives of the strategic organisation will ensure that the industry achieves better maintenance, quality engineering, scheduling, inventory control, asset disposal, and obsolescence. Strategic procurement in the oil and gas industry will benefit the organisation via improved

supplier management, selection, and delivery. The third theme in asset management, the development of supply risk policies, will ensure that the organisation has a stable provision of asset management platforms to cease the usage of manual tools. BCPs in the oil and gas industry will enable the company to have increased integration of systems, real-time data accessibility, data accuracy, and information.

The third tier in the model reflects how managerial aspects and the application of the framework influence the real-world improvement of asset management. This explains the eight boxes in the figure. For instance, the strategic objectives of an institution will provide better leadership, management, and decision making. Strategic objectives will ensure that the organisation has increased production and exploration, land acreage, and brand promotion. Additionally, strategic objectives will ensure that the organisation has a global presence.

Strategic procurement in an organisation is also beneficial as it increases change preparedness and the embracement of new business development tactics. It even improves the regulatory compliance, by ensuring that there is less ambiguity in understanding laws. The third theme, development of supply risk policies, is crucial for ensuring that the company has increased employee engagement, training, and reduced shortage of skilled staff. The development of supply risk policies adds to the interdepartmental communication, consultation, and coordination that encourage departments to co-work together. The fourth theme, BCPs, ensures that the company meets stakeholder expectations, maintains strong customer relations, and provides quality services. Furthermore, BCPs lead to increased revenues, profits, and cost-effectiveness.

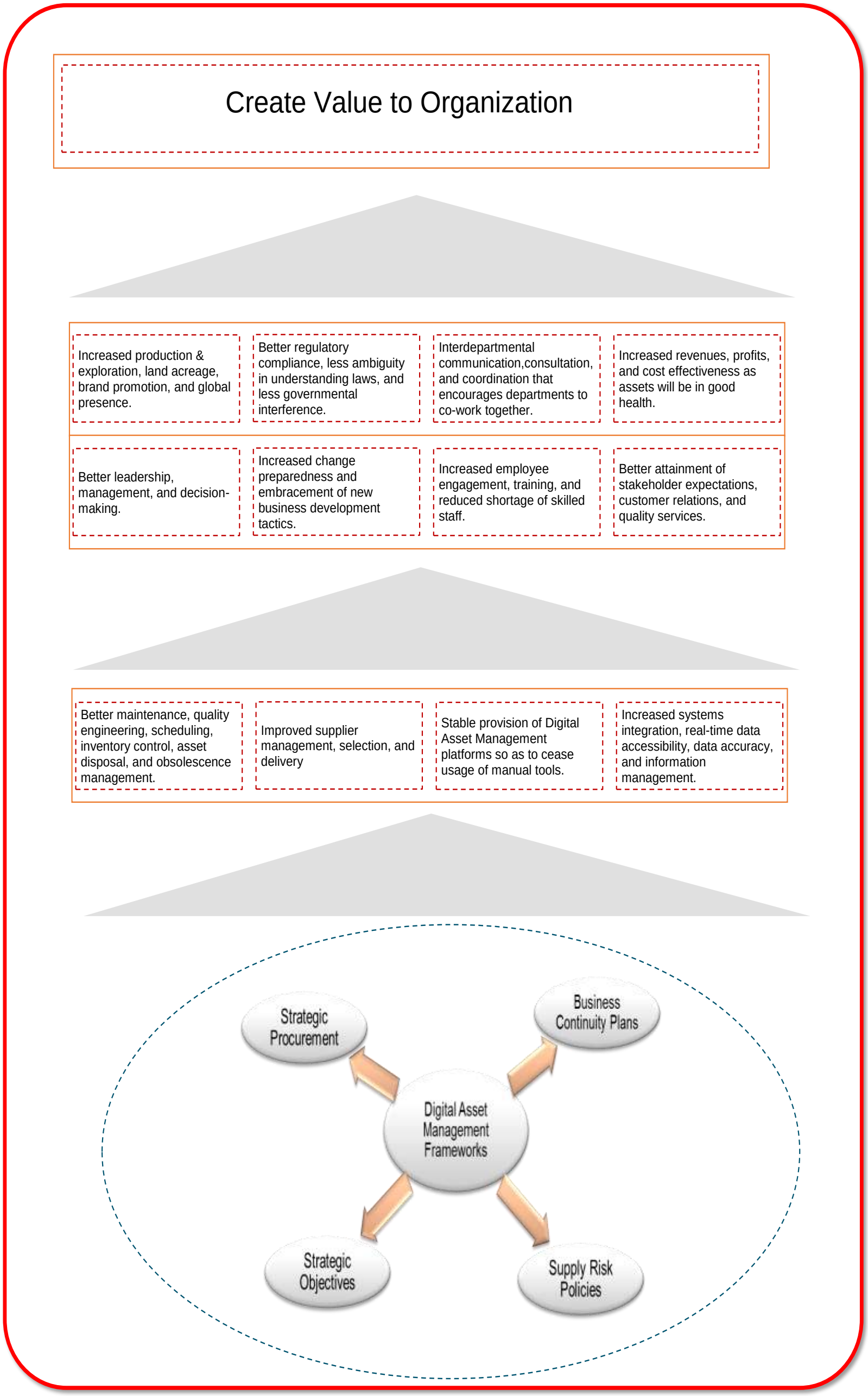

Figure 5. 1. Initial asset management framework

5.15 Chapter Summary

This chapter outlined the themes and sub-themes construed from the interviewees' responses and discussed them thoroughly in connection with the Literature Review. These themes included supply risk, strategic procurement, strategic objectives, organisational structure, BCPs, asset management frameworks, communication, unwillingness to change, poor leadership, non-integration of systems, insufficient regulations, and workforce issues. The conceptualisation of these themes represents the various challenges that are hindering the application of asset management in the oil and gas business sphere. The chapter also provided several solutions with which to address these challenges and enforce a more sustainable operational environment. The following chapter will validate the built framework discussed above.

Chapter 6: Validation of The Asset Management Framework

As mentioned in the research methods chapter, two FGDs were held to validate the research outcomes of the first phase of analysis, which involved analysing the data from in-depth interviews with subject matter experts, and the discussion text was converted into research insights for validation. Analysis of data was carried out using the NVivo software program. Responses and discussion points were coded and converted into broad themes and sub-themes as presented below. Later, a revised framework based on the validation is presented.

6.1 Results

The focus group data were reviewed and analysed by the researcher as a validation method after the completion of the first phase of data collection, which helped to provide a detailed and different approach to this part of the research. The focus groups were a very lively part of the research, where the proposed framework was offered to two different groups for consideration and review. The focus groups were guided by the chairperson (the researcher) used to ensure that the key parts of the discussion were conducted. This enabled different data to be collected, and thus the researcher considered that a different method of analysing and evoking the data would be required. The other consideration was regarding the method of presenting the focus group outputs to the reader that would help them truly live the group discussions. The researcher wanted the reader to be there in the moment of the group and not just read codes, data, and comparisons. This part looks to argue the value and utility of the framework; therefore, the output must be a liveable experience for each reader. This leaned towards the recommendations by Lichtenstein and Swatman (2003) who have conducted a number of validation research projects. Lichtenstein and Swatman (2003) argue that validation and its analysis when presented correctly allow the reader to immerse themselves in the discussion with a no holds barred release of the discussion. This helps them to really become part of the group, and thus agree and disagree with the outcomes of each group. This approach is also supported by the research of Dahlberg and Kivijärvi (2006) who add that this approach delivers a very different data presentation and analysis approach compared to the norm within research. This exciting approach has been selected by the researcher to support the output and

validate the framework via independent focus groups. This is a robust method of collecting data while test driving the framework at the same time.

6.1.1 Strategic procurement

First, the researcher explained the concept of strategic procurement as follows: "The procurement processes adopted by the organisations include activities such as the manufacture of capital items according to design features specified by the purchasing organisation; agreed date and delivery of completed capital item, product or service; delivery in compliance with the quality specified by the buying organisation; and the development of a review and evaluation process of the delivered product or service, not only to ensure suitability of the purchase itself but also to assess the supplier with a view to decide their suitability for further procurement purchases". After this, the discussion began on how strategic procurement policies are formulated within organisations. The first common theme that emerged from the discussion was that the procurement policies were aligned with the overall strategic direction and governance of the organisation. In addition, organisations understand that to achieve this purpose, collaboration among different functions is crucial.

One of the participants responded: *"First of all, we make sure that the procurement policies are aligned with the overarching organisational strategy. Also, we collaborate with other departments to undertake a procurement needs analysis exercise wherein we identify precise requirements and gain insights on parameters like – type of the assets; desired quality of the assets; annual planned expenditure vis-à-vis affordability etc".*

"As for the strategic alignment aspect of the procurement policy, we adhere to our core values related to overall corporate governance, sustainable procurement, compliance with regulations, being efficient and effective at the same time, and risk management".

Another respondent said: *"I don't know about other organisations, but for us, the procurement policies are developed in-house. First of all, we make sure that the procurement policies are aligned with the overarching organisational strategy".*

Next, in terms of governance, there was a consensus that it is important to align strategic procurement with governance. As one of the respondents stated: *"Governance is an important element and we ensure that the procurement policies are well-aligned with the organisational vision, policies and strategic objectives. Also, as part of the governance, we review our procurement policies and strategies on an annual basis. Similar actions are adopted to continually review our relationships with the suppliers and how those can be developed further as part of the future roadmap. And there is one more important objective for us that percolates directly from one of the strategic objectives – we have to be necessarily efficient as we have to meet the targets of cost optimisation that this usually runs into millions of dollars every year".*

However, further analysis of the data revealed that not all organisations designed their strategic procurement policies in-house and without any external consideration. For one organisation, the regulations set by governmental bodies was a key influencing factor:

"OK, I believe that I am going to bring forward one exceptional scenario here. For my organisation, the procurement policies are set according to the guidelines laid down by the Ministry of Oil & Gas. The authorities establish the guidelines and we have to prepare our documents in such as a way that the requirements of the governing body are fulfilled".

Upon further investigation, the respondent revealed a specific example of how the government's foreign direct investment (FDI) focus influences procurement policies:

"Well, as a specific example, the government is keen to leverage the FDIs to the hilt, and in accordance with this, they are quite strict on the Local Content Requirements (LCRs). Various laws and regulations have been put in place that put the onus on oil and gas companies to accord priority to local firms when it comes to procurement of goods and services required for oil and gas operations. In fact, these requirements are aimed to maximise the benefits for the locals in terms of skills development and employment generation as well".

6.1.2 BCPs

The next topic of discussion was related to BCPs. The facilitator began with a brief overview of the topic:

"The management of operated assets should include responsibility for ensuring that effective business continuity and contingency plans are in place to respond to events and disruptions that could imperil these facilities. Business continuity management can be used to consider potential events that could cause an unexpected loss of operational dependencies (e.g. offshore infrastructure, people, supplies and services) and the resulting impacts to the business. In assessing these risks from a business continuity perspective, the assumption is made that the worst-case scenario can happen, however low the probability, and is used in conjunction with traditional risk assessment processes. This combined approach enables operators to be sure they have assessed risks from all aspects and can implement appropriate risk controls, pre-incident".

Next, the rationale for having BCPs in place was discussed. It was discovered that BCPs were important for organisations to minimise risk exposure. As one of the respondents stated: *"Our goal is to minimise our risk exposure and, in this direction, we strive to involve the quality engineering function as well – top of the line quality in terms of equipment ensures business continuity".*

Another respondent pointed towards the fact that BCP is important for operational sustainability: *"One of the aims of aligning procurement processes with business continuity is to make sure that any dependency related to this does not cause adverse impact in terms of operational continuity".*

Finally, one of the respondents raised an important point about information security in the context of BCP: *"Information protection in terms of its integrity and availability is key to business continuity and therefore, we make sure that loss of data or documents does not hamper our operational sustainability".*

6.1.3 Risk management

The discussion on the topic of supply risks began with a description of the subject matter, provided by the researcher. Essentially, management of supply risks is about how older assets should be cared for to minimise risks that come along during the purchase, supply, and utilisation of assets. Therefore, first, the researcher expressed that the idea of having this conversation was to assess the views on how organisation perceive supply risks related to older assets. Further, this was aimed to understand how older assets should be cared for to minimise risks that come along during the purchase, supply, and utilisation of assets. An analysis of the responses indicated that from an asset management perspective, organisations perceived the management supply risks as a task primarily related to the monitoring of assets and to ensure that this practice aids in keeping the organisation competitive in the marketplace. As one of the respondents reported: *"In my organisation, we see supply risk pertaining to older assets as the question of setting up mechanisms which would ensure that assets are continually monitored for ageing and obsolescence".*
"The need to adopt these monitoring mechanisms arises from the fact that older assets may become obsolete and no longer serve the organisation to stay competitive in the marketplace".

Another respondent placed special emphasis on the importance of obsolescence and this was agreed upon by most of the respondents. Specifically, it was observed that the management of obsolescence of assets meant regular maintenance of assets as well as repair and final replacement. Additionally, the participants agreed that clearly defined processes for the management of obsolescence of assets would help in the mitigation of supply risks. The following response reinforces these findings: *"It is necessary for the organisation to design and optimise processes that relate to regular maintenance of the assets, their repair, and eventual replacement. Such processes help in the mitigation of supply risks associated with older assets".*

6.1.4 Integration of systems

The next topic that came up for the FGDs was the integration of systems. The researcher aimed to establish a backdrop to this subject and, therefore, the following excerpt from the previous primary research and data analysis was presented:

Primarily, it has been observed that oil and gas companies waste substantial amounts of resources every year due to a lack of integration between systems. This does not include effects that are hard to estimate accurately, such as the inability to adjust direction quickly enough, and frustration due to perceived inefficiencies. Additionally, it does not include the reduced cost and increased flexibility of sourcing integration solutions from companies experienced in this type of solution in the region. There is a strong case for system integration, which has been verified by different research studies. For example, a recent study on the Gulf Corporation Council region by McKinsey (2017) estimates that petrochemical producers there could achieve an additional 10 percent in Return On Investment by optimising every aspect of their operations. In addition, an element of optimising operations is the integration of formerly disparate systems to increase productivity. Integrating automation, safety, and other systems can yield savings between 15 and 20 percent on both capex and opex investments. However, as it was pointed out, a lack of system integration is a major issue, which can lead to a wastage of resources.

After a brief overview of the topic was provided, the participants were invited to share their views about the current state of system integration in their respective organisations. Analysis of the responses indicated that system non-integration was still a lingering issue within oil and gas organisations–specifically, it was observed that most of the applications developed and implemented by the organisations were created for individual functions and, due to this, these had grown disparate and autonomous. Additionally, organisations faced a tough challenge in terms of integrating these systems because of issues related to duplicate and redundant data, which in turn were not standardised. In addition, there were issues related to data accuracy and manual entry of the data into the system. As for the latter, this problem was perceived to be specifically challenging as the process of manual data entry was considered to be inefficient as well as prone to human errors.

One respondent expressed the following: *"However, the problem with my organisation is that we have applications built to serve the needs of individual functions and over time, they became so autonomous that we now have diverse information and no mechanisms to enforce an integration between different applications".*

Also, some of the applications and databases are archaic – leading to the problem of data accuracy. Moreover, there is lots of inefficient effort involved in manually collecting the information. Since this manual, individual approaches influence the way data and information is fed into the system".

Another respondent agreed with the observation made above and added another dimension: *"Often, it becomes difficult to get timely access to accurate data. And this has an adverse impact on our decision-making processes because even a single missing data element can stall the analysis exercise".*

"Clearly, there is a need to adopt ERP packages so that all the systems are integrated from an organisational perspective and there is a boost to productivity. Data availability assurance is key to our operational success".

Clearly, the lack of availability of accurate and timely data hampered the decision-making processes of the organisations and, in turn, this was having an adverse influence on operational effectiveness and efficiency.

An analysis of other responses indicated that while having disparate, disconnected systems did not create problems for respective functions, the issue caused a great challenge when it came to doing tasks that required close collaboration among different teams.

The following comment from a participant confirms this: *"This is especially true for collaborative work where several team members are involved. As you can imagine, sometimes we have to access multiple systems to retrieve information that is required and, in many cases, we have to wait for days to get the data if we lack access authorisation. This hurts our planning processes. Also, same data is stored using multiple system and getting a true picture becomes a big challenge".*

Finally, the FGD on system integration veered towards another important topic—usage of manual tools. Analysis of the responses from the participants confirmed the findings of the first phase of the primary research, wherein it was discovered that in most of the organisations, manual tools were used for asset management and this

hampered the productivity of the tools. The evidence for this comes from the comments made by two different participants:

"Indeed, this is another challenge that hampers my work. Manual tools are cumbersome to say the least. At any given point in time, I am not aware whether I am following the schedules in a systematic manner".

"Usage of manual tools is not very efficient and one way of dealing with the problem is to offload this responsibility to third-party players. But as you can imagine, this cannot be a permanent solution. First, this is not sustainable in the long run as we lose the chance adopting the latest products and processes. Secondly, we end up paying a lot of money to the consultants with literally limited control over their processes".

Clearly, the last observation makes it clear that the usage of manual tools is commonplace and, in terms of adverse implications, this practice leads to inefficiencies. In addition, since a significant portion of work is outsourced to third-party vendors, there is a lack of control over the processes and the organisation ends up incurring costs.

6.1.5 Human resources

From the analysis of the feedback provided by the participants of the FGD sessions, it became apparent that oil and gas organisations suffer from workforce issues. The following observation from one of the participants gives an indication of this:

"*Indeed, we do not do things which are important as far as workforce engagement is concerned. Individuals are not given any responsibility to come up with novel solutions and collaborate with each other. They are not encouraged to remain engaged and proactive. And you can easily guess the outcomes. People do not feel motivated to analyse the way they work and suggest improvements. Of course, this kind of mindset shift requires encouragement from the top and adequate training."*

Another respondent stated that: "*this point to lead another problem – many of the employees may perceive that they do not have a stake in the decision-making processes. Maybe, it is because the leadership is less democratic. However, I believe that changes must be introduced so that the workforce remains highly motivated. This can have a tremendous impact on productivity and effectiveness of the organisation as a whole. And as far as asset management function is concerned, this issue is of big importance as it has a bearing on asset monitoring and reliability".*

Another respondent agreed to these remarks: " *Establishing team that is highly skilled and equipped with the right knowledge, is a challenge for us. I believe that this is an issue that our human resource department need to fix"*

6.1.6 Communications management

After analysing the responses provided by the FGD participants, a conclusion could be formed that communication across different functions was inadequate and less than fully effective (in the oil and gas organisations that were studied as part of the research). One specific response summed it up:

"There are many hurdles that we face when it comes to communicating across different functions and with top leaders. Lower level employees do not have the means and mediums to talk to the senior leaders directly about issues that adversely impact organisational or functional performance. Email might be an option but then no one is sure who reads it and when. Other than that, there is a natural tendency to change the nature of the information when it passes through different levels within the organisation. This sort of filtering reduces the import of the original communication to a large extent. Also, I must point out that it is not that the managers are solely responsible for this. Some of the employees may lack necessary education and expertise to communicate effectively. So, as you can see, there is a need for both training and strong processes".

6.1.7 Information security

The subject matter of information security came up for discussion as one of the participants pointed out that this dimension pertained to BCP and asset management.

Further, there was a consensus among the participants that information security was an important, contemporary topic, with most parts of the asset management discipline affected by the advent of digital technologies. Notably, information security was not mentioned or discussed by any of the participants during the first phase of the research. At the outset, the responses were directed towards the rationale of according importance to information security. An analysis of these responses indicated that the incidents of security breaches have alerted organisations to bring functions such as BCP, disaster recovery planning (DRP), and risk management closer to each other. As one of the respondents stated:

"You see, the way BCP has been viewed traditionally, it is supposed to be program in itself. However, in the recent past, security breaches have become more commonplace and therefore, it is all the more important for IT security professionals, BCP, DRP and Risk Management to collaborate with each other".

Further, the respondent explained that in the case of security breaches, IT and the control systems of the organisation become unavailable and in the absence of these assets, the organisation is not able to continue its business operations:

"So, in case a cyberattack happens, it makes the IT systems unavailable to the organisation, then there can be a severe impact on the business's ability to operate its assets and continue to generate revenues".

Clearly, information security is an important issue for the oil and gas organisations as any security breach causes the loss of revenues. In addition, organisations incur costs associated with the resurrection of the systems and assets that have been hit by the cyberattacks. To highlight that information security is specifically important for the oil and gas sector, one participant gave an evidence-based insight: *"Just to illustrate the gravity of the situation, the department of homeland security of the US recently identified more than 900 information security-related vulnerabilities among the US energy firms. This was found to be much higher than any other industry. Similarly, another study of the oil and gas companies in the Gulf Coast found out that most of the firms were using Windows XP or older version of the operating system. Clearly, if an information security breach happens, then these firms' operations will be hit and there BCP action plans will go for a toss".*

Finally, with regards to the convergence of BCP and information security, analysis of the responses revealed that while the legacy view of BCP considered the security of people and physical assets, the contemporary operations of oil and gas organisations are underpinned by digital technologies wherein different business processes are executed over the web, intranet, and cloud. Therefore, asset management has become more digital and, in view of this, information security becomes an important discipline that warrants attention.

Next, upon the request of the facilitator, the FGD moved towards the issue of connections between asset management and information security. The idea behind discussing this connection was to gain a deeper understanding of how information security had become more relevant within the context of asset management, a centre-piece of this research. Analysis of responses indicated that in terms of operations, the upstream part faced more challenges—it was perceived that cyberattacks may be carried out on the assets to pilfer important data regarding drilling and other operations.

As one of the respondents noted: *"We must know that for the upstream operations, drilling and production are the most vulnerable areas when it comes to facing the threats of cyberattacks. Obviously, we have to protect assets and industrial control systems from these domains as hackers may attempt to steal important field data or to simply disrupt our operations if they are cyber-terrorists".*

In addition, there was a danger that, with poor information security management systems, hackers may be able to disrupt the upstream operations, which in turn may lead to financial as well as reputational losses: *"And of course, if we are not able to protect ourselves against these cyberattacks, then we are setting ourselves up for reputational losses and even the lives of our people may be endangered".*

Finally, it was noted that information security breaches may lead to other challenging issues such as environmental damages and loss of public lives or property:

"Lest I forget, there is a need to emphasise that such attacks on our assets and operations can also lead to environmental catastrophes owing to the peculiar nature of operations in our industry".

The next stage of the discussion addressed the topic of how oil and gas organisations could devise strategies around information security. In the beginning, the participants noted that the ideal place for an organisation to start is the information security governance framework. An illustrative response is presented below:
"Yes, I think the first thing that an organisation must be looking at is establishing the information security governance framework. However, even before this, I think an organisation must adhere to certain principles".

However, it was observed that before creating a governance framework, organisations must understand and adhere to certain principles. First, an organisation must refrain from focusing on individual functions on a standalone basis and instead it should construct a holistic view: *"First, they must take a unified view of the organisation and assess the impact of information security from that holistic and strategic view".*

This was identified as one of the most important considerations as a unified view of the organisation would ensure that information security policies and strategies are designed according to the needs of each function and that such policies and strategies are uniformly understood by everyone in the organisation. Moreover, such a strategic and unified view of the organisation would preclude the possibility of gaps appearing in the information security governance framework.

Next, organisations must pay attention to delivering effective training to its employees: *"Next, awareness and training must take precedence over anything else – if this is not taken care of, then adoption rates are expected to be miserable and there will be a lot of confusion about precise roles and responsibilities with regards to information security management".*

The participants agreed that if employees are not made aware of the importance of information security, then they would not adhere to the processes and practices. Moreover, they would not be able to understand their roles and responsibilities fully

and, in such an event, it would not be appropriate to hold them accountable for information security management.

Finally, three more principles were identified—establishing tracking mechanisms to measure the effectiveness of information security processes; scan the environment for security challenges and assess the impact on customers and operations; and promote openness and collaboration among different functions of the organisation. The following statement summarises this finding:
"Thirdly, an organisation must establish robust monitoring mechanisms to track which strategic policies are proving to be effective and which teams are performing well. Also, there is a need to scan the external environment – are security incidents affecting customers and damaging the organisation's reputation? And then there is the oft-repeated issue of collaboration and openness among members from different teams. People must be empowered to approach the leadership with ideas and concerns".

At this stage, one of the participants raised the question of having a clear information security policy. Another participant, who had some experience in this domain, observed that having a clear information security policy was important. In fact, it was noted that it was a prerequisite as per the guidelines of ISO 27001:
"As part of the ISO 27001 system, having an information security policy is a key prerequisite as it becomes the basis for building out your information security management system. At a higher level, the top leadership of the organisation along with the board members provide their approval for a simple and coherent information security policy to be put in place".

Further, it was observed that the top leadership and board members might formulate the information security policy based on the strategic objectives of the organisation as well as the compliance related requirements.

The next part of the discussion moved towards the tactical and operational levels of information security management in oil and gas organisations. Most of the participants agreed that similar to any other policy, the information security policy should have clearly defined objectives that must be useful for employees at all levels of the

organisation. Additionally, it must align with the legal and regulatory obligations that the organisation must fulfil:

"Commensurate to this, the policy must be capable of providing a broad guidance and it should also contain smart information security objectives. It is also advisable that your information security policy clearly specifies how different regulatory and legal requirements will be addressed".

In addition, from an operational point of view, the analysis of responses revealed that for any information security management system, access control was a key issue. This was perceived to be important as human errors were designated as a key factor that caused most of the information security breaches. Thus, it was important for an oil and gas organisation to have strong access control systems so that it could decide about granting privileges to different employees and being able to monitor those who were accessing the organisational databases:

"First, any oil and gas organisation willing to take up information security management seriously must put in place robust and reliable access control systems. This is important as most of the breaches involve human factors and therefore, it is imperative to know who has access to what data and information".

In specific terms, certain systems and measures were identified such as granting data access based on roles, single sign-on, two-factor authentication, and creating regular data backups:

"One of the popular and common choice is to go for access control based on respective roles that are tied up with specific business functions and job responsibilities. Then there are other policies such as single sign-on and two-factor authentication. And yes, another important policy relates to periodic back of data. Now that we have cheap cloud storage available, creating backups of important data and documents should not be a problem at all".

An additional aspect was also identified, which was related to audits. It was observed that due to the size of the oil and gas organisations, they could afford to have in-house information security management teams that could conduct regular audits of all the

systems and assets. In addition, they could also be tasked to monitor and review the information security policy for regular updates. This was perceived to be important because the technology landscape has become too dynamic and, therefore, organisations can expect newer information security challenges to arise.

Finally, it was observed by one of the participants that having a robust incident reporting system was important—if employees were aware of such processes, then they would be in a position to deal with security breaches and, in turn, this would help BCP and DRP.

The facilitator then asked a specific question regarding standard frameworks, which could help the oil and gas companies in designing and implementing their information security management programs in a systematic and structured manner. One of the participants responded that the National Institute of Standards and Technology (NIST) framework could be utilised for this purpose. In addition, the NIST framework was developed by the Department of Commerce, US.

After enquiring about the objectives of this framework, the participant shared this knowledge: *"NIST came out with this framework as it was felt that the country relied heavily on the continuous working of its critical infrastructure. Given this, cybersecurity attacks can exploit the weaknesses of these systems as they become more connected over time. It is not difficult to surmise that such attacks can put national security as well as public health at grave risk".*

Clearly, the framework was created to help the nation deal with the threats emanating from cyberattacks that could harm national security as well as public health. It was also observed that private sector organisations could use the framework as they were a part of the critical, national infrastructure, and thus they were likely to suffer from financial and reputational losses in the event of an information security breach. Next, the facilitator wanted to understand the different components of the NIST framework. In response, the participant noted that the first component was called the "Framework Core", which specified certain activities that organisations were supposed to undertake to increase their information security management: *"OK, the "Framework Core" is*

the first component that specifies activities that organisations must undertake to achieve specific outcomes in terms of information security".

Next, the respondent added that within the framework core, "Functions" were defined within which the activities were grouped at the highest level. Furthermore, the key functions of the framework were identified as identify, protect, detect, respond, and recover. Below this level, the participant listed other components, which are presented below, verbatim:

"After that there are categories which divide Functions into - "Asset Management," "Identity Management and Access Control," and "Detection Processes". Next, there are sub-categories which relate to outcomes of managerial or technical nature. Some of the examples would be - "External information systems are catalogued," "Data-at-rest is protected," and "Notifications from detection systems are investigated". Finally, there are Information References – these are specific protocols, procedures, policies, standards and guidelines related to each sub-category".

In summary, analysis of these responses indicate that at the highest level, the NIST framework consists of "Functions" (identify, protect, detect, respond, and recover), which are followed by categories (asset management, identity management and access control, and detection processes), followed by sub-categories, and finally the information resources that pertain to granular level policies, procedures, and protocols.

Notably, after this participant mentioned the core elements of the NIST framework, another one highlighted something similar to Functions, but that was more operational in nature. The participant emphasised that since having a dedicated team in place for information security management was an important step, it was equally worthy to consider setting up an operation centre:

"I think a related and equally important step to undertake is to establish an information security operation centre. This centre is actually a combination of skilled experts and facilities. As part of this operation centre, people work 24x7 to prevent security breaches from happening, to detect potential threats and to respond to cyber security attacks".

In terms of the importance of having such an operation centre in place, the participant pointed towards certain benefits that included better control over security monitoring and incident response, better readiness for compliance purposes, and more meaningful interactions with the regulators.

The specific response is presented below:
"With these in-house capabilities in place, an organisation can have better control over those activities that are related to security monitoring and response. And perhaps more importantly, they will be in better position to evaluate their compliance readiness and when they get to meet with the regulators, then they will be equipped with richer and more relevant information".

However, further analysis of the responses indicated that the setting up of such operation centres can be a costly affair for the organisation. It was also agreed that since oil and gas organisations were big and had huge budgets, they could be in a position to afford to have such in-house centres. Moreover, organisations had a choice of outsourcing this part to third-party experts.

6.2 Discussion

6.2.1 Strategic procurement

According to Too (2008), within the context of asset management and asset creation, the key challenges pertaining to strategic procurement include identifying and fulfilling the needs of customers; making optimal use of organisational resources to achieve the desired levels of efficiency and effectiveness; controlling for the adverse effects on operations; managing the procurement process so that scope, budget, and schedule related constraints are not transgressed; and managing for the changes. In light of these challenges, it is paramount to craft strategic procurement policies through which the main objectives of asset management can be achieved. While the observations regarding procurement challenges presented above may commonly apply to different industry contexts such as construction and manufacturing procurement, the oil and gas industry poses a unique set of challenges (Handfield, Primo, & Oliveira, 2015). At one level, projects undertaken in this industry face frequent disruptions due to the extreme operating conditions. Specifically, volatility in the macro-environment

presents significant challenges that include uncertainty caused by geopolitical events and investment cycles, variability in the cost of inputs, and restrictions imposed owing to local content requirements. However, oil and gas projects are typically different from construction and manufacturing in another vital aspect—a large number of these projects are carried out in remote locations, and thus asset creation and procurement processes become difficult. Primarily, the remote locations of these projects make it difficult and risky to provide supporting logistics infrastructure. Nevertheless, one of the critical characteristics of a successful project in the oil and gas sector is that different functions collaborate with each other and there is regular communication between them during the asset procurement stage. Notably, this resonates with one of the critical findings of this research, i.e. organisations that adopt a strategic view of procurement tend to witness close collaboration among different functions. Specifically, a procurement needs analysis exercise is performed wherein different parameters such as asset quality, asset type, budgetary constraints, and affordability are considered. More importantly, these findings confirm the results of the analysis undertaken during the first stage of the research.

Another critical issue that finds prominent mention in academic studies related to strategic procurement is that of the alignment between an organisation's vision and its strategic objectives. For example, Nollet, Ponce, and Campbell (2005) recommend that supply chain/procurement managers must make efforts to discover and comprehend the business/corporate strategy of their respective organisations. A thorough understanding of the vision and strategic objectives can help them align the procurement strategies and highlight how these contribute to the overall organisational performance. Further, a translation and communication of business demands in terms of procurement requirements stimulate knowledge exchanges and imbibes a sense of unified ownership. Additionally, evaluation of the procurement function's contribution towards the achievement of business goals allows the managers to recognise improvement areas and to remain flexible when changes occur at the business level. Snider (2006) asserts that, traditionally, managers viewed procurement as a tactical rather than strategic function. Primarily, in many organisations, procurement processes are undertaken once the needs have been identified, and thus there is a greater focus on making tactical decisions involving the mechanisms rather than on strategic decisions that are geared towards optimising the end outcomes.

Hence, to ameliorate this situation, it is recommended that procurement managers be recognised as leaders, who then must be allowed to participate in strategic decision making. Further, the participation of the procurement managers in the needs analysis exercise makes it easier for them to understand the perspective of the users and line personnel, and thus allow them to effectively evaluate different procurement options. The findings of this research indicate that a few oil and gas organisations view procurement from a strategic perspective, i.e. their procurement processes are aligned with the organisational vision, risk management principles, and regulatory requirements. Furthermore, some of the organisations pay attention to the issue of governance, with procurement processes not only aligned with organisational vision and values, but they are also regularly reviewed and updated. In addition, they understand that the procurement function has to be strategic as they strive to be efficient and effective. However, as per our findings, not all organisations have a strategic view of the procurement function. Specifically, for some organisations in the oil and gas sector, regulations imposed by governments influence the way procurement policies and processes are framed. For example, we mentioned in our findings that for one organisation, it was essential to prepare the strategic procurement policies in strict accordance with the guidelines laid down by the Kingdom of Saudi Arabia. Specifically, it was discovered that because the government was keen to leverage the FDI to the maximum, strict requirements had been implemented associated with LCRs. Further, the primary aim of the government was to ensure that the oil and gas companies operating in the country gave preference to the local firms for procurement and, in turn, this was meant to promote skill development and employment generation at the local level.

The issue of local content requirements has been discussed in academia quite extensively. For example, Esteves and Barclay (2011) state that worldwide a new trend has emerged wherein opportunities are created for local businesses to take part in the supply chain activities of major projects, which require immense resources for completion. In some instances, governments have been encouraging or influencing firms (especially in the mining and oil and gas sectors) to devise procurement policies and standards in such a way that local procurement and community content is accorded priority. Further, firms are found to be willing to undertake such actions towards LCRs as they recognise the importance of local economic development and other benefits

that accrue to the organisations themselves. As far as the latter perspective is concerned, companies understand that local economic participation provides them with a “social licence”, and thus their operations in different countries are perceived to be socially legitimate. More specifically, through liquidity coverage ratio LCRS, oil and gas firms can give communities a substantial stake in the projects and they also stand to benefit in terms of supply chain reliability because local suppliers are located in close proximity to the operator. At the other end, local communities benefit as local suppliers receive more business and the inflow of capital is utilised for the economic upliftment of the indigenous communities. Kaye Nijaki & Worrel (2012) add to this discussion by suggesting that, traditionally, companies have either focused on local economic development through local buying programs or on the sustainability of the environment through green procurement programs. The authors recommend that both these goals can be accomplished by amalgamating the two distinct strategies. Specifically, the procurement policies can begin with a step wherein products and services are identified that can be procured from local vendors. Next, the policy should evaluate whether such growth is compatible with the required industrial mix and local workforce capabilities. Finally, the policy should address the sustainability perspective by ensuring that environmental, economic, and equity goals are achieved.

Finally, Ovadia (2014) takes up the case of Angola and Nigeria to highlight the importance of LCRs for sustainable economic development, which is driven by the utilisation of natural resources. The author begins with an observation that Angola and Nigeria are at the centre of a paradigm shift that was triggered by recent offshore oil discoveries. In specific terms, the Angolan government has undertaken steps to achieve the goals of economic diversification. In this regard, LCRs have been imposed through laws and regulations as well as Production Sharing Agreements between the government and the global oil and gas firms. Furthermore, the Angolan Ministry of Petroleum has made it mandatory for these firms to prepare and submit workforce planning documents so that employment is generated at the local level. In addition, these firms are regularly monitored to ensure that these plans are implemented on the ground. For Nigeria, the national government implemented the *Nigerian Oil and Gas Industry Content Development Act* in 2010. As part of this, the participation of Nigerian suppliers has been made mandatory (together with minimum targets) in 280

categories of oil and gas services. Due to this, the capture of oil industry expenditure on local services has increased from 5 percent to 49 percent in just one decade.

6.2.2 BCPs

BCPs are a discipline that have been extensively covered by academic researchers. From a general perspective, a BCP can be defined as "a management process that identifies potential factors that threaten an organisation and provides a framework for building resilience and the capability for an effective response" (Speight, 2011, p. 529). Notably, the response of an organisation to threatening factors is expected to protect and preserve the interests of all stakeholders of the organisation. In addition, such a response must protect the reputational capital of the firm, its brand image, and business activities that generate economic value. The last aspect of ensuring the survival of business processes was also mentioned in our findings, i.e. multiple respondents suggested that the alignment of BCP with asset management is necessary for operational continuity. Another set of respondents stated that BCP is important for oil and gas organisations as it helps in risk minimisation. Speight (2011) confirms that mitigation is an important aspect of BCP wherein the main goal is to identify, reduce, and manage different types of risks. Furthermore, the "identification, analysis, measurement, control, and financing of risk enables organisations to evaluate their vulnerabilities and balance the risk against the cost of the countermeasures required to direct their response to the threat potential" (Speight, 2011, p. 537).

6.2.3 Risk management

In our findings, we mentioned that many organisations viewed supply chain risk management from the lens of asset management. In particular, oil and gas organisations perceive that supply chain risks may arise due to the use of old assets and, therefore, those assets must be continuously monitored for ageing. The need for continuous monitoring arises as older assets may become obsolete at any time and, because of this, oil and gas companies may lose their ability to stay competitive. Additionally, it was agreed upon by most of the research participants that asset obsolescence was crucial and that it encompassed regular maintenance and final replacement. Furthermore, it was observed that effective process management with

regards to asset obsolescence would help in the mitigation of supply chain management risks in the oil and gas sector.

The issue of asset obsolescence has been addressed in academic research by several scholars. Palkar and Markeset (2012) assert that worldwide components of offshore oil and gas reservoirs (both physical facilities and asset infrastructure) have reached a stage where the originally designed usage lifespan is on the verge of being breached. At the same time, oil and gas firms recognise the fact that if the lifespan of the field asset is enhanced, then they can extract more profits from their existing operations because oil fields are still producing enough recoverable resources. However, considerations pertaining to the safety and current conditions of the assets pose stiff challenges. Therefore, to overcome this problem, organisations can follow a set of guidelines that can help them in making life extension decisions, which can ensure that the technical and operational integrity of assets is maintained. Specifically, there are three aspects to be considered—degradation of assets in material terms, management of assets that are going to be obsolete, and organisational issues regarding the management of ageing assets. For the first aspect, it is essential to put in place adequate processes and mechanisms for regular and favourable maintenance of assets. For obsolescence management, assets may age because of prolonged use in operations and they may become outdated at some point in time. Thus, backlogs are created in the inspection and maintenance plans and, often, these plans have to be evaluated and revised to consider the ageing of the equipment. While outdated technology is one aspect of the problem, obsolescence also covers the need for new technological options. Therefore, oil and gas organisations must evaluate the extent, scope, and soundness of the existing knowledge to assess whether effective decisions can be made regarding the life extension of assets. Finally, from an organisational point of view, assets and the workforce might both be ageing at the same time. As a consequence, the transfer of knowledge assumes special significance. In particular, as the teams that are responsible for asset obsolescence management change or age, it becomes essential for oil and gas organisations to regularly test preparedness in the face of emergency situations and crises. Additionally, the workforce must be trained to remain competent regarding their knowledge about asset ageing and its impact on the organisation. With most of the workforce reaching retirement age, there is always a chance that the

organisation might lose corporate knowledge and memory. Thus, workforce planning must be included as part of the asset obsolescence and ageing management process.

Baker (2011) recommends that the reliability, obsolescence, and integrity management processes should be managed as a unique business process, which can be called life cycle management. Specifically, it has been suggested that the processes related to asset reliability in the oil and gas sector are confined to the project phases. However, this need not be the case for organisations. The entire gamut of integrity management processes has been confined to the operations phase. Therefore, it is crucial for organisations to enhance the scope of both processes and to start taking them into consideration from the design phase itself. With regards to asset obsolescence, the cost of updating the industrial control systems is of a magnitude that would imply the cessation of operations in the immediate future. Thus, it is recommended that oil and gas organisations should include asset obsolescence processes in the design phase.

6.2.4 Integration of systems

The issue of information systems integration has a long history in its coverage in academic research. Ball, Ma, Raschid, and Zhao (2002) suggest that the process of supply chain integration (SCI) received a boost due to two factors —increase in the globalisation of operations and advancement in ITs. Furthermore, the following two distinct types of system integration paradigms were adopted in different industries: ERP packages that helped to improve the performance of organisations by eliminating data inconsistencies and increasing processual transaction efficiencies; and SCI packages that provide support for top-level planning and decision-making efforts associated with those coordination processes, which spanned across multiple organisations in terms of production and operations. Over time, these two domains began to overlap, and integrated ERP/SCI systems began to emerge. In terms of information sharing, there are two types that must be considered—sharing of information within the organisation and sharing of information between organisations. Furthermore, information sharing must take place at two levels—at the data level and at the level of business processes. For the former, it is essential for an organisation to identify and connect all the systems along the entire supply chain. For the latter, it is

recommended to identify the business process relationships and trigger applications based on specific business events. Gunasekaran and Ngai (2004) reinforce the notion that SCI is a tool for organisational competitiveness and, therefore, it emerged as a strategy for global operations at the turn of this century. To gain competitiveness via enhanced agility and flexibility, organisations have been implementing the SCI paradigm with the help of enabling ITs. Specifically, organisations have long been trying to create and sustain virtual enterprises by outsourcing and, in this context, the role of IT and system integration has entered the spotlight. The integration of supply chains means that the focal organisations and suppliers will cooperate with each other in terms of information sharing; therefore, it has become essential to pay attention to the communication aspect and analyse the role of information systems and how they are managed by the focal organisations. In particular, firms are required to invest capital and energy in making fundamental changes to business and technical processes, changing the procedures related to providing services to customers, and training employees to create organisations that are genuinely IT-enabled. However, problems are commonly reported when organisations try to utilise IT for supply chain management. First, firms tend to ignore that there must be an integration between the core business model and IT capabilities and initiatives. Second, many firms tend to bypass the process of strategic planning as they race towards the adoption of the latest digital technologies. Next, the organisations implement IT (towards the creation of a virtual enterprise) in an inadequate manner, or worse, they possess a poor IT infrastructure. Finally, they tend to lack sufficient knowledge and expertise when it comes to implementing IT for SCI. Nevertheless, these problems can be overcome if organisations agree to follow standard, comprehensive frameworks for IT implementation in the context of SCM.

Trkman, Indihar Štemberger, Jaklič, and Groznik (2007) recommend one such approach towards SCI. These authors assert that for the effective use of IT in SCI projects, the role of business model innovation, business process modelling, and simulations cannot be overlooked. However, more importantly, these methods must be combined to improve the performance of supply chains. Because supply chain performance improvements can be achieved through the integration of various tiers, the prior depiction of the current and desired state of business processes is crucial if the organisation wants to innovate its business practices supported by information

sharing through IT systems. With regards to the importance of information sharing within the supply chain, while it is widely acknowledged that the deployment of IT can lead to reduced operational costs, a critical aspect that is often ignored is that IT can also help in the facilitation of information exchange among all the supply chain participants. However, to achieve this goal, it is essential to re-design the business processes so that this information is effectively used by all supply chain partners. However, the mere adoption of IT is not adequate to improve supply chain efficiency. To leverage the IT systems effectively, it is imperative to achieve coordination between different business activities. This coordination allows for the strategic use of information and, towards the achievement of this objective, business process modelling, process innovation, and simulation can be of great help.

The findings of our research indicate that a lack of integration between disparate systems is a problem that many oil and gas organisations are facing even in the current era. Primarily, it was recognised that this problem arose because different systems were developed for individual purposes (specific to different business activities or functions). Moreover, this problem was compounded by the fact that efforts towards the integration of these systems were stymied owing to the lack of data standardisation and duplication of data. The issue of data standardisation has been addressed by academic scholars in the past, for example, Tarn, Yen, and Beaumont (2002) acknowledge that the implementation of ERP systems is complicated because of the requirements related to business model transformation and data standardisation. Similarly, Ross (2003) cites the case of an organisation that tried to directly leapfrog from a siloed information systems landscape to a rationalised data IT architecture but failed twice. Moreover, two other organisations succeeded in doing so but were able to receive payoffs from their IT investment after many years. In conclusion, this author asserts that firms can benefit from new integration technologies only when their managerial competencies are adequate. Thus, data standardisation, rationalisation, and system integration efforts yield desirable outcomes only when the managers are able to absorb the strategic objectives of IT architecture related initiatives.

6.2.5 Human resources

The observations listed in the results section are in sync with the findings of the literature review. Workforce engagement is an important factor that many organisations ignore at their own peril. However, often the leadership is willing to measure and improve and yet they are not aware of what to do with the data that is available with them (Kennedy & Daim, 2010). While many organisations conduct surveys to measure the level of employee satisfaction and engagement, they lack the skills and techniques to use that data in decision-making. Clearly, in today's world, organisations compete against each to attract and retain top talent and oil and gas sector is no exception. However, based on the results obtained through this research effort, it can be stated that the HR function should be more proactive in identifying the needs of the employees and suggest ways to the top leadership to improve workforce engagement (Eldor, 2019).

Despite of the fact that oil and gas organisations currently lag in terms of ensuring workforce engagement, it cannot be said that these entities have no avenues for improving along this dimension in the future. There are some steps which they can implement to boost employee engagement and become more competitive in the marketplace. For example, the first thing to do is to create and institutionalise an integrated HR value chain (Lee Whittington & Galpin, 2010). The HR value chain consists of different elements (which must be connected) such as - the sourcing and hiring of talent, workforce development and engagement, and even employee separation. Next, organisations must opt for full-range leadership. Specifically, the transformational style of leadership must be adopted wherein the leaders and the followers form a relationship which elevates the bar for morality and motivation. This style of leadership fosters highest levels of trust as a transformational leader imbibes a sense of mission in others and has a keen sense to judge what the followers need. Finally, oil and gas organisations must pay attention to the aspect of job-enrichment. In practical terms, it must be ensured that employees are given and variety of tasks that are significant in nature and which supports their sense of self-identity. Also, they must be allowed a reasonable level of autonomy and are provided feedback at the right junctures.

6.2.6 Communications management

The observations recorded in the results section resonate with the literature review findings. One of the key hurdles that organisations face while trying to achieve cross-functional communication is that individuals belong to different knowledge domains and they face the challenges of knowledge differentiation and integration (Kotlarsky, van den Hooff & Houtman, 2012). Specifically, employees belonging to different knowledge boundaries may face difficulty in communicating with the each as they are not fully familiar with the terms, the underlying meaning of the language used by others, and finally, they may miss out on the contextual factors that are essential to gaining a full spectrum of understanding on any subject-matter. Other process level issues that can impact the effectiveness of cross-functional communication include – the frequency of communication, the quality of the messages exchanged, and the informality of communication processes.

Concerning the issue of top management support, research evidence suggests that organisational communication plays a crucial role (Bueno & Gallego, 2017). Specifically, formal communication processes help in resolving the conflicts that may arise between different teams and functions. And in this regard, adoption of information systems/information technology tools becomes important. Primarily, information systems/information technology systems facilitate open communication and sharing of knowledge. Furthermore, the coordination at the operational level is also improved. In summary, in any organisation, communication processes not only influence the way work is managed, but they also allow the employees to understand their roles and what the top leadership expects from them.

6.2.7 Information security

As highlighted in the results section, information security management was mentioned as a significant concern within the context of digital asset management. Correctly, it was observed that the incorporation of digital technologies has radically modified the practices of asset management across all organisations. Moreover, since the incidents of security breaches have become more frequent, the discipline of information security management is converging with BCP and DRP. This observation finds support in the form of research evidence. Cerullo and Cerullo (2004) assert that

with the widespread adoption of IT infrastructure, organisations have witnessed an increased risk of business interruptions. Specifically, while the traditional view of BCP considered risks arising due to natural disasters such as earthquakes and hurricanes, there are other types of business interruptions that may arise due to human errors, infrastructure breakdowns, and malicious attacks by external agents. Thus, organisations have been moving towards including external and internal information security threats within the ambit of their BCPs. Concerning the influence of information security breaches, it is worthwhile to study the case of large GCC company, an oil and gas organisation. In 2013, the network infrastructure of this organisation was attacked by a self-replicating virus, which adversely affected more than 30,000 machines that used the Windows OS. While the organisation did not suffer from significant accidents, oil spills, or explosions, its business processes were severely affected, and it is presumed that important drilling and exploration data was lost. Despite possessing vast amounts of accumulated capital, the company took almost two weeks to recover from this disaster. Notably, it was estimated that to introduce the virus to the firm's network required access to its in-premise computers and, therefore, serious concerns were raised about its physical security processes and mechanisms Bronk (2013).

Another important observation made by the research participants was that while the legacy focus of BCP was on protecting physical assets and human resources, asset management has become more digital over the last 15 years and, therefore, most of the business activities are now performed using digital technologies such as the internet and cloud-based platforms. Moreover, in terms of the connection between information security management and asset management, it was observed that attacks could be carried out on cyber physical systems such as the control systems utilised in upstream operations. Shafi (2012) suggests that for such systems, there are specific information security objectives, which the organisations must consider. First, there is a need for confidentiality—proprietary information about the operations of the firm should not be disclosed to external systems or people who lack access to authority. This objective can be met by using different data encryption technologies. Second, the integrity of operational information must be maintained at all times; therefore, unauthorised modification of data must be prevented. In the event of a cyberattack, the perpetrator of the incident might send false information to the embedded sensors,

which may compromise the integrity of the system. Third, the system, as well as the information, must be available for use whenever required by the business users. This includes both the physical assets as well as the communication channels. The final requirement pertains to authenticity, wherein all the transactions and communications must be accurate, reliable, and genuine.

Onyeji, Bazilian, and Bronk (2014) confirm that cyberattacks on firms providing critical energy infrastructures are on the rise. Moreover, such attacks have become more frequent and sophisticated and, therefore, their security implications have become starker for oil and gas organisations. Clearly, for oil and gas sector firms, their upstream and downstream operations are becoming more suffused with IT and, therefore, their vulnerability to information security breaches is increasing. The risk landscape has significantly expanded as more and more systems are becoming connected to the internet. As an example, while the SCADA systems (used for controlling assets from remote locations) were initially designed to be closed-type systems, they are now being integrated with the internet and other systems. Apparently, this has increased the risk of information security breaches. As for oil and gas sector organisations, they may have their operations spread worldwide. Consequently, they may get attacked by foreign agencies through cyberespionage. However, despite the fact that the risk of cyberattack has been increasing, it remains challenging to monitor and manage such risks. Moreover, industry participants have complained that there is a lack of coordination among different firms and no global mechanism exists that can ensure cybersecurity and minimise the damages. Finally, due to the transnational nature of the oil and gas business, various legal and policy issues come into play as well. While individual nations may produce regulatory frameworks to deal with cybersecurity concerns, there is a gap when it comes to international agreements and joint effort among different governments.

Concerning the impact of information security breaches, participants also observed that such incidents would lead to reputational losses as well as damages to the environment and public health. In this regard, Campbell, Gordon, Loeb, and Zhou (2003) suggest that firms may indeed suffer from financial and reputational losses due to information security breaches. In a study of 43 such events affecting 38 firms, the authors found that the financial impact was dependent upon the nature of the breach.

Specifically, for information security breaches related to unauthorised access to confidential data, the negative reaction of the stock markets was particularly significant. McFadzean, Ezingeard, and Birchall (2007) analysed 29 firms for their information security management practices and indicate that with the adoption of best practices in this domain, the organisations reap the external rewards of an excellent reputation for secure systems and safe transactions. In addition, oil and gas firms can enhance their corporate social responsibility profiles by adopting best practices for information security.

An asset can be defined as something that carries value and from an asset management perspective, it is imperative for an organisation to secure its physical IT infrastructure, data, information, digital assets, and reputation. Therefore, it is essential for an organisation to identify a relevant and useful information security framework, which can be utilised to achieve the above-mentioned objective. In principle, an information security framework encompasses policies, procedures, processes, and tasks that specify the way in which information is managed within the firm with a view to mitigating security risks. Globally, there are more than 200 information security frameworks that have been developed to address the needs of a diverse set of industries and sectors. However, we discuss only a few commonly identified frameworks, including Control Objectives for Information and Related Technology (COBIT) and International Standards Organisation (ISO)/International Electrotechnical Commission (IEC) 27000.

The ISO/IEC 27000 family of standards were developed to aid organisations in keeping their digital assets secure. Using this family of standards, organisations can secure their assets including financial information, data about their employees, and processes and physical operations, and information provided by third parties. Furthermore, within this family of standards, there are multiple standards that can be used to address different goals. For example, ISO/IEC 27001:2013 provides specifications related to the requirements for "establishing, implementing, maintaining and continually improving an information security management system within the context of the organization". The requirements specified as part of this standard are general in nature and, therefore, they can be adopted by any organisation irrespective of its size or industry sector. Moreover, ISO/IEC 27001:2013 includes requirements

for the evaluation and addressing of risks associated with information security, and customised based on the needs of the organisation. ISO/IEC 27002:2013 provides guidelines for organisational information security standards and information security management practices including the selection, implementation, and management of controls taking into consideration the information security risk environment of the organisation. Specifically, this standard can be adopted by those organisations that want to specify controls within the process context of ISO/IEC 27001, adopt and implement control mechanisms that are commonly accepted, and develop their own information security management guidelines and mechanisms.

With the ISO IEC 38500 and other IT governance initiatives, COBIT 5 for Information Security gives the most current view on information security governance and management. The most critical guidance and standards were scrutinised during the development of COBIT 5 for Information Security. COBIT 5 for Information Security allows the adjustment with other relevant frameworks, standards, and models in the business world, such as the ISO/IEC 27000 series, the Information Security Forum Standard of Good Practice, and Business Model for Information Security. Moreover, Information Systems Audit and Control Association (ISACA), information security governance services, Information Security Governance: Guidance for Information Security Managers and Information Security Governance: Guidance for Boards of Directors and Executive Management, second edition were also studied while developing COBIT 5 for Information Security.

COBIT 5 offers a revised process model, which not only clarifies the role of governance and management but also reflects how they are related to each other along with the process model for COBIT 5, which is an information security system, works towards integrating both business and IT functional responsibilities. It outlines the roles and responsibilities at various levels of the enterprise while also providing a clear demarcation between information security governance and information security management practices, and incorporates all the steps in the process, from start to finish. All-inclusive and holistic guidance on information security is given shape by COBIT 5 for Information Security; therefore, all the parameters for the processes to all enablers, including information, structures, culture, policies and their interdependence are scrutinised equally.

An observation made in the results section pertained to the efficacy of the NIST framework for the purpose of information security governance. In terms of the components of the framework, it was recognised that at its "Core," specific activities were included that any organisation must undertake if it wanted to meet its objectives related to information security management. This part of the framework contains industry standards, guidelines, and practices that can be utilised to communicate about activities and outcomes starting from the top leadership level down to the execution level of the organisation. At one level below the core, functions are defined. These functions help in organising the information security practices at the highest level and are composed of the following types: identify, protect, detect, respond, and recover. The Identify function is used to develop an organisational understanding related to the risks posed towards systems, people, assets, data, and capabilities. The activities included in this function are foundational as their implementation ensures that the entire NIST framework is used effectively. Therefore, the activities covered under the Identify function relate to a broad-level understanding of the business context and the identification of critical resources that provide support to multiple business functions. Associated information security risks are identified and aligned with the risk management strategy/strategic objectives of the organisation. This alignment helps the organisation in identifying the tasks that have to be accorded the highest priority.

Analogous to the identify function in the NIST framework, the alignment of information security management and strategic information systems development has been extensively studied by academic scholars. For example, Doherty and Fulford (2006) assert that the two most essential artefacts that ensure effective implementation of IT are the strategic information systems plan (SISP) and the information security policy (ISP) document. The SISP is designed to ensure that information systems are developed and deployed in such a way that an organisation's strategic objectives are met. The ISP is designed to ensure that the information systems are developed and operated within the ambit of a secure framework. Careful and deliberate alignment of these two is desired because in the absence of such integration, there is a risk that the outcomes of the SISP will be jeopardised due to security-related problems. Some of the benefits of aligning the ISP with the overall business context and needs include there is a stronger business orientation of the information security policy; new risks can be mitigated as the information security policy can be modified whenever a new

information system deployment is planned; a proactive information security culture is imbibed as the focus shifts from rectification to prevention; with a parallel review of both the ISP and SISP, potential new security controls can be identified; it will also become feasible to incorporate information security principles and procedures in the training/user documentation prior to the deployment of a new strategic information system; and managers can be made aware of the business impact of information security breaches in terms of reputational and financial losses.

The next function that forms the core of the NIST framework is that of "protect". This activity ensures that effective security safeguards are developed and deployed. Further, these safeguards ensure that critical business and IT services are delivered without any major interruption. This function supports the ability to limit or contain the impact of a potential cybersecurity event and the outcomes included in this function are identity management and access control, awareness and training, data security, information protection processes and procedures, maintenance, and protective technology. Regarding the issue of identity management, Clauß & Köhntopp (2001) suggest that the lack of trust and privacy are the two major barriers to the adoption of information systems. Therefore, it is essential to implement privacy and security directly into information systems. Further, identity management systems allow users to control the amount and nature of information released in the public domain. Thus, they support the goals of trust and privacy as users are allowed the right of informational self-determination. There is no gainsaying the fact that digital identities of users engaging in online tasks are valuable assets that must be protected. Any abuse or unauthorised leakage of this information may lead to serious consequences for the organisation. Concerning the issue of access control, Castiglione et al. (2015) suggest that it is essential to ensure that only authorised employees of the organisation are allowed to access assets and resources. Sohrabi Safa, Von Solms, and Furnell (2016) suggest that training and awareness influence the knowledge possessed by employees regarding information security policies and, in turn, this knowledge influences the attitudes of individuals towards information security compliance. Furthermore, the knowledge gained through deep experience with information security is more durable and tangible for the employees and leads to changes in attitudes towards information security compliance. Training courses, formal presentations, posters, workshops, emails, web pages, meetings, and games can all

form part of different training approaches. Proper information security training heightens the information security awareness, which is a critical factor in information security assurance.

The third function of the NIST core is that of “detect”. This function is related to the development and implementation of processes for the identification of events that might pose information security threats. Further, this function allows for the timely detection of cyber threats and covers outcomes such as anomalies and events, security continuous monitoring, and detection processes. Ben-Asher and Gonzalez (2015) assert that ensuring information security is a difficult task because organisations need to possess knowledge about this domain as well as having cognitive ability to identify/detect threats by parsing through a vast amount of network data. Although recent advancements in information security have enabled security analysts to detect cyber threats, such tasks cannot be fully automated. Therefore, information security experts still must possess exceptional analytical abilities and, moreover, knowledge in network operations and information security influence the detection of intrusions in a simple network. Ahmed, Naser Mahmood, and Hu (2016) assert that, despite the availability of detection techniques, some gaps still exist in this area. For example, there is a need for an intrusion detection mechanism that is universally applicable to all possible scenarios. Currently, a technique applicable to a wired network is of no use when it comes to a wireless network. Next, it is still difficult for analysts to separate out noise from real data anomalies. Finally, behaviours that are considered standard today may change in the future and, therefore, current intrusion detection techniques may not remain relevant forever. Thus, in the face of continually evolving behaviours, it is essential to invent/design newer threat detection techniques.

The next function of the NIST core is “respond”. The respond function pertains to the development and deployment of those activities that ensure a proper and adequate response to detected information security incidents. Expressed differently, these activities help organisations minimise the potential impact of cybersecurity incidents. The outcome categories included in this function are response planning, communications, analysis, mitigation, and improvements. Concerning the aspect of response planning, Iannucci and Abdelwahed (2018) suggest that since the frequency and sophistication of cyberattacks have been increasing over the last few years, system administrators are now finding it difficult to address the alarms raised by intrusion

detection systems. In response to these situations, it has been proposed that automated intrusion response systems be used instead. The intrusion response systems are supposed to extend the capabilities of the intrusion detection systems by generated automatic responses to cyber intrusions. Furthermore, these automated responses are generated in two ways. First, static responses are triggered based on a pre-defined map of incidents and responses; and second, a quantitative analysis is undertaken to evaluate all possible responses based on a pre-defined database of multiple decision criteria. Ahmad, Maynard, and Shanks (2015) confirm that within an organisation, the cyber Incident Response Teams (IRTs) are responsible for reacting to information security process outcomes (both successes and failures). Specifically, IRTs diagnose security breaches and intrusions, undertake a root cause analysis, contain the adverse fallout, identify and eliminate the technical issues that cause incidents, and help the organisation in recovering and resuming its normal business activities. Furthermore, the experience gained by the IRTs in dealing with attacks and processing violations can be used to improve information security and more in-depth analysis of incidents may reveal several weaknesses related to "inaccurate risk assessments, insufficient, misleading or contradictory advice in policies, ineffective or misaligned strategies, and inadequate security education, training, and awareness" (. Ahmad, Maynard, and Shanks, 2015, p. 717).

"Recover" is the last function captured under the NIST core. This function entails the development and deployment of those activities that ensure the reinstatement of resources and services that have been adversely influenced by an information security incident. Additionally, these activities ensure that organisational resilience is maintained. The Recover function supports timely recovery to normal operations to reduce the impact from a cybersecurity incident, and its outcomes include recovery planning, improvements, and communications. Sahebjamnia, Torabi, and Mansouri (2015) assert that there might be different recovery and continuity plans for the same information security incident, each of which can be characterised by different requirements in terms of resources and utilisation. However, these contingency plans must be deployed in an integrated fashion, as otherwise managers will find it difficult to understand the precise timing and mechanism of transitioning from the continuity phase to the recovery phase. With regards to communication and information exchange, Skopik, Settanni, and Fiedler (2016) state that the modern networks are so

complex and interconnected that their protection can only be assured if the efforts are financed and coordinated in a shared way. Currently, individual organisations are engaged in the task of incident detection and response planning, and there is a lack of inter-organisational knowledge exchange. Therefore, to prevent future damages due to large-scale cyberattacks, it is imperative to establish an information sharing mechanism, which may include "covert cyber-attacks and new malware, issuing early warnings, advice about how to secure networks, and selectively distribute threat intelligence data" (Skopik, Settanni, and Fiedler, 2016, p. 154).

Another important discovery made from the analysis of the FGD is that information security governance is key to the success of any information security management program in an organisation. Specifically, it was mentioned that as part of the information governance principles, a unified view of the organisation must be formed. It was agreed upon that communication of information security policies is a must because it is only through awareness and training that employees can be motivated to adhere to the rules and best practices. The issue of information security governance has attracted the attention of many academic scholars. Tan, Maynard, Ahmad, and Ruighaver (2018) assert that information security governance ensures that the strategic decision-making processes are aligned with security objectives and, therefore, the investments made in preserving security are not wasted. Additionally, information security governance encompasses a wide array of activities such as modifying the current organisational structure, designing and clarifying new roles and responsibilities, making optimal resource allocation decisions, identifying and mitigating risks, monitoring and evaluating outcomes, and assessing the effectiveness of security audits and reviews. Furthermore, it was observed that while most of the organisations follow standard frameworks such as ISO/IEC 27000 to ensure information security, they are still struggling to address the challenge of the increasing number of sophisticated cyberattacks and information security breaches. One key reason for this is that the sole focus is on information security controls and other aspects such as strategic objectives, implementation, and accountability measures tend to be ignored. In addition, the authors find that three fundamental problems persist when it comes to having an effective information governance regime in place: (1) limited diversity in decision making; (2) lack of guidance in corporate-level mission statements to security decision makers; and (3) a bottom-up approach to security

strategic context development" (p. 1). Finally, Safa et al. (2015) confirm that training employees and making them aware of information security issues changes their attitudes and behaviours. Specifically, awareness is the key to information security assurance and, therefore, adequate and relevant training must be provided to achieve secure behaviour. Furthermore, to reduce risks, it is essential that technology-based and procedural control procedures are combined and, regarding the latter, the human element of information security becomes central. Controls can be ignored or abused by the users; therefore, it is imperative to change the perceptions of the users through training.

6.3 Asset Management Framework

Analysis and validation of the qualitative data revealed that there were multiple barriers impeding the successful execution of asset management in the oil and gas industry. In this section, the researcher isolates these barriers and links them with the industry best practices and standard frameworks that can help mitigate the various problems associated with asset management. Based on the validation analysis of the FGD data and a review of the extant literature, a revised asset management framework was developed (shown in Figure 6.1). The key components of the framework are described below.

One of the barriers identified during the data analysis phase was that organisations do not possess sufficient knowledge on how to manage assets that have reached the end of their economic lives. Further, there were concerns over funding related to the substantial costs incurred to renew or replace ageing and obsolete capital assets. Therefore, to meet the challenges related to asset obsolescence, organisations should, first and foremost, develop their asset management objectives in relation to supply risk policies. This will help curb against asset obsolescence as it optimises inventory tracking systems. These systems will trail the inventories and report about their current health conditions (to see whether they are functioning okay or almost reaching their obsolete status). Additionally, organisations should install an auto-replenishment system within their asset management framework, which will notify the management when new assets need to be purchased to replace the older ones, as well as when older assets need to be sold off before they are completely obsolete.

According to Woodhouse(2016), a review of the extant literature suggests that a section of researchers believe that multiple assets in different organisations have already crossed the lifespan that they were originally designed/planned for and a failure to replace them has resulted in several adverse repercussions, i.e. unsustainable consumption of energy, increased costs due to repeated and more frequent maintenance breaks, and an increased risk of accidents and disasters. In contrast, some scholars and practitioners assert that organisations have incurred additional costs due to the replacement of assets that were entirely unnecessary or replenishments that were premature. In view of these conflicting opinions, it is imperative for organisations to design and implement a decision-making approach for asset replacement and replenishment. An optimal decision-making approach is expected to aid an organisation in choosing the best option from an operational point of view and in reducing downtime as well as maintenance costs. Towards this goal, the author proposes the following factors that the oil and gas firms (and other sectors) could consider while addressing the challenges of asset management:

6.3.1 Information security

The most important component aspect of the asset management is that of information security. This part of the framework derives its importance from the fact that in the current era of asset management, the deployment and use of digital technologies has transformed the domain. Specifically, it has become imperative to protect the upstream and downstream assets (IT and industrial control systems) from information security breaches (loss of important data). One of the key reasons these assets must be protected is that any cyberattack on the organisation's assets will lead to financial, reputational, and environmental damages. In addition, such attacks may put public health at risk and, consequently, the organisation may suffer from heavy penalties and public censure.

An asset can be defined as something that carries value and from an asset management perspective, it is imperative for an organisation to secure its physical IT infrastructure, data, information, digital assets, and reputation. Therefore, it is essential for an organisation to identify a relevant and useful information security framework, which can be utilised to achieve the above-mentioned objective. In principle, an information

security framework encompasses policies, procedures, processes, and tasks that specify the way in which information is managed within the firm with a view to mitigating security risks. Globally, there are more than 200 information security frameworks that have been developed to address the needs of a diverse set of industries and sectors. However, we discuss only a few commonly identified frameworks, including Control Objectives for Information and Related Technology (COBIT) and International Standards Organisation (ISO)/International Electrotechnical Commission (IEC) 27000.

The ISO/IEC 27000 family of standards were developed to aid organisations in keeping their digital assets secure. Using this family of standards, organisations can secure their assets including financial information, data about their employees, and processes and physical operations, and information provided by third parties. Furthermore, within this family of standards, there are multiple standards that can be used to address different goals. For example, ISO/IEC 27001:2013 provides specifications related to the requirements for "establishing, implementing, maintaining and continually improving an information security management system within the context of the organization". The requirements specified as part of this standard are general in nature and, therefore, they can be adopted by any organisation irrespective of its size or industry sector. Moreover, ISO/IEC 27001:2013 includes requirements for the evaluation and addressing of risks associated with information security, and customised based on the needs of the organisation. ISO/IEC 27002:2013 provides guidelines for organisational information security standards and information security management practices including the selection, implementation, and management of controls taking into consideration the information security risk environment of the organisation. Specifically, this standard can be adopted by those organisations that want to specify controls within the process context of ISO/IEC 27001, adopt and implement control mechanisms that are commonly accepted, and develop their own information security management guidelines and mechanisms.

With the ISO IEC 38500 and other IT governance initiatives, COBIT 5 for Information Security gives the most current view on information security governance and management. The most critical guidance and standards were scrutinised during the

development of COBIT 5 for Information Security. COBIT 5 for Information Security allows the adjustment with other relevant frameworks, standards, and models in the business world, such as the ISO/IEC 27000 series, the Information Security Forum Standard of Good Practice, and Business Model for Information Security. Moreover, Information Systems Audit and Control Association (ISACA), information security governance services, Information Security Governance: Guidance for Information Security Managers and Information Security Governance: Guidance for Boards of Directors and Executive Management, second edition were also studied while developing COBIT 5 for Information Security.

COBIT 5 offers a revised process model, which not only clarifies the role of governance and management but also reflects how they are related to each other along with the process model for COBIT 5, which is an information security system, works towards integrating both business and IT functional responsibilities. It outlines the roles and responsibilities at various levels of the enterprise while also providing a clear demarcation between information security governance and information security management practices, and incorporates all the steps in the process, from start to finish. All-inclusive and holistic guidance on information security is given shape by COBIT 5 for Information Security; therefore, all the parameters for the processes to all enablers, including information, structures, culture, policies and their interdependence are scrutinised equally.

Furthermore, firms that maintain an accurate record of information about their assets are more likely to perform better in terms of information security management. Therefore, it is essential that the organisation maintains an informational record of their assets, which is updated in real time. Next, it is important for organisations to start with the implementation of an information security governance framework. Organisations should first develop a holistic view of their organisation, and thus they can make use of different enterprise architecture and business process models. Another important principle is that organisations must set aside capital for employee training and awareness. If awareness levels are low, then information security processes and protocols are less likely to be taken seriously. Additionally, there should be clarity around the roles and responsibilities related to information security management. Third, organisations must put in place monitoring and tracking mechanisms to ensure

that information security strategies yield the desired outcomes. Fourth, the organisation must adopt a market-oriented perspective to keep track of any cybersecurity incidents and the influence on their customers. Finally, it is important for organisations to implement cross-functional information security processes that promote collaboration and integration when it comes to prevention as well as the formulation of a response to a cybersecurity incident.

For the purpose of having practical knowledge about the implementation of information security management systems, it is recommended that the NIST framework be used. Specifically, there are five processes that any oil and gas sector organisation should consider. The first process is that of identify and the first category under this is asset management. As part of this, data, personnel, devices, systems, and facilities that enable the organisation to achieve business purposes are identified and managed consistently with their relative importance to organisational objectives and the risk strategy of the organisation. The next category is that of business environment under which the organisation's mission, objectives, stakeholders, and activities are understood and prioritised. This information is used to inform cybersecurity roles, responsibilities, and risk management decisions. The third category is that of governance under which the policies, procedures, and processes to manage and monitor the organisation's regulatory, legal, risk, environmental, and operational requirements are understood and inform the management of information security risk. Fourth, under the category of risk assessment, the organisation understands the cybersecurity risk to organisational operations (including mission, functions, image, or reputation), organisational assets, and individuals. Fifth, under the category of risk management strategy, the organisation's priorities, constraints, risk tolerances, and assumptions are established, and are used to support operational risk decisions. Finally, under the last category of supply chain risk management, the organisation's priorities, constraints, risk tolerances, and assumptions are established and used to support risk decisions associated with managing supply chain risk. Thus, the organisation can establish and implement the processes required to identify, assess, and manage supply chain risks.

The second high-level process under the NIST framework is that of protect. The first category belonging to this process is that of identity management, authentication, and

access control. As part of this category, access to physical and logical assets and associated facilities is limited to authorised users, processes, and devices, and is managed consistently with the assessed risk of unauthorised access to authorised activities and transactions. The second category is that of awareness and training wherein the organisation's personnel and partners are provided cybersecurity awareness education and are trained to perform their cybersecurity-related duties and responsibilities consistent with related policies, procedures, and agreements. Third, under data security, information and records (data) are managed consistently with the organisation's risk strategy to protect the confidentiality, integrity, and availability of information. Fourth, as part of information protection processes and procedures, security policies (that address purpose, scope, roles, responsibilities, management commitment, and coordination among organisational entities), processes, and procedures are maintained and used to manage the protection of information systems and assets. Fifth, under maintenance, the maintenance and repairs of industrial control and information system components are performed consistent with policies and procedures. Finally, as part of protective technology, the technical security solutions are managed to ensure that the security and resilience of systems and assets are consistent with related policies, procedures, and agreements.

The third high-level process is termed as detect and the first category under this, anomalies and events, covers the detection of anomalous events and a study of their influence on the business. Second, under the category of security continuous monitoring, information systems and assets are monitored to identify cybersecurity events and verify the effectiveness of protective measures. Third, under detection processes, the detection processes and procedures are maintained and tested to ensure awareness of anomalous events.

The fourth high-level process is that of respond. Under this, the first category is that of response planning. As part of this, response processes and procedures are executed and maintained to ensure response to detected cybersecurity incidents. Next, under the category of communications, response activities are coordinated with internal and external stakeholders (e.g. external support from law enforcement agencies). As part of the third category called analysis, analysis is conducted to ensure effective response and support recovery. Fourth, under mitigation, activities are performed to prevent the

expansion of an event, mitigate its effects, and resolve the incident. Finally, as part of improvements, organisational response activities are improved by incorporating lessons learned from current and previous detection/response activities.

The last and fifth high-level NIST process is called recover. The first category under this process is recovery planning, in which recovery processes and procedures are executed and maintained to ensure restoration of systems or assets affected by cybersecurity incidents. Second, as part of improvements, recovery planning and processes are improved by incorporating lessons learned into future activities. Third, under communications, restoration activities are coordinated with internal and external parties (e.g. coordinating centres, Internet Service Providers, owners of attacking systems, victims, other Critical Incident Response Team, and vendors).

6.3.2 BCPs

The analysis of data and subsequent discussions revealed that BCPs must be considered as an integral part of any asset management framework. Study participants summarised that BCP as an endeavour to ensure that the provision of business operation is optimally continued to run the enterprise's operation requirements through a managed process. Lack of BCPs will expose a serious risk with potentially devastating consequence for the business. Therefore, it is recommended that oil and gas organisations should adopt the concept of BCPs in order to develop asset management practice for their business .

6.3.3 DRPs

As part of the overall BCP, disaster recovery planning is important and this exercise must begin with an analysis of the impact that specific interruptions may have on the assets or business operations. Further, metrics such as recovery time objective and recovery point objective should be used. There is must be processes in place to assess the adequacy of backup plans, establish the order of priority based on which assets must be replaced, list the qualified suppliers who can provide support as part of the DRP, plan for emergency situations, check preparedness through drills and simulations, and implement other procedures that can expedite the recovery of the assets in the aftermath of a disaster.

6.3.4 Risk Management

The analysis undertaken as part of this research indicates that there is a need for BCP, DRP and Risk Management functions to collaborate with each other. This is especially important in the context of Information Security. Additionally, it is recommended that all organisational risks must be identified before searching for ideal risk management solutions. Furthermore, these risks should then be classified and analysed according to which functions they emanate from (using both qualitative and quantitative approaches) and what are likely impacts upon risk realisations. Based on these, risks should be rated and prioritised and addressed accordingly.

6.3.5 Governance and compliance

Due to too much political/government interference, businesses lose focus and miss out on long-term planning. Most of the interviewed organisations are forced by the law to abide by the general asset management regulations, which are usually very constricting and incomprehensible. This type of government involvement interferes with company policies, regulations, financial controls and, in some cases, the actual delivery of specific asset services. Therefore, businesses end up performing poorly. Governmental interference also weakens managerial authority over the financial and operational aspects of these businesses, and it imposes contradictory objectives in addition to politicising investment decisions, labour relations, prices, and the technological choices used. Organisations are urged to remain out of the political arena and avoid political risks as much as possible. They can achieve this by procuring political risk insurance cover or hiring a director of political affairs to notify them of oncoming political risks.

6.3.6 Information Technology

Based on participant responses one of the most significant challenges facing asset management of oil and gas sector is the absence of integrated IT systems. The lack of integrity of IT systems relates primarily to the absence of integrating IT iterations which results in an absence of a seamless information service, which itself represents a risk to the organisation. Respondents acknowledged that the oil and gas industry currently suffers a major technology integration with their asset management

system. Therefore, in order for organisations to effectively manage their asset's performance, IT systems integrations is required to facilitate the operation.

6.3.7 Integration of systems

Integration of systems across different functions is revealed to be a key problem within the oil and gas organisations. Every year, these organisations waste a large amount of financial resources due to the lack of communications between disparate systems and this leads to operational inefficiency. Also, it makes it difficult for the organisations to make quick strategic changes in the face of marketplace uncertainty. Data accuracy is another factor that was identified as an area of concern. Therefore, it is recommended that oil and gas organisations should opt for integrated system solutions as it is expected to make the asset management processes stronger and to improve its practice.

6.3.8 Strategic objectives

The third core part of the revised asset management framework is that of strategic objectives. The data analysis exercise revealed that, frequently, the strategic objectives of an organisation may seem a bit complicated for the functions to follow. To make matters worse, these objectives are not properly communicated to all stakeholders and often these objectives lack specific directions for appropriate actions. To rectify these issues, the top leadership must explain decisions regarding cost optimisation and value generation. Details must be provided about the level of service that must be achieved to meet customer expectations. Additionally, communication must occur regarding the level of reliability to be maintained, the different compliance requirements that act as constraints, and the targets for cost savings together with practical pathways to accomplish these objectives.

6.3.9 Communication management

Communications management remains an area of concern for the oil and gas organisations. Collaboration between different functions is hindered as members are not aware of the deep and contextual meanings of the words and terms used by others. In addition, lower level employees do not have access to mediums to communicate with the top leadership. Also, they may not be fully equipped to communicate their

observations and concerns effectively. In light of this, it becomes important for oil and gas organisations to adopt specific information systems/information technology systems that facilitate communication processes and help is resolving conflicts in order to improve asset management implementation and practice

6.3.10 Human resources

Within oil and gas organisations, workforce engagement is a serious issue that needs to be addressed. Currently, it is perceived that employees do not feel the urge to be creative and proactive as they are not given an opportunity to participate in key decision-making processes. However, as the literature suggests, it is important for organisations to improve employee engagement if they wish to remain competitive. In this regard, they should view the HR processes as an integrated value chain; should opt for the transformational leadership style; and should strive for job enrichment for each and every employee at all levels of the organisation.

6.3.11 Leadership governance

One of the key insights obtained from the analysis of data was that poor leadership was weakening business coordination and disrupting the flow of processes in the context of asset management in the oil and gas industry. Thus, it is recommended that the challenge of poor leadership be addressed by linking asset management objectives with the organisational structure. The organisational structure provides a clear path of the organisation's hierarchy that demonstrates different job roles and management positions such that tracking down a poorly-performing individual is easier. The organisational structure will also enable easy/ regular monitoring and evaluation programs to verify if the strategic objectives are being met. The monitoring and evaluation will spot insufficient employee engagement and then solve them through creating more group discussion, more team building platforms; encouraging people to spur healthy workplace politics; more work delegation; and target achievements.

According to Hastings (2015), the ISO 55000 guidelines suggest that leadership is a crucial factor that influences the effectiveness of asset management. In terms of best practices, it is recommended that senior management appoint a representative to the asset management function if the organisation wants to achieve and sustain a

leadership position in the asset management domain. In the absence of this leadership representation, business plans may face obstacles as the required support is not forthcoming. Specifically, it is recommended that the organisation creates a Chief Asset Manager position, which is equivalent of at least a Vice-President role in terms of authority and prestige. Furthermore, it is essential for a Chief Asset Manager to possess knowledge about overarching organisational objectives and how these objectives can be attained by effective asset management. This knowledge is necessary so that business and asset management plans are aligned and furthermore, adequate *"asset provision, asset support, and resources for the sustainment of an effective asset management system"* (Hastings, 2015, p.54). Finally, effective leadership also means that a positive workplace climate is established and sustained. In addition to providing a robust system for asset management support, leaders must also encourage and facilitate collaboration among members at all levels of the organisation. This active participation from employees ensures that a culture of safety, reliability, and cost-effective operation is maintained.

With regards to a real-life scenario wherein the importance of effective leadership in the context of asset management is highlighted, Eacott (2019) cites the case of Scottish Power (SP), part of the Iberdrola Group, who were responsible for operating 6.4 GW of power plants, including coal, gas, and hydro stations across the UK. SP, as an organisation, was able to transform itself into an epitome of process safety and asset management through its Operational Transformation Program. The main objective of this program was to embed process safety throughout the organisation and to make it an essential part of the job for every employee. To achieve this goal, the program incorporated a comprehensive leadership work-stream, with the main aim being to raise awareness about the issue of process safety at all levels of the organisation. Additionally, this stream laid the foundation for strong and effective leadership and governance mechanism. In specific terms, because the Operational Transformation Program team wanted to demonstrate leadership commitment starting from the top, a document called "Process Safety Principles" was produced and signed by the Chief Executive Officer. Finally, SP established a governance schedule for its process safety and effective asset management initiative. Essentially, these governance mechanisms drove periodic reviews of process safety performance and allowed the management to identify trends and undertake proactive actions to prevent accidents or process failures.

Specifically, governance at SP assumed two distinct forms—formal governance wherein *"regular review meetings were scheduled at all levels in the organisation, from the facility level up to the SP board, to establish ownership and accountability for process safety management"* and culture, wherein *"all staff were required to understand the hazards and risks evident in everyday operations and to report and challenge any concerns they may have about process safety"* (Lloyd, 2017, p. 118).

6.3.12 Strategic procurement

This research indicates that for some oil and gas organisations, the strategic procurement policies are developed in-house, but for some organisations, the view towards procurement is not strategic. The organisations falling under the former category try to align procurement policies with organisational strategies and core values. Also, as part of the governance mechanisms, these organisations review their procurement policies periodically. This alignment results in better efficiency and cost savings. However, it was also noted that for some organisations, procurement policies were heavily influenced by the regulations imposed by the government, specifically in the context of local content requirements.

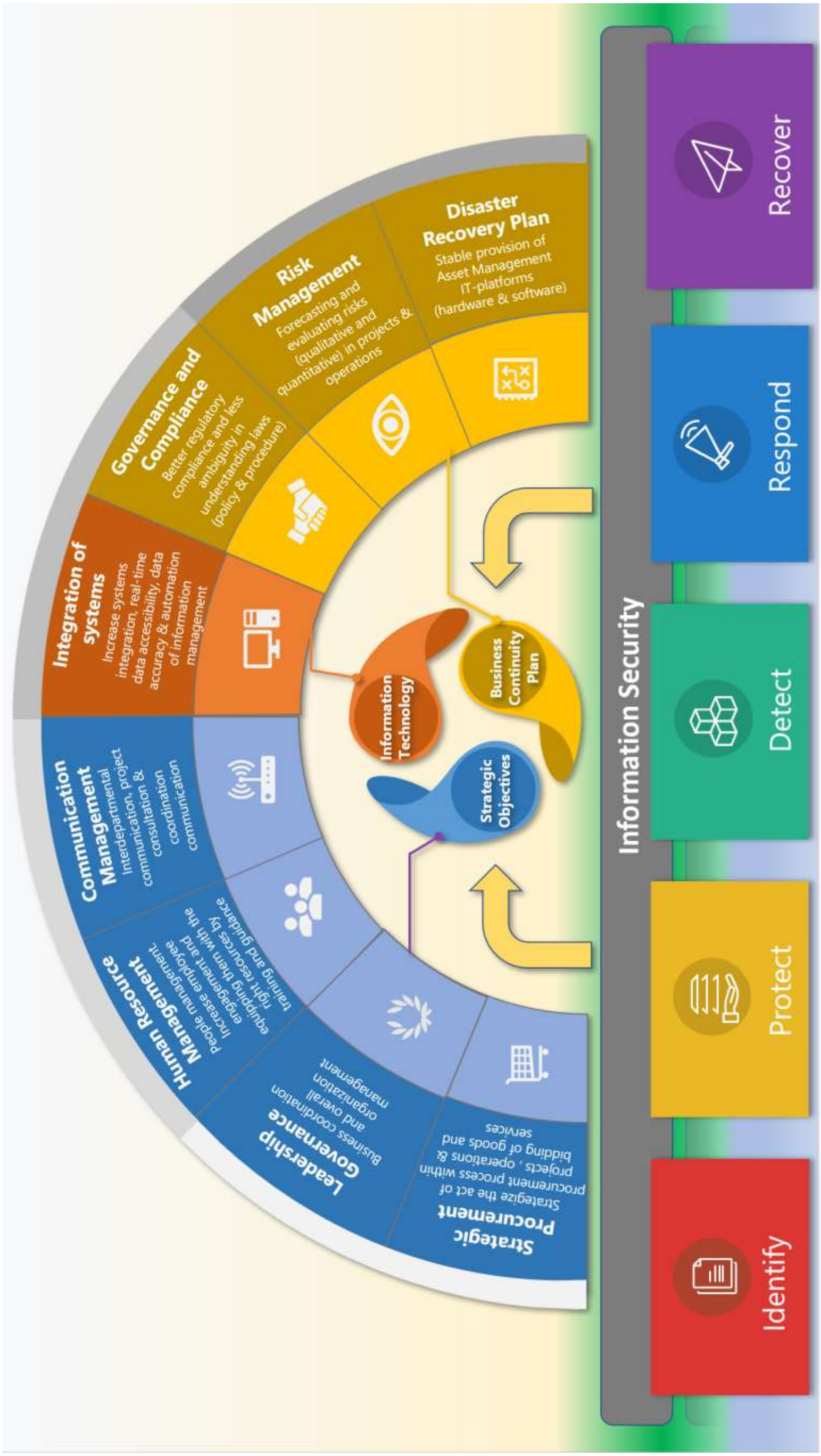

Figure 6. 1 Asset management framework

6.4 Chapter Summary

This chapter outlined the results of framework validation. FGDs were undertaken to validate the framework and its underlying theory. As a systematic method of approaching this objective, the researcher examined and revised each component of the developed framework during the first phase for discussion in a sequential manner and any new sub-themes were construed from the interviewees' responses and discussed thoroughly in connection with the Literature Review. A revised framework, thereafter, was built based on the validation results and discussions.

Chapter 7: Conclusion

7.1 Introduction

This chapter marks the culmination of this thesis and provides a recap of all the elements contained in this thesis. In particular, the chapter will determine whether the study succeeded in meeting the objectives set out in the research questions. The research objectives are of great significance, as they are the ones that set the pace for the study. They mold the structure of a research study by prescribing the problem areas that need further research and theory development.

7.2 Summary

The Introduction chapter of this thesis begins with outlining the research problem. It was observed that an asset can be defined as any tangible or intangible artefact that can generate value for the organisation. The nature of assets may vary from organisation to organisation; however, they are the core component for any organisation as they help generate monetary benefits. Business assets go beyond physical infrastructure alone, they also encompass abstract components such as data, software, and virtual environments. Here, data represent one of the key assets that an organisation possesses and utilises in the current era. Today, many organisations use data from market research to understand customer behaviour and preferences as well as product performance. Thus, assets are integral constituents of an organisation—they require optimal usage and maintenance. Moreover, businesses must make the most of their assets and, for this goal to be achieved, they must integrate and maintain effective asset management practices in their day-to-day operations. A lack of management could result in lost or damaged assets that could have crippling impacts on any organisation.

In terms of the definitional aspects of asset management, it was noted that this discipline is concerned with establishing systematic processes that facilitate efficient employment, operation, maintenance, and disposal of assets throughout their lifetime. These activities ensure the proper care and effective deployment of business assets. Additionally, the sequencing and coordination of these activities are paramount because different functions in the organisation collectively attempt to realise these goals within the context of organisational structures and resource constraints. In terms of operational characteristics, asset management entails several processes such as risk

identification, maintenance planning and execution, and asset management compliance. It is imperative for businesses to adopt asset management best practices in pursuit of the goal of managing assets proficiently. If organisations are able to manage their assets efficiently, then they can reap optimal benefits by preserving assets for future use. Preservation helps organisations save costs of untimely and expensive purchases and frequent repairing. Thus, preventative maintenance supports reliability as a tangible return to an organisation.

In terms of the justification of this research study, there is a need to develop a suitable framework that will demonstrate better implementation of asset management systems. The asset management framework (Figure 6.1) was developed based on the gaps in research, which were identified within the domain of asset management in the oil and gas industry (with the aim to enhance reliability and sustainability of equipment and systems). This proposed framework aimed to eliminate the challenges facing asset management function within oil and gas organisations. Some of the issues identified were poor decision making, poor leadership, legislation irregularities, rigid political framework, non-integration of systems, and weak supply risks. Thus, the research investigated these challenges in-depth from the limited secondary resources that exist as well as from the responses of 50 selected employees (research sample group) currently working as professionals within this industry. The study uncovered the key managerial challenges that organisations face in the oil and sector, which stymie the implementation efforts of asset management systems within this sector. This study also proposed solutions to these problems. The formal research problem in this study was: “How can oil and gas organisations improve the performance of their assets and contribute value to their organisations?” The answer to this question was illustrated throughout the course of this study and through discussion of the interview responses given by the interviewees and then further validated within the FGD sessions.

The second goal of this study was to close the research gap that currently exists within the asset management academic domain. By drawing attention to the asset management related challenges within the oil and gas sector, this study will encourage scientists, researchers, and the government to invest in intensive R&D initiatives aimed at addressing these challenges and improving the current situation. Furthermore, this thesis can be referred to by potential investors and business entities

to gain rich insight into the implementation of asset management frameworks in the context of oil and gas organisations. Finally, this thesis will act as a manual or guiding document for new entrants who are just venturing into the oil and gas industry and would like to gain more knowledge on this area of concern, its challenges, and solutions.

Concerning the academic significance of this research study, an overview of the existing literature confirmed that there is a substantial research gap. Despite the fact that asset management is a real concern for various oil and gas platforms, there is still little academic material explaining asset management best practices and implementation processes in this industry. The existing material mostly covers basic, overarching guidelines and only a few extant literature resources provide detailed theory about asset management in the oil and gas sector. Moreover, there is a lack of a common platform from which to offer a reliable and tested knowledge base. There is even less literature on the subject of asset management in the oil and gas sector; therefore, this thesis aimed to contribute to bridging this gap. This study relied on intensive primary research that was specifically focused on the challenges affecting asset management implementation in the oil and gas sector. Face-to-face interview sessions were conducted with selected employees working in oil and gas organisations. This was done to collect data about their perceptions and knowledge of this area. This was further developed and validated with FGDs; thus, completing the full journey starting from problem identification to the development of the proposed framework.

Finally, the Introduction chapter identified and presented the key research objectives, i.e. to determine the key managerial challenges hindering asset management in oil and gas organisations, and to develop, field trial, and publish a suitable framework that will support the enhanced implementation of asset management systems that will subsequently eliminate asset management challenges. The key research questions were presented, which were what is the significance of asset management systems in the oil and gas sector; what are the challenges currently facing the implementation of asset management systems in this sector; how can these challenges be resolved or at least reduced; and what type of framework can demonstrate and support better implementation of asset management systems in this sector?

The Literature Review chapter started with an insight that the majority of businesses have come to realise the value of asset management, which is using employment efficiently, and the operation, maintenance, and upgrading of assets to reap maximum benefits from them during the course of their economic life and have integrated it within their departmental segments to preside over their assets. Asset management is of great importance especially in the case of the oil and gas industry, and is considered as the perfect strategy in managing their corporate properties as the organisations in this sector operate a huge volume of assets including oil treatment plants, pumping units, heating units, storage tanks, gas generators, metering systems, desalting plants, gas separators, and turbine expanders. These assets are highly mechanical in nature and are always in constant physical motion. The equipment starts wearing out in a short period after purchase. Therefore, their maintenance is crucial, so they do not burn out rapidly, rendering longer-term investment useless.

The implementation of asset management, through adequate risk inspection and maintenance management, helps identify any problems or obstacles within physical equipment such as the production constraints experienced when machinery unexpectedly breaks down and fails to operate. The success of asset management depends greatly on strategic procurement, which is an exhaustive plan that is carefully devised to enable businesses to obtain the goods, services, materials, and equipment required for project deliverables. Other important components to run a project glitch-free from start to finish are raw materials, human labour, land (project site), buildings, equipment, and machinery. Also required is a well-planned time schedule to ensure that the program is well organised and delivers within the scheduled time. Close examination and evaluation ensure that the project is carried out with the highest levels of value and integrity.

The “Research Methods” chapter of this thesis began with a description of various research philosophies and proposed the use of constructivism for this study. Constructivism is also known as interpretivism and is based on the belief that reality is not universal. Instead, reality is presumed to be complex and rich, which is constructed by the observers in social settings through the use of culture and language. Constructivism maintains that reality cannot exist independently of the human participants and that the observers comprehend and construct reality when they accumulate experiences and later think about those experiences. Furthermore,

observers can experience or construct multiple realities and they can derive different meanings or interpretations. Constructivism is in direct contrast to the beliefs and principles of positivism. Positivism is perceived to be overly simplifying the reality, whereas constructivism focuses on human perception, attitude, reviews, feedback, opinion polls, interview responses, faith, customs, religion, political beliefs, ethics, and logics. Furthermore, constructivism constructs knowledge or insights from main themes, implications, or key insinuations prevalent in these sources. This thesis adopted the constructivism research philosophy because the researcher believes that the domain of oil and gas asset management is complex and the knowledge about this domain can be best obtained by collecting and analysing qualitative data, which is more processual in nature. Furthermore, the researcher aimed to extract insights about this topic by collecting and analysing subjective information provided by the subject matter experts. Evidently, each subject matter expert was expected to view asset management differently and each may derive different meanings and interpretations based on individual experiences in this domain. Positivism and realism do not provide this platform wherein people can converge to create novel worldviews and, therefore, they yield knowledge that is devoid of processual richness and context.

Concerning the research approach, this study embraced inductivism. The inductive approach is preferred in cases where the researcher may want to find new information about the phenomena under study. The absence of this information and knowledge about the domain of asset management in the oil and gas sector compelled the researcher to adopt an inductive approach to explore more on this issue and gather more data to publish it in peer-reviewed journals. Thus, there was the need to conduct in-depth research on the asset management challenges to understand the root causes of such problems in the oil and gas sector. It was proposed that the optimal way to generate new knowledge was to employ an inductive approach and not a deductive approach. Inductive approaches enable participants to converge and discuss important issues at length while taking a deep dive into specific areas of concern. Further, participants share their experiences, positive and negative views, thoughts, and attitudes concerning that issue. Additionally, if problems are identified, then various people may aid others to devise and implement certain solutions. It was expected that an inductive research approach would enable the researcher to collect views and

thoughts on asset management, and the various challenges hindering its efficient implementation in the oil and gas industry.

Because this thesis aimed to explore the challenges preventing effective asset management within the oil and gas industry, a qualitative methodology helped in obtaining more information and thoughts on this topic. This is because a qualitative research strategy engages people and prompts them to talk intuitively about a given topic, the present challenges, and possible solutions. From a review of the extant literature on research strategies, it was confirmed that the collection and analysis of qualitative data would be ideal as it is textual and abstract. A qualitative data collection and analysis strategy allows for a rich and complex examination of the subject matter from multiple subjective perspectives. For the data collection strategy, face-to-face interviews were conducted. Interviews consisted of the researcher posing a series of questions and the interviewees providing their answers to these questions. While interviews can be of different types such as face-to-face, via the telephone, Skype, online conferences, and group interviews, face-to-face interviews are the most effective. Face-to-face interviews bring together the interviewer and the interviewees into the same physical space, which allows more details to be collected. Being in the same physical environment or vicinity reveals more details besides the verbal replies that an interviewee may give during the question-answer session.

For the purpose of this research study, the researcher administered face-to-face interviews because the aim was to observe cues and the meaning of body language indicators during the generation of subjective data. Furthermore, the interviews were organised in a structured manner, i.e. all the interviews contained the same questions. The structured interviews were designed that the questions were presented in a pre-determined standardised format and the interviewer did not deviate from this format while conducting interviews with different participants. Additionally, the interviews consisted of closed-type questions and it was expected that this would yield specific responses. The advantage was that because they contained a fixed format, they only required minimal time. Furthermore, it was relatively easy for the researcher to analyse the final data because almost all the answers to each question contained a somewhat identical theme or concept. It was expected that the data from the structured interviews

would be reliable and easy to code. The developed data thereafter was validated via organised FGD to demonstrate more reliability.

In the “Results” chapter, qualitative data collected using the interviews was analysed with the help of the NVivo software program. The first major category of insights generated through this analytical exercise was related to the strategic objectives of the oil and gas organisations. Analysis of the data revealed that the oil and gas sector organisations adopted a wide array of strategic objectives. The first one was that of improved compliance. Primarily, firms that had adopted a green approach to operations perceived that it was imperative for them to adhere to the laws and regulations at both the global and local levels. These organisations were keen to improve their workers and utilise this as a competitive edge in the marketplace. The next important strategic objective mentioned by the participants was that of improving the quality of products and services. It was revealed that providing excellent services, high-quality practices, and unmatched quality for the levels of services was imperative to succeed in the marketplace. Specifically, one of the organisations was found to be producing high-quality products and premium services with the help of TQM practices. Third, a set of organisations attached value to the objective of workforce development culture. Such organisations believed that their success depended on the success of the employees and, therefore, they made significant investments in workforce development initiatives.

Next, some of the respondents said that it was strategically important for them to promote a healthy ethical climate supported by the internal operational control to achieve the integrity of their companies’ operations. Specifically, one organisation achieved this goal with the help of strategic communications. Thereafter, it was revealed that for some of the participants, increased brand promotion and global presence was an important strategic objective. These organisations wanted to be pioneers in the market and leaders in the oil and gas, as well as chemical and plastic manufacturing sectors. Some had an overarching objective of being able to retain and sustain leadership position across the Asian oil and gas markets and establish themselves as a brand of choice for the customers.

In addition to these objectives, certain others were also enumerated including increased business alliances, increased production and exploration, increased profits and revenue, increased technology innovations, and exceeding stakeholders' expectations.

The next important theme to emerge from the data analysis exercises was regarding the existence of asset management frameworks in the oil and gas sector organisations. Notably, all the organisations under study had some form of such frameworks in use. While the minority used the Google Drive SharePoint framework, the majority had developed in-house EAM portals. In terms of the advantages of the Google Drive SharePoint framework, it was revealed that this tool was useful in the maintenance and management of assets including property, infrastructure, oil reservoirs control system, plants, and other public infrastructure. However, this tool had some disadvantages as well including lack of simplification of work and ineffectiveness in the absence of proper training. On the other hand, EAM portals offered certain advantages such as ideal for the purpose of inventory control; effective for scheduling the operations of maintenance, repair and overhaul of assets, spares and inventory management control; and providing a holistic approach for the management, procurement, disposal, repair, maintenance, and various other activities related to the asset in the life cycle of asset management. In addition to these discoveries, it also emerged that most of the organisations suffered from the lack of system integration. Most of the respondents averred that while efficient management of information was crucial for achieving strategic objectives, not much was being done to integrate the different systems. Therefore, disintegrated systems were causing information to be considered as unreliable and it was considered necessary to integrate the systems to achieve the following objectives: ensure improvement in the performance of assets, improve the need to utilise the workforce for asset management, and decrease the cost for maintenance of assets.

Concerning the theme of aligning strategic objectives with the function of strategic procurement, analysis of the responses confirmed that not all the organisations had linked their strategic policies with their strategic procurement policies. In terms of benefits accrued from this alignment, it was revealed that it enhanced the selection and evaluation processes of the suppliers, their performance, the agreement of the service,

and business value. Procurement was considered to be of strategic importance as it lent stability as well as a perfectly designed supply chain that ensured all the supply chain goals were achieved before every fiscal year for capital and revenue items. Procurement was also seen to reduce the cost of raw materials. Having a comprehensive procurement aligned with the company's objectives added value in the form of optimised external spend on operations. In addition, strategic procurement policies are aligned with the day-to-day operations of the organisations and this enables the employees to make informed decisions in real time. Moreover, one of the key findings that emerged from the data analysis was that if procurement policies and processes are not aligned with the strategic objectives of the organisation, then the organisation will lose out on the opportunity to become lean in the true sense. Specifically, becoming lean means that the organisation will be procuring its assets just in time, and this procurement practice is in alignment with the principles of TQM. Finally, the strategic procurement processes of an organisation need to be mapped and aligned so that effective auditing can occur, and useful feedback is gathered as well as shared.

In terms of the present status of the alignment between procurement and asset management within oil and gas sector organisations, it was revealed that many organisations were unable to align their strategic objectives with their asset management policies. One of the key reasons behind this was that their asset management functions were either outdated or that it was still a new concept. Because of the latter, organisations were unable to fully assimilate and internalise the concept of alignment between procurement and asset management. A section of the respondents stated that their organisations lacked a basic asset management framework, while some of them stated that the asset management policies were still under development and they had poor capacity management. The majority of the respondents stated that their organisations were able to align procurement processes with organisational strategies and objectives. Additionally, these respondents felt that it was imperative to align the asset management policies of the organisation's needs with the strategic objectives of the organisation. The key reason behind this was that strategic plans generate the demand for the creation of operational plans and tactical goals. In turn, asset management and planning processes for assets are designed within the ambit of the performance benchmarks established by the organisation. Strategic

objectives also play a significant role in providing advisory services when the oversight committee plans the asset management framework for the organisation, keeping in view all the objectives of that organisation's individual business units.

In terms of the benefits that strategic procurement provided to the domain of asset management, several specific advantages were found through the exercise of analysing individual responses. First, it was discovered that it led to better record management as the organisation was able to record the downtime of assets and the scheduled and unscheduled maintenance in the form of logs. Second, strategic procurement helped in better monitoring of asset life cycle as organisations could actually monitor the entire life cycle for asset, which is extremely important for observing asset reliability. Strategic procurement helped in enhancing the accountability for the use of assets throughout the life cycle of the assets. Third, having a strategic perspective on procurement helped in better inventory control. Next, strategic procurement helped in achieving improved regulatory compliance as the alignment between strategic procurement and asset management aided the organisation in the form of better internal controls and external audits, thereby ensuring successful regulatory examinations. Finally, alignment between procurement and asset management ensured better risk management. In a specific instance, it was revealed that the safe operation of a company's sea terminals would be exposed to higher risk if chartered vessels were not in line with procurement policies in terms of compliance as well as quality.

Another important theme that emerged from the data analysis exercise was related to the alignment between BCPs and strategic procurement. It was discovered that a minority of the organisations had this alignment in place. For those organisations that had aligned procurement with BCP, the benefits were clear. First, it led to better quality engineering, i.e. the assets procured were required to be of the highest standard and, therefore, procurement policies had to be aligned with the quality engineering department to ensure that the correct equipment was purchased. In turn, this led to improved business continuity. Second, risk mitigation benefited from this as BCP helped in having a proper risk mitigation practice in place. This ensured that every project had risk mitigation sessions, which helped in minimising the risks on assets and improvement in operations. Third, aligned procurement processes and BCPs led to improved asset procurement procedures as complete business assessment was

accounted for, which allowed the organisation to plan strategic procurement. Additionally, this allowed for the procurement of assets based on the priority for an asset to be made available to the organisation. Finally, it was observed that the linkage between procurement and BCP helped create more sustainability in the businesses and helped ensure simplicity in supply chains. For those organisations that did not achieve this alignment, the underlying reasons were analysed. First, it was discovered that the concept of BCP was new to the organisations, especially for those that were operating in the Middle East region. Second, for some of the organisations, the concept of BCPs was not considered to be very significant. Finally, it was revealed that some organisations had alternative policies in place, e.g. Risk Management Policy, Disaster Recovery Plan, and an Emergency and Contingency Plan.

It was also demonstrated that there existed specific linkages between information security and asset management, especially in the context of the oil and gas industry. Areas of operations are not that vulnerable, but there are certain specific areas that are being digitalised. Once data porting from one area to another becomes a common practice, then the information security risk may rise. Even the upstream, downstream operations of pipeline management, refining, etc. are vulnerable to information security breaches. The results and analysis showed that the information security preparedness level of an oil and gas organisation is intricately linked to its ability to maintain information about its assets. If an organisation is maintaining an accurate record of its assets in real time, then it has already set itself up for success when it comes to having a mature information security regime in place. It was agreed that information security management is an important area that must be considered in the context of BCP and asset management for the oil and gas industry.

7.3 Limitations of the Study

This study has two major limitations. The first one encompasses the fact that the study's success or failure was determined by the willingness of the interviewees to share their opinions, experiences, and professional information devoid of bias. As a means to counter the lack of completely unbiased information, participant views were pseudo-triangulated through corroboration with other available information, including published reports and other academic research.

In addition, there was very minimal literature on asset management. This made undertaking research on the topic difficult. A primary rationale for carrying out this research was to contribute to this very limited availability of information relating to asset management specific to the oil and gas sector. Owing to the current inaccurate comprehension of what asset management entails, which is prevalent across the sector, this research adopted an inductive approach to discover the core strategies relating to oil and gas asset management. The adopted approach represents a useful strategy for resource organisations to use to upgrade their essential processes through the investment of human and financial capital in core capabilities. Nevertheless, while this study represents a guide for oil and gas asset managers to enhance the practical models that govern their oversight of physical assets, many areas of asset management require further research.

7.4 Further Recommendations

This thesis has described the current challenges hindering asset management functionalities in the oil and gas industry. The thesis has also provided several viable solutions with which to solve these challenges. The study urges the industry operators to engage in more R&D programs to unearth more innovative ways in which to develop a better asset management framework, not only in the oil and gas sector, but also in all other industries that are asset-intensive. R&D is one of the most inventive ways through which a business can investigate market trends, new technological innovations, problem-solving ideas, and new product designs and processes. All industrial organisations ought to employ research engineers and industrial specialists, whose main job role is to conduct business market research and come up with newer and fresher product concepts as well as innovatory technologies.

Oil and gas organisation should employ research experts who will help to develop asset management techniques, which are newer, more creative, and more dedicated to asset management functions. This is the only way that businesses will move forward and improve the value of their asset management processes, thus enhancing their economic worth. Additionally, the limitations to this research that have been noted above present a good starting point for future conceptual and empirical investigation.

The results from this thesis are drawn from empirical data gathered solely from within oil and gas sector organisations. Further research should be undertaken to determine the degree of inter-connectivity of processes and to measure the direct impact that these oil and gas asset management processes have on productivity. Additionally, it would be beneficial for further research to be undertaken to test the framework in practice and to measure outcomes to determine any precise improvements in operational performance. Many of the results from such research projects would be transferable to similar resource-based organisations who manage comparable assets beyond the scope of the oil and gas industry.

7.5 Closing Comments

A serious challenge facing asset managers is the need for them to receive the required resource allocation to achieve their strategic objectives. To raise the profile of asset management, asset managers could follow the strategy of focusing on interconnected company resources as a means to draw attention to the fact that specific assets may be potentially central to the company's entire operations. This study, for example, has identified that information security, strategic objectives, strategic procurement policies, technology adoption, and the integration of information management are (together with asset information management processes) key to maintenance management. Thus, these must be prioritised.

Similarly, the integration of technology systems and staff skilling is necessary to develop these capabilities to their fullest potential. Therefore, interconnecting the twin capabilities of technology and staff training will ensure that the investment of resources capabilities is fully developed. In summary, it is important to acknowledge that each specific asset management capability that this study has identified possesses its own status and that there is not necessarily a hierarchy of importance in existence. A seemingly unimportant aspect of asset management, for example, may actually have the potential to carry severe implications for the entire business if it fails. Consequently, it is incumbent on asset managers to develop capabilities across a spectrum of areas depending on the present state of the asset's life cycle. Essentially, specific strategies regarding an asset's management may depend on how advanced it is in its economic life cycle.

Finally, resource organisations may need to focus more heavily on promoting stakeholder connectivity and involve them in decision making when an asset is in its planning phase. When a similar asset is in its operational and maintenance phase, it may be appropriate to consider technological absorptive capabilities to optimise that asset's performance. Consequently, while specific strategic approaches require designing according to their developmental phases, certain strategies will be universally shared and overlapping irrespective of which phase they are in. An example of this is the need for integrated information management, irrespective of which phase of the life cycle the asset is in.

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Appendices

Appendix A: Introductory Letter (In-Depth Interview)

ASSET MANAGEMENT RESEARCH INTERVIEW

PHD RESEARCH

PARTICIPANT INFORMATION SHEET

INFORMATION AND PURPOSE:

THE INTERVIEW, FOR WHICH YOU ARE BEING ASKED TO PARTICIPATE IN, IS A PART OF A RESEARCH STUDY THAT IS FOCUSED ON DEVELOPMENT OF AN ASSET MANAGEMENT FRAMEWORK FOR THE OIL AND GAS INDUSTRY.

AIM OF STUDY

THE PURPOSE OF THIS STUDY IS TO INVESTIGATE THE CHALLENGES AND OBSTACLES FOR ASSET MANAGEMENT IN THE OIL & GAS INDUSTRY. THE STUDY AIMS TO DETERMINE THE KEY MANAGERIAL CHALLENGES OF MANAGING PHYSICAL ASSETS AND TO FIND THE SOLUTIONS REQUIRED TO PROVIDE VALUE AND CONTINUED ASSET PERFORMANCE. THE INTERVIEW QUESTIONS WILL INCLUDE AREAS ABOUT ASSET STRATEGY, ASSET MANAGEMENT TOOLS, CHALLENGES, RISKS, AND BUSINESS CONTINUITY.

YOUR PARTICIPATION:

PARTICIPATION IN THIS RESEARCH IS VOLUNTARY. YOUR PARTICIPATION IN THIS RESEARCH WILL CONSIST OF AN INTERVIEW LASTING APPROXIMATELY FOURTY-FIVE MINUTES. YOU WILL BE ASKED A SERIES OF QUESTIONS ABOUT YOUR ORGANISATION'S POLICIES. YOU ARE NOT REQUIRED TO ANSWER ALL THE QUESTIONS. YOU MAY PASS OVER ANY QUESTION THAT MAKES YOU FEEL UNCOMFORTABLE. AT ANY TIME YOU MAY NOTIFY THE RESEARCHER THAT YOU WOULD LIKE TO STOP THE INTERVIEW AND YOUR PARTICIPATION IN THE RESEARCH. THERE ARE NO PHYSICAL RISKS ASSOCIATED WITH YOUR PARTICIPATION IN THIS RESEARCH. THERE IS NO PENALTY FOR DISCONTINUING PARTICIPATION.

BENEFITS:

THE MAIN BENEFIT OF YOUR PARTICIPATION IS TO CONTRIBUTE INFORMATION TO MY RESEARCH AND ADD TO THE KNOWLEDGE OF ACADEMIA. MY FINDINGS MAY ALSO BE USED TO IMPROVE ASSET MANAGEMENT IN THE OIL & GAS INDUSTRY. THIS RESEARCH MAY ALSO REVEAL NEW ASPECTS. OTHER BENEFITS MAY INCLUDE AN ASSET MANAGEMENT FRAMEWORK THAT WILL BE FRIENDLY TO THE ENVIRONMENT.

CONFIDENTIALITY:

THE INTERVIEW WILL BE RECORDED WITH YOUR PERMISSION. HOWEVER, YOUR NAME WILL NOT BE RECORDED. YOUR NAME AND IDENTIFYING INFORMATION WILL NOT BE ASSOCIATED WITH ANY PART OF THE WRITTEN REPORT OF THE RESEARCH. ALL OF YOUR INFORMATION AND INTERVIEW RESPONSES WILL BE KEPT CONFIDENTIAL. THE RESEARCHER WILL NOT SHARE YOUR INDIVIDUAL RESPONSES WITH ANYONE OTHER THAN THE RESEARCH SUPERVISOR.

IF YOU HAVE ANY QUESTIONS OR CONCERNS, PLEASE CONTACT THE CURTIN UNIVERSITY RESEARCH COMMITTEE HTTP://RESEARCH.CURTIN.EDU.AU/ETHICS/HUMAN.CFM OR MY SUPERVISOR PROFESSOR MOHAMMED QUADDUS M.QUADDUS@CURTIN.EDU.AU

THIS STUDY HAS BEEN APPROVED UNDER CURTIN UNIVERSITY'S PROCESS FOR LOWER-RISK STUDIES. THIS PROCESS COMPLIES WITH THE NATIONAL STATEMENT ON ETHICAL CONDUCT IN HUMAN RESEARCH.

FOR FURTHER INFORMATION ON THIS STUDY CONTACT THE RESEARCHERS NAMED ABOVE OR THE CURTIN UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE. C/- OFFICE OF RESEARCH AND DEVELOPMENT, CURTIN UNIVERSITY, GPO BOX U1987, PERTH 6845 OR BY TELEPHONING 9266 9223 OR BY EMAILING HREC@CURTIN.EDU.AU.

YOU ARE ENCOURAGED TO ASK QUESTIONS OR RAISE CONCERNS AT ANY TIME ABOUT THE NATURE OF THIS RESEARCH OR THE MEANS OF THE INTERVIEW PROCESS.

WITH YOUR PERMISSION, OUR DISCUSSION WILL BE RECORDED TO HELP ACCURATELY CAPTURE YOUR INSIGHTS IN YOUR OWN WORDS; AND WILL ONLY BE HEARD BY THE RESEARCH STUDENT WHO WILL INTERVIEW YOU AND THE SUPERVISOR (IF REQUIRED). IF YOU FEEL UNCOMFORTABLE WITH THE RECORDING, YOU MAY ASK THAT IT BE TURNED OFF AT ANY TIME.

YOU ALSO HAVE THE RIGHT TO WITHDRAW FROM PARTICIPATING IN THIS RESEARCH AT ANY TIME.

AHMED MOHSEN BASWAID
PHD RESEARCH STUDENT
CURTIN BUSINESS SCHOOL
CURTIN UNIVERSITY

Curtin University

Appendix B: Consent Form

Asset Management Research Interview

Interview Consent Form

I am satisfied with the information provided and am willing to participate in this research interview on Asset Management.

I understand the purpose of the interview is to gather information on designing an Asset Management Framework for the Oil & Gas sector.

I understand that this research is to assist Oil & Gas companies to improve their operation efficiency and take care of the environment.

I furthermore allow the use of a voice recording device to record my answers to facilitate analysis. I understand that this information will only be used for this research purpose and its objectives.

I understand that I can terminate and withdraw from this interview at any time.

I understand that I can ask questions or raise concerns at any time about the nature of the research or the means of the interview process.

By signing this consent form I certify that I _____ agree to the terms of this agreement.

_____ _____

(Signature) (Date)

_____

Company Name

Company Address

Appendix C: Ethical research guidelines (First Phase)

Standard conditions of ethics approval

These standard conditions apply to all research approved by the Curtin University Human Research Ethics Committee. It is the responsibility of each researcher named on the application to ensure these conditions are met.

1. **Compliance.** Conduct your research in accordance with the application as it has been approved and keep appropriate records.
    a. **Monitoring** - Assist the Committee to monitor the conduct of the approved research by completing promptly and returning all project review forms that are sent to you.
    b. **Annual report** - Submit an annual report on or before the anniversary of the approval.
    c. **Extensions** - If you are likely to need more time to conduct your research than is already approved, complete a new application six weeks before the current approval expires.
    d. **Changes to protocol** - Any changes to the protocol are to be approved by the Committee before being implemented.
    e. **Changes to researcher details** - Advise the Committee of any changes in the contact details of the researchers involved in the approved study.
    f. **Discontinuation** - You must inform the Committee, giving reasons, if the research is not conducted or is discontinued before the expected completion date.
    g. **Closure** - Submit a final report when the research is completed. Include details of when data will be destroyed, and how, or if any future use is planned for the data.
    h. **Candidacy** - If you are a Higher Degree by Research student, data collection must not begin before your Application for Candidacy is approved by your Faculty Graduate Studies Committee.
2. **Adverse events.** Consider what might constitute an adverse event and what actions may be needed if an adverse event occurs. Follow the procedures for reporting and addressing adverse events (http://research.curtin.edu.au/guides/adverse.cfm).Where appropriate, provide an adverse events protocol. The following are examples of adverse events:
    a. Complaints
    b. Harm to participants. This includes physical, emotional, psychological, economic, legal, social and cultural harm (NS Section 2)
    c. Loss of data or breaches of data security
    d. Legal challenges to the research
3. **Data management plan.** Have a Data Management Plan consistent with the University's recordkeeping policy. This will include such things as how the data are to be stored, for how long, and who has authorised access.
4. **Publication.** Where practicable, ensure the results of the research are made available to participants in a way that is timely and clear (NS 1.5). Unless prohibited from doing so by contractual obligations, ensure the results of the research are published in a manner that will allow public scrutiny (NS 1.3, d). Inform the Committee of any constraints on publication.
5. **Police checks and other clearances.** All necessary clearances, such as Working with Children Checks, first aid certificates and vaccination certificates, must be obtained before entering a site to conduct research.
6. **Participant information.** All information for participants must be approved by the HREC before being given to the participants or made available to the public.
    a. **University logo.** All participant information and consent forms must contain the Curtin University logo and University contact details for the researchers. Private contact details should not be used.
    b. **Standard statement.** All participant information forms must contain the HREC standard statement.
    This study has been approved under Curtin University's process for lower-risk Studies (Approval Number xxxx). This process complies with the National Statement on Ethical Conduct in Human Research (Chapter 5.1.7 and Chapters 5.1.18-5.1.21).
    For further information on this study contact the researchers named above or the Curtin University Human Research Ethics Committee. c/- Office of Research and Development, Curtin University, GPO Box U1987, Perth 6845 or by telephoning 9266 9223 or by emailing hrec@curtin.edu.au.
    c. **Plain language.** All participant information must be in plain language that will be easily understood by the participants.

Please direct all communication through the your Form C Ethics Co-ordinator.

* Form C Coordinator cannot not approve amendment request, these must be approved by a Form C reviewer.

Appendix D: Interview guide questions (First Phase)

1. **Respondent personal details**
   I. What is your job title?

   II. What is your primary role?

   III. How many years in a similar role?

2. **About the organisation**
   I. What are the strategic objectives of the company?

   II. Can you please explain briefly about the organisational structure of your department?

   III. Do you have an existing Asset Management Framework in your organisation?

   IV. Can you please explain further?

   V. Would you be able to align the strategic objectives of your organisation with Strategic Procurement policies in your department? If yes – how? If not – please explain.

   VI. Would you be able to align the strategic objectives of your organisation with Asset Management policies in your department/organisation? If yes – how? If not – please explain.

3. **About Strategic Procurement:**
   I. Does your company have well established and documented Strategic Procurement policies?

   II. If no - Can you, please explain more?

   III. If yes - How are these Strategic Procurement policies developed?

   IV. Are these policies developed in relation to Asset Management?

   V. If, not, why not? Were there any challenges, difficulties?

   VI. If yes – can you please provide more details

   VII. If any difficulties, how were those issues solved?

VIII. What were the main challenges to create procurement policies for Asset Management?

IX. Do you think Strategic Procurement can add significant value to Asset Management?

X. If yes, to what extent? If not, can you please explain why not?

XI. In terms of inter-department communications: How often do Asset Management personnel communicate with strategic procurement department and/or vice versa?

XII. Can you please explain if there were any challenges or issues in communications?

Next I would like to ask about Business Continuity in your department.

I. Are Strategic Procurement policies linked to Business Continuity strategy?

II. If yes - can provide some examples?

III. If no – can you please explain?

IV. Do you see Business Continuity as important in your department/organisation? Please explain.

V. What role can you foresee Business Continuity playing a major role in Asset Management?

4. About Asset Management

I. Who manages the asset management/maintenance program?

II. Can you please explain if there are any specific reasons for that role?

III. Are there any benefits of that?

IV. Are there any risks associated with that?

V. In terms of asset reliability - How reliability are the current physical assets?

VI. Are there any monitoring activities of these assets? Please provide more details.

VII. Are there any issues and challenges in this monitoring process?

5. About Supply Risk

I. How do you view supply risk for older assets?

II. How critical do you think Supply Risk is, in your organisation?

III. Can you please explain a bit about your organisation's Supply Risk policies?

IV. If you don't have such a policy, are there plans to establish one?

V. How would you go about establishing a new Supply Risk policy?

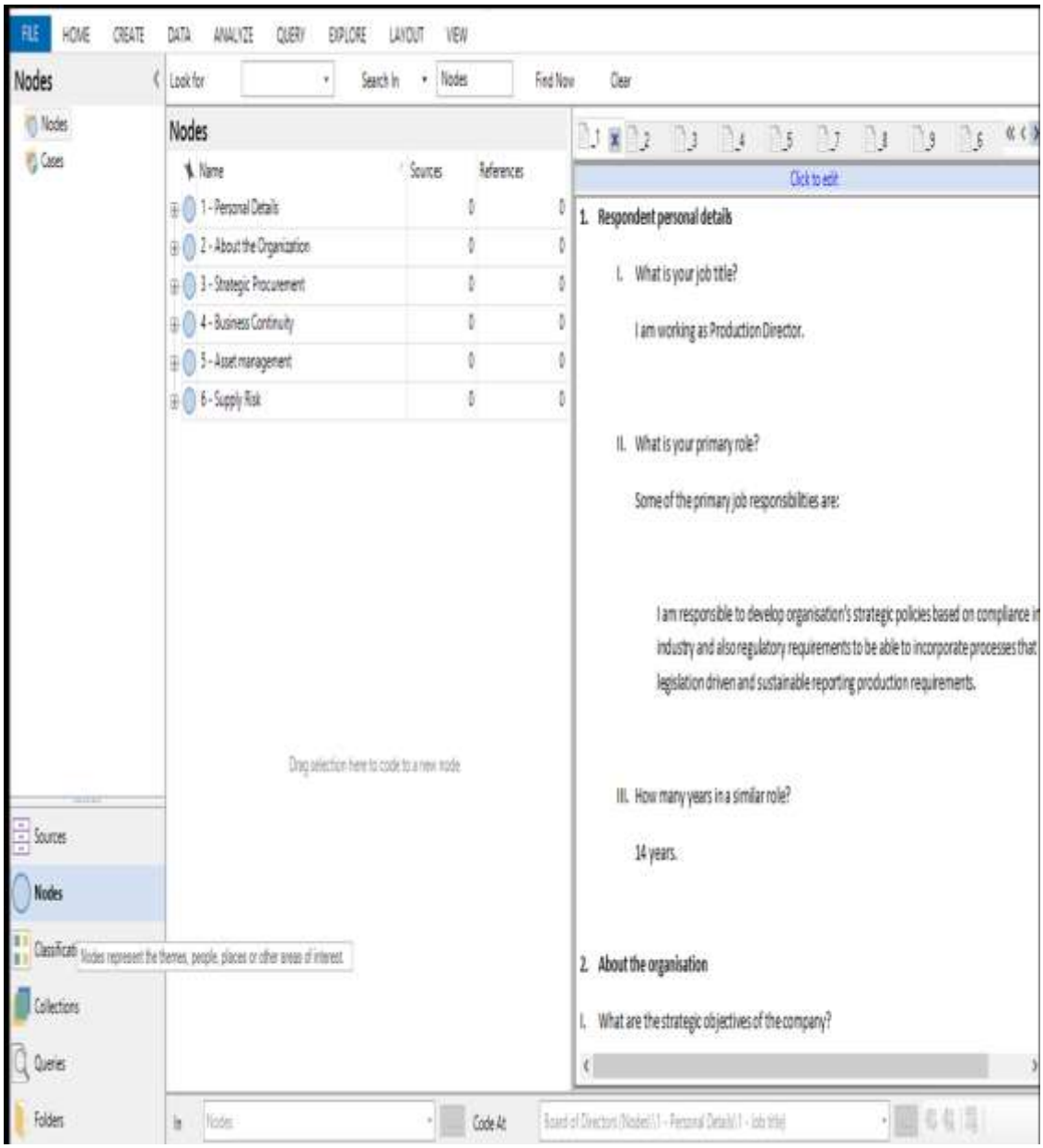
VI. Would you relate these policies to Asset Management and Strategic Procurement?

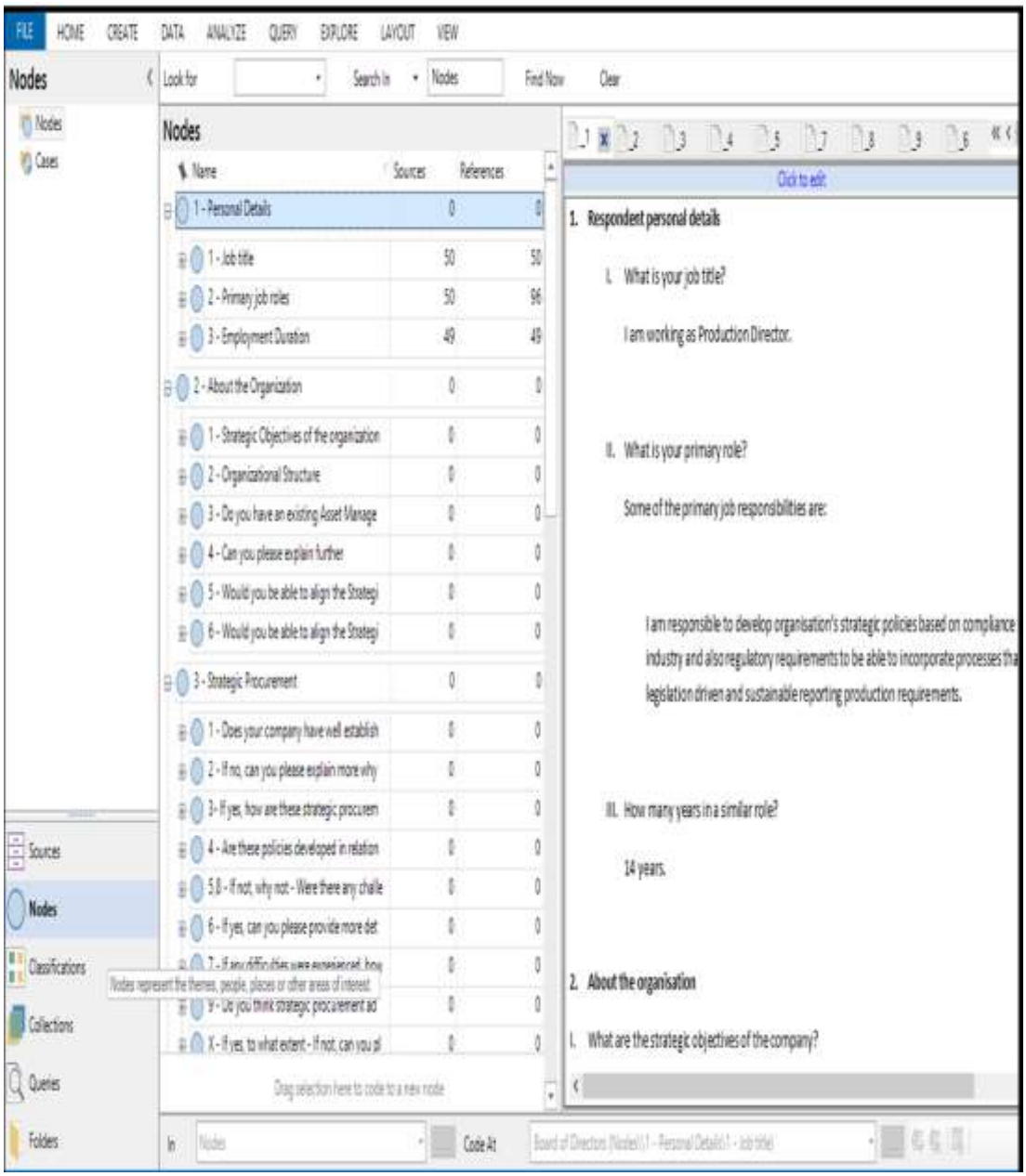
VII. If yes – please explain more.

VIII. If not, why not?

IX. How often do you think is best to forecast supply risk?

Appendix E: NVivo Screenshots (First Phase)

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1 - Personal Details
1 - Job title
2 - Primary job roles
3 - Employment Duration
2 - About the Organization
1 - Strategic Objectives of the organization
2 - Organizational Structure
3 - Do you have an existing Asset Manage
4 - Can you please explain further
5 - Would you be able to align the Strategi
6 - Would you be able to align the Strategi
3 - Strategic Procurement
1 - Does your company have well establish
2 - If no, can you please explain more why
3- If yes, how are these strategic procurem
4 - Are these policies developed in relation
5.B - If not, why not - Were there any challe
6 - If yes, can you please provide more det
Click to edit
1. Respondent personal details
I. What is your job title?
I am working as Production Director.
II. What is your primary role?
Some of the primary job responsibilities are:
I am responsible to develop organisation's strategic policies based on compliance
industry and also regulatory requirements to be able to incorporate processes tha
legislation driven and sustainable reporting production requirements.
III. How many years in a similar role?
14 years.
2. About the organisation
I. What are the strategic objectives of the company?
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Queries
Folders
Nodes represent the themes, people, places or other areas of interest
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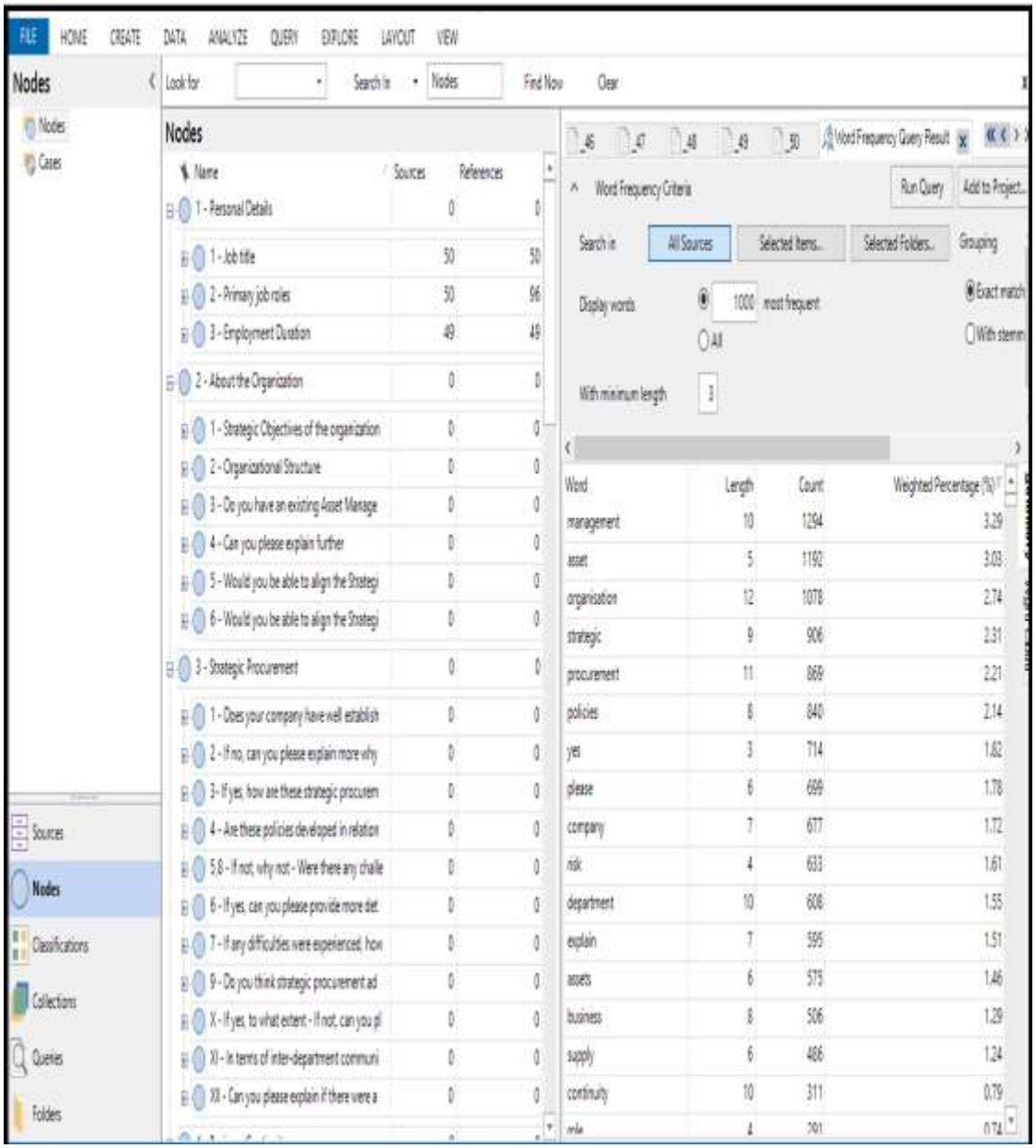
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1 - Personal Details
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2 - Organizational Structure
3 - Do you have an existing Asset Manage
4 - Can you please explain further
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6 - Would you be able to align the Strategi
3 - Strategic Procurement
1 - Does your company have well establish
2 - If no, can you please explain more why
3 - If yes, how are these strategic procurem
4 - Are these policies developed in relation
5 8 - If not, why not - Were there any challe
6 - If yes, can you please provide more det
7 - If any difficulties were experienced, how
9 - Do you think strategic procurement ad
X - If yes, to what extent - If not, can you pl
XI - In terms of inter-department communi
XII - Can you please explain if there were a
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Queries
Folders
Word Frequency Query Result
Word Frequency Criteria
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Exact match
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Length
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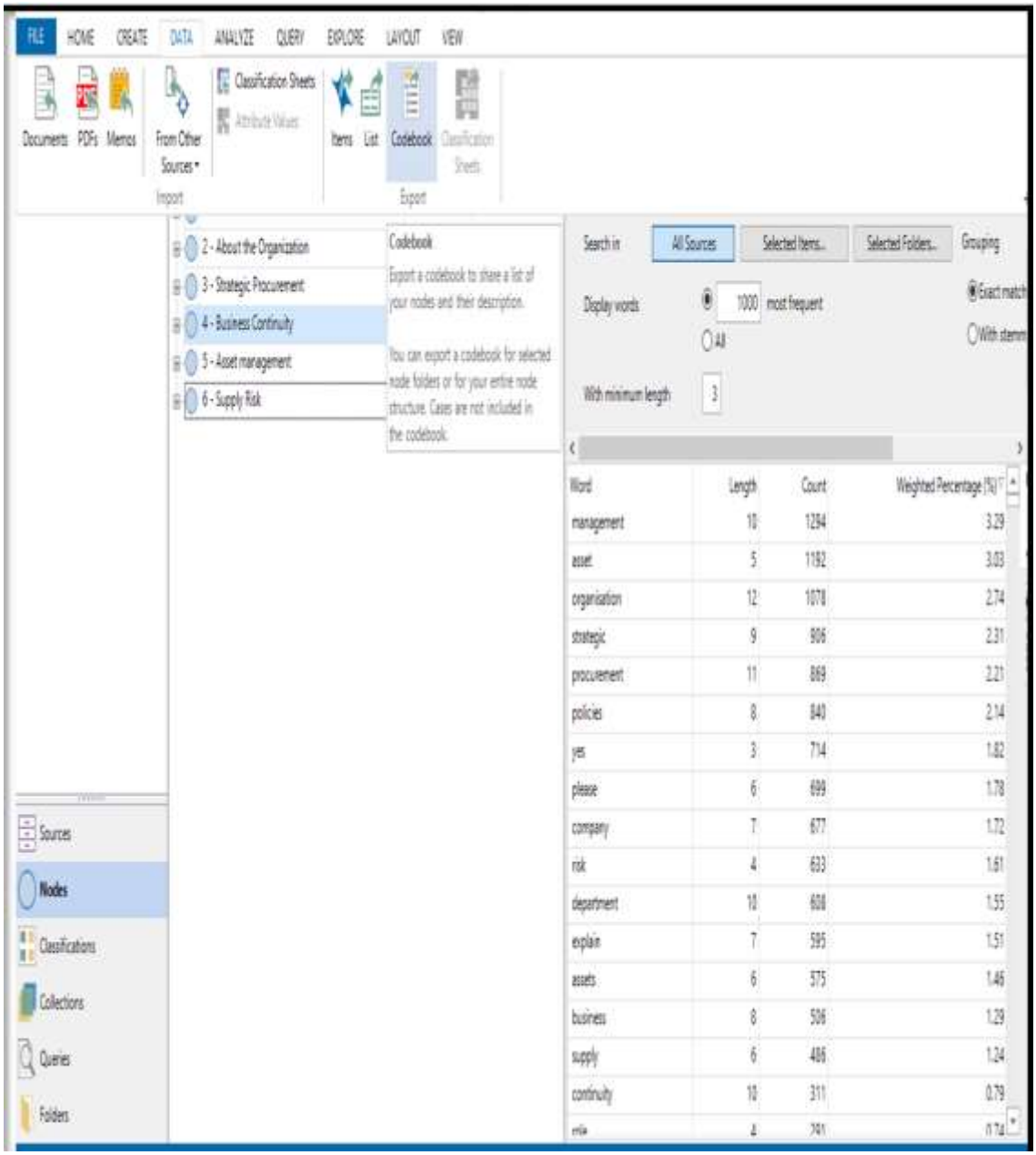
Weighted Percentage (%)
management 10 1294 3.29
asset 5 1192 3.03
organisation 12 1078 2.74
strategic 9 906 2.31
procurement 11 869 2.21
policies 8 840 2.14
yes 3 714 1.82
please 6 699 1.78
company 7 677 1.72
risk 4 633 1.61
department 10 608 1.55
explain 7 595 1.51
assets 6 575 1.46
business 8 506 1.29
supply 6 486 1.24
continuity 10 311 0.79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Attribute Values
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Codebook
Classification Sheets
Import
Export
2 - About the Organization
3 - Strategic Procurement
4 - Business Continuity
5 - Asset management
6 - Supply Risk
Codebook
Export a codebook to share a list of your nodes and their description.
You can export a codebook for selected node folders or for your entire node structure. Cases are not included in the codebook.
Search in
All Sources
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Selected Folders...
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Weighted Percentage (%)
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asset 5 1182 3.03
organisation 12 1078 2.74
strategic 9 906 2.31
procurement 11 869 2.21
policies 8 840 2.14
yes 3 714 1.82
please 6 699 1.78
company 7 677 1.72
risk 4 633 1.61
department 10 608 1.55
explain 7 595 1.51
assets 6 575 1.46
business 8 508 1.29
supply 6 486 1.24
continuity 10 311 0.79
Sources
Nodes
Classifications
Collections
Queries
Folders

Appendix F: Asset management codebook

Name	Description	Sources	References
❖ Personal Details		0	0
1 - Job title		50	50
Board of Directors		23	23
Board of Management		27	27
2 - Primary job roles	What is your primary role?	50	96
Board of Directors		23	49
Asset management		4	4
Business continuity		3	3
Customer Relationship Management (CRM)		1	1
Engineering		5	6
Human, Safety & Environmental impact (HSE)		3	3
Infrastructure management		3	3
Production & operations		8	8
Regulatory frameworks		4	4
Risk management		5	5
Staff training & mentorship		2	2
Strategic procurement		5	6
Supplier management		4	4
Board of Management		27	47
Act as a representative between the board and the management (CEOs)		5	5

Asset management		2	2
Business development		3	3
Communications coordination		1	1
Developing business plans		4	4
Engineering		3	3
IT management		3	3
Leadership provision		1	1
Oversee operations for entire organisation		7	7
Production & operations		6	6
Project management		3	3
Regulatory compliance		1	1
Risk management		4	4
Senior management		0	0
Supply chain management		4	4
3 - Employment Duration	How many years in a similar role?	49	49
0-5 years		0	0
11-15 years		26	26
16-20 years		3	3
21-25 years		7	7
6-10 years		13	13
❖ About the Organisation		0	0
1 - Strategic Objectives of the organisation		0	0
Better HSE compliance		6	7

Enhanced quality of products and services		8	8
Enhanced workforce development culture		9	9
Improved internal organisational setup		2	2
Increased brand promotion & global presence		21	21
Increased business alliances		10	10
Increased production & exploration		22	23
Increased profits & revenue		7	7
Increased technology innovation		6	6
To exceed stakeholder expectations		8	8
2 - Organisational Structure		0	0
Corporate governance		0	0
Board of Directors		22	31
Board of Management		21	44
Subordinate departments & staff		0	0
Accounting		1	1
Administrations		3	3
Assets integrity		1	1
Automation Department		1	1
Brand management		1	1
Business Development		1	1
Cards		1	1
Communications		2	2

	Compliance		1	1
	Consultancy services		4	5
	Corrosion control		2	2
	Credit committees		0	0
	CRM		1	1
	Digital Oilfield Resource Management		1	1
	Drilling		2	2
	Engineering		15	15
	Finance		5	5
	Health, Safety, & Environment analysis		1	1
	Human Resource		6	6
	Information Technology		10	12
	Infrastructure Development		1	1
	Instrumentation & Project Controls Department		1	1
	Integration Services Management		1	1
	Internal audit		2	2
	Labours		4	5
	Leak Detection		1	1
	Legal department		4	4
	Logistics		2	2
	Manufacturing		6	6
	Marketing		4	4
	Operations		13	13

Piping & Static		1	1
Process and plants		4	5
Production & exploration		5	5
Project management		1	1
Quality control		2	2
Refinery		1	1
Research & development		3	3
Risk management		2	2
Sales and retail		2	2
Supply chain management		4	4
Training and organisational development		2	2
Treasury		3	3
Value park		3	3
Wire line department		1	1
3 - Do you have an existing Asset Management Framework in your organisation		0	0
Yes		50	50
Delivery methodology		2	2
Google Drive - Share Point		3	3
In-house EAM portals - Spreadsheets		27	27
4 - Can you please explain further		0	0
Delivery methodology		0	0
It is regularly updated		1	1
Google Drive - Share Point		0	0

Problems		2	2
Does not simplify work		1	1
Lack of leadership decision's making		1	1
Uses		2	2
Inventory control		2	2
In-house EAM portals		0	0
Problems		10	11
Framework does not simplify work		1	1
It is old-fashioned and very basic		3	4
Lack of highly skilled professionals		1	1
Lack of international frameworks		1	1
Systems non-integration		4	4
Usage		22	27
Compliance, surveillance and governance		2	2
Engineering operations		1	1
Financial control		1	1
For project use		1	1
Inventory control		16	16
Model optimisation		1	1

Recovery management of assets		1	1
Risk management		1	2
Simulation purposes		1	1
Strategic procurement		1	1
5 - Would you be able to align the Strategic Objectives of your organisation with Strategic Procurement policies in your department		0	0
Yes		42	42
If yes, how		0	0
Alignment methodology		3	3
Developed by the organisation's oversight committee		1	1
Excessive planning of the policies		1	1
Stipulated by the Ministry of Oil and Gas		1	1
Benefits		29	33
Better audits		1	1
Better supplier management		2	2
Higher attainment of company goals		11	11

Improved asset procurement		9	9
Minimised operational risks		3	3
Smooth decision making		1	1
Smooth operations		5	5
Sustainable and ethical policies		1	1
6 - Would you be able to align the Strategic Objectives of your organisation with Asset Management policies in your department or organisation		0	0
No		8	8
If no, please explain		8	9
AM function is outsourced		2	2
AM is still a new concept		3	3
Company lacks AM framework		1	1
Policies still under development		1	1
Poor capacity management		1	1
Reluctance to change		1	1
Yes		22	23
If yes, please explain		0	0
Alignment methodology		2	2

Through careful capacity planning		1	1
Through detailed monitoring of organisation's assets		1	1
Benefits		26	31
Better asset service delivery		1	1
Higher attainment of company's goals		5	5
Higher market share		2	2
Higher return on investments		3	3
Improved asset performance		5	5
Increased workforce engagement		1	1
Minimised risks		2	2
Operational excellence		9	9
Smooth decision making		3	3
❖ Strategic Procurement		0	0
1 - Does your company have well established and documented Strategic Procurement policies		0	0
No		0	0
Yes		50	50

2 - If no, can you please explain more why		0	0
Not applicable		41	41
3- If yes, how are these strategic procurement policies developed		0	0
Managed by organisation – Autonomous		22	22
Advantages		11	11
Fulfil stakeholders' expectations		3	3
Increased profits & revenue		4	4
Smoother procurement procedures		3	3
Smoother production & exploration		1	1
Regulated by the State - Restrictive		0	0
Categories		0	0
Governed by the Ministry of Oil & Gas		12	12
Policies in line with the Public Procurement Regulatory Authority		8	8
4 - Are these policies developed in relation to Asset Management		0	0
No		23	23
Some but not all policies		7	7
Yes		20	21

5,8 - If not, why not - Were there any challenges, difficulties		0	0
Examples of challenges experienced		41	98
Asset-related challenges		28	45
AM framework is new, not comprehensive		5	5
AM function outsourced		1	1
Lack of clear standard policies for AM		26	37
Systems non-integration		2	2
Coordination		14	17
Both departments work independently of each other		13	16
Geographical distance between departments		1	1
Procurement		17	24
Ambiguous regulations		4	6
Inadequate regulations		1	1
Insufficient policies on quality control		2	2
Lack of autonomy in policies regulated by the State		9	12

Need for international standards		1	1
Unable to estimate procurement needs		2	2
Staff		8	8
Inadequate training		1	1
Poor task allocation		1	1
Shortage of skilled staff		6	6
Suppliers		4	4
Difficult supplier selection & management		1	1
Loose data confidentiality		3	3
6 - If yes, can you please provide more details		0	0
Alignment methodology		1	1
Through coordination of cross functional teams		1	1
Benefits of aligning them		15	18
Better decision-making processes		1	1
Business improvement		1	1
Helps achieve company's strategic objectives		3	3
Higher return on investments		2	2
Improved asset management processes		3	3
Improved service delivery		2	2

Increased oversight & accountability		2	2
Increased quality assurance		4	4
7 - If any difficulties were experienced, how were they solved		0	0
Solutions implemented		13	17
Increased communication & dialogue		3	3
Increased consultation		5	6
Increased employee engagement		1	1
On-the-fly access to regulations		1	1
Systems integration		3	3
Through embracing change		3	3
The solutions have not yet been implemented		4	4
They are still under consideration		4	4
9 - Do you think strategic procurement add significant value to asset management		0	0
No		7	7
Yes		42	42
X - If yes, to what extent - If not, can you please why not		0	0
If no, can you please explain why not		3	3

Both functions are independent of each other		3	3
If yes, to what extent		29	36
Better maintenance of records		2	2
Better monitoring of asset life cycle		3	3
Better planning for inventory control		14	14
Better regulatory compliance		3	3
Enhanced risk management		2	2
Enhanced service quality		3	3
Improved relationships with suppliers		2	2
Increased cost effectiveness		4	4
Reduced tendency to work in silos		3	3
XI - In terms of inter-department communications - How often do Asset Management personnel communicate with Strategic Procurement department and vice versa		0	0
A bit frequently (quarterly)		2	2
Not at all		1	1
Rarely		22	22
Very frequently		25	25

XII - Can you please explain if there were any challenges or issues in communication?		0	0
No, there were no challenges		25	25
Examples		0	0
Both departments are in the same wing		1	1
They communicate frequently		1	1
Yes, they were challenges		22	24
Examples		22	24
AM function outsourced		1	1
Both departments are independent of each other		10	10
Geographical distance		3	3
Systems non-integration		10	10
❖ Business Continuity		0	0
1 - Are strategic procurement policies linked with business continuity strategy		0	0
No		32	32
Yes		13	14
2 - If yes - can you provide some examples		0	0
Examples of benefits		7	8
Enhanced quality engineering		1	1
Enhanced risk mitigation		3	3

Improved asset procurement procedures		2	2
Increased business sustainability		1	1
Simplicity in supply chains		1	1
3 - If no – can you please explain		0	0
Reasons		36	66
BCP concept still very new		5	5
No BCP strategy hence it is not significant		33	42
Other strategies already in place - risk management		19	19
4 - Do you see business continuity as important in your organisation		0	0
No		20	20
Reasons		16	16
Other strategies besides BCP already exist		16	16
Yes		12	12
Reasons		14	17
Better risk analysis		4	4
Disaster recovery		4	4
Enhanced job security		2	2
Helps achieve company's goals and vision		1	1
Round-the-clock monitoring		1	1

Smoother operational measures		2	2
Stabilises company's share price		2	2
Timely deliverables		1	1
5 - What role can you foresee Business Continuity playing a major role in Asset Management		0	0
A highly significant role		16	16
Reasons		11	13
Continued operations		3	3
Enhanced procurement planning		1	2
Enhanced risk management		4	4
Ensures all infrastructure are in place		3	3
Improved relationship with suppliers		1	1
No significant role		20	20
Reasons		9	9
BCP is external to the organisation		2	2
No relation between BCP & AM		4	4
There already is risk management		3	3
❖ Asset management		0	0

1 - Who manages the asset management-maintenance program		0	0
Compliance & Regulatory Department		2	2
Engineering Support Department		6	6
Facilities Asset department		2	2
Maintenance Department		9	9
Operations Department		18	18
Outsourced company		2	2
Procurement Department		1	1
Quality Control		3	3
Risk Management Department		1	1
2, 3 - Can you please explain if there are any specific reasons for that role		0	0
No, there are no reasons for this		27	34
Reasons		15	17
It is just part of hierarchical structuring		15	17
Yes, there are specific reasons for that		27	39
Compliance & Regulatory Department		2	5
AM roles are handled by the proper departments who have high-skilled experts		1	1

Obsolescence management of assets		1	1
Regular auditing		1	1
Tasked with asset life cycle activities		1	1
Timely replacement of assets		1	1
Engineering Department		3	4
Enhanced asset health		1	1
It is their job		1	1
Reduced maintenance costs		1	1
Well-versed with assets physical conditions		1	1
Facilities Asset Department		2	3
Better analysis of capital plan		1	1
Increased accountability		1	1
Owners of asset service deliveries		1	1
Maintenance Department		4	5
All-time round asset availability		1	1
Regular asset maintenance		2	2
Operations Department		11	14

Asset monitoring & maintenance		4	4
Enhanced risk management		1	1
Enhances utilisation of company resources		1	1
It is mandated by the State		2	2
It is their job		2	2
Roles handled by experts		4	4
Outsourced company		4	4
Helps to obtain the required skill set		2	2
Lack of in-house capabilities		2	2
Procurement department		3	3
Improved correspondence with suppliers		2	2
It is their job		1	1
Quality control		1	1
To expand asset life cycle		1	1
4 - Are there any risks associated with that		0	0
No, there are no risks		26	26
Reasons		4	4
It is the most suitable method		4	4
Yes, there are risks		0	0

Examples		14	18
Maintenance Department		1	2
Incorrect usage of assets		1	1
Risk of injuries		1	1
Operations Department		8	9
Over-dependency on Ministry of Oil & Gas		3	3
Over-dependency on Operations department		3	3
Works in isolation		3	3
Outsourced companies		4	5
Exposure of confidential data		2	2
Higher cost risk, delivery time, and quality control		1	1
Over-dependency on outsourced company		2	2
Procurement Department		1	1
Over-dependency on		1	1

Procurement department			
Risk Management Department		1	1
Improper risk management		1	1
5 - In terms of asset reliability, how reliable are the current physical assets		0	0
Assets are not so reliable		2	2
Reasons		17	20
Ageing of assets		4	4
Difficulties in maintaining asset integrity		2	2
Difficulties in reducing warehouse overheads		1	1
Inadequate demand forecasting		2	2
Need for Reliability Excellence		2	2
Poor asset disposal		1	1
Poor asset maintenance		3	3
Reluctance to change		5	5
The asset reliability is excellent		10	10
Reasons		23	27
AM is a visionary tool		1	1
Implementation of reliability management		3	3

It is environmentally friendly		1	1
It is in line with compliance processes		2	2
Proper maintenance		8	10
Regular audits, inspections, & evaluations		8	8
There are functional improvement lead teams		1	1
There is effective communication		1	1
6 - Are there any monitoring activities of these assets		0	0
Yes		3	3
How often is the monitoring		0	0
Annually		4	4
Bi-monthly		1	1
Daily		2	2
Monthly		1	1
Quarterly		1	1
Types of tools used		0	0
Bar coding		1	1
Enterprise portal spreadsheets		35	35
Google drive share point		5	5

7 - Are there any issues and challenges in this monitoring process		0	0
Yes		5	5
Examples		44	98
Business continuity related challenges		1	1
Need for a Business Continuity Plan		1	1
Leadership		16	16
Poor leadership		16	16
Regulations		9	11
Basic regulations		1	1
Complex regulations		6	7
Inadequate regulations		2	2
Poor compliance		1	1
Supplier issues		4	4
Difficult supplier selection		1	1
Difficult to maintain good relationships with suppliers		3	3
Systems non-integration		24	41
Data inaccuracy		7	7

Decentralisation of systems		10	12
Poor data accessibility (real-time)		8	9
Poor recording of data		3	3
Urgent need for integration		10	10
Usage of manual tools		13	13
Causes divided monitoring cycles		2	2
Frameworks not user-friendly		2	2
Need for better information management		1	1
Need for hand-held PCs		1	1
Requires outsourcing which is expensive		3	3
Technological incompetency		1	1
Workforce		11	12
Poor employee engagement		2	3
Poor role allocation		1	1

Shortage of skilled manpower		8	8
❖ Supply Risk		0	0
1 - How do you view supply risk for older assets		0	0
Explanation		16	21
Assets should be regularly monitored		1	1
It's hard to control supply risks for older assets		1	1
Risk of supplier being able to follow through		1	1
There should a proper asset maintenance plan		7	7
There should be proper asset disposal		5	5
There should be regular monitoring of assets		6	6
2 - How critical do you think Supply Risk is in your organisation		0	0
Critical		22	29
Examples		5	5
Helps attain geographical scalability		1	1
Helps manage external risks		2	2
Proper supplier selection		1	1
Timely asset procurement		1	1

Not critical		19	24
Reasons		3	3
Assets obtained are always new		1	1
No assets have ever been obsolete		1	1
There is always new technology		1	1
3 - Can you please explain a bit about your organisation's Supply Risk policies		0	0
The supply risk policies in place are inefficient		1	1
Reasons		1	1
They poorly define asset disposal measures		1	1
There are no supply risk policies in place		44	75
Reasons		33	52
Organisations use risk management policies instead		33	52
There are well-established supply risk policies in place		5	5
Explanation		3	3
Help enforce proper supplier management		3	3
4 - If you do not have such a policy, are there plans to establish one		0	0
No		43	73

Reasons		20	27
There already is another policy in place (Risk Management)		20	27
Yes		7	10
Reasons		1	1
To create more business value		1	1
5 - How would you go about establishing a new Supply Risk policy		0	0
Explanations		14	19
By considering all scenarios potential to risk		2	2
Consulting the audit team		1	1
Encouraging change preparedness		2	2
Encouraging contribution from all organisational departments		9	9
Ensuring policies are in line with company's strategic objectives		3	3
Seeking approval from top management		2	2
6 - Would you relate these policies to Asset Management and Strategic Procurement		0	0
No		20	31
Yes		30	40
7 - If yes – please explain more		0	0

Reasons		20	25
Better accountability structure		1	1
Better asset procurement		1	1
Better risk management		4	4
Development of the business continuity plan		1	1
Enables better planning		5	5
To be abreast with information about the assets		2	2
To better manage operational goals		2	2
To better monitor finances		3	3
To ensure safe operations		4	4
To meet all statutory regulatory requirements		1	2
8 - If not, why not		0	0
Reasons		5	5
AM & supply risk policies are independent of each other		4	4
The company lacks a dedicated management team		1	1
9 - How often do you think is best to forecast supply risk		0	0
Annually		14	14
Bi-annually		8	8
Bi-monthly		1	1

Every 3 years		1	1
Every now and then - ad-hoc or strategic		8	8
Monthly		5	5
Once every two months		1	1
Quarterly		11	11
Uncertain		3	3

Appendix G: Interview Transcript (Example)

1. Respondent personal details

I. What is your job title?

Managing Director.

II. What is your primary role?

- I am responsible to receive information from every site, regional offices and oil and gas exploration site to be able to make informed decisions for engineering site. There is a need to take appropriate decisions, action and other compliance related fiscal guidelines that have been established by the asset management department of the organisation keeping a record of asset monitoring.
- I am responsible to monitor the tasks that have been assigned not only to the district offices but also other exploration and production sites for oil and gas. There needs to have activities around fund balances and other financial activity related to exploration of oil and gas by the organisation.
- I am responsible to participate not only in meetings from the petroleum engineering department but also to conduct various workshops and other seminars and related activities aimed at gathering information which is then pushed out to relevant users and project stakeholders of the business.
- I am responsible to recommend changes that are reflected as part of business impact assessment for the organisation. The change control mechanism ensures monitoring the updates and outages used by the

asset management system uses the reporting mechanism for emergency situation. It is also imperative to ensure the management of response to the crisis plans. The aim of this system is to ensure the provision of the efficient and effective utilisation of project resources.

III. How many years in a similar role?

13 years.

2. About the organisation

I. What are the strategic objectives of the company?

The company's Executive Directors have planned the business strategy for the company to ensure that the company has not only gotten its presence in KSA, but the company is also capable of the sales and distribution through the operational plan in various locations of the world.

At the moment the company is increasing its land size which means enhancing upon its acreage position not only in KSA but also regions of the Gulf where its core operation is.

The Company strategy and set milestones for the organisation, the company tends to position its acreage in the KSA ensuring the extensive establishment and holding in the KSA region.

II. Can you please explain briefly about the organisational structure of your department?

Our business has various departments and division, to name a few:

1- HR

2- IT

3- Engineering

4- Government Affair

5- Value Park

6- PMO

7- Infrastructure

8- Operation

III. Do you have an existing Asset Management Framework in your organisation?

Yes. The company has a maturity model used from project management practices to ensure that the organisation has sufficient capability in place to deal with the management of assets in the organisation.

IV. Can you please explain further?

The Asset Management Framework in the Company has been implemented in-house using Microsoft keeping in view the requirement for the maintenance and configuration

V. Would you be able to align the strategic objectives of your organisation with Strategic Procurement policies in your department? If yes – how? If not – please explain.

I personally believe that in the project controls role at the Company so far, I have always noticed that the organisation and specifically the Executive have always made decisions that are in line with the strategic directions of the organisation, so is the case with the policies of the organisation. The

policies of the organisation are in line with the strategies of the organisation.

VI. Would you be able to align the strategic objectives of your organisation with Asset Management policies in your department/organisation? If yes – how? If not – please explain.

Yes. the strategic objectives of the organisation determine where the organisation would like to see it positioned in the market in the next 5-10 years. Different organisations have different business models and function according to those models and strategies and plan their operational goals accordingly.

The Company ensures that the trends followed in the oil & gas market in the KSA are kept under consideration at the time of planning company's strategic goals. Therefore, the Company has its asset management practices in line with the strategic procurement policies of the organisation, which is the need of time.

Appendix H: Introductory Letter (FGD)

DEVELOPMENT OF ASSET MANAGEMENT FRAMEWORK RESEARCH FOCUS GROUP

PHD RESEARCH

PARTICIPANT INFORMATION SHEET

THANK YOU FOR AGREEING TO TAKE PART IN THIS RESEARCH FOCUS GROUP AS PART OF THE LARGER RESEARCH PROJECT THAT IS FOCUSSING ON DEVELOPMENT OF AN ASSET MANAGEMENT FRAMEWORK SPECIFICALLY WITHIN THE OIL AND GAS INDUSTRY. THE FOCUS GROUP DISCUSSION SESSION WILL LOOK TO COVER THE TOPIC FROM DEBATING THE PROBLEM THROUGH TO CONSIDERING A PROPOSED FRAMEWORK.

THE SESSION IS DESIGNED TO ENSURE THAT ALL THE FOCUS GROUPS RETAIN A SYSTEMATIC AND STANDARD APPROACH THAT ENSURES SIMILARLY THAT GOES TOWARDS SUPPORTING THE RESEARCH FINDINGS FROM THE FIRST PHASE THAT CONDUCTED BY THE RESEARCHER EARLIER. THE SESSION IS NOT DESIGNED TO CONSTRAIN THE DEBATE AND DIVISIONS BUT SIMPLY TO RETAIN AN AGREED FOCUS AREA AND ENSURE CONTINUITY. THE FOLLOWING DISCUSSION POINTS ARE TO INFORM THE GROUP MEMBERS AHEAD OF TAKING PART TO ASSIST IN A FLUID PROCESS AND ENSURING EVERYONE'S TIME IS USED EFFECTIVELY. THE APPROACH WILL BE TO VALIDATE THE MAIN PROBLEMS SEEN BY THE PARTICIPANTS, DISCUSS THE OPTIONS AND THEN CONSIDER AND PROVIDE FEEDBACK ON THE FRAMEWORK PRESENTED TO THE GROUP(S). THE SESSIONS WILL BE RECORDED BY YOUR ORGANISATION TO ALLOW FOR A MORE DYNAMIC DISCUSSION AND AVOID STALLING DUE TO NOTE TAKING BY THE RESEARCHER WHO WILL HOST THE SESSIONS.

CONFIDENTIALITY:

THE DISCUSSION WILL BE RECORDED WITH YOUR PERMISSION. HOWEVER, YOUR NAME WILL NOT BE RECORDED. YOUR NAME AND IDENTIFYING INFORMATION WILL NOT BE ASSOCIATED WITH ANY PART OF THE WRITTEN REPORT OF THE RESEARCH. ALL OF YOUR INFORMATION AND RESPONSES WILL BE KEPT CONFIDENTIAL. THE RESEARCHER WILL NOT SHARE YOUR INDIVIDUAL RESPONSES WITH ANYONE OTHER THAN THE RESEARCH SUPERVISOR.

IF YOU HAVE ANY QUESTIONS OR CONCERNS, PLEASE CONTACT THE CURTIN UNIVERSITY RESEARCH COMMITTEE HTTP://RESEARCH.CURTIN.EDU.AU/ETHICS/HUMAN.CFM OR MY SUPERVISOR PROFESSOR MOHAMMED QUADDUS M.QUADDUS@CURTIN.EDU.AU

THIS STUDY HAS BEEN APPROVED UNDER CURTIN UNIVERSITY'S PROCESS FOR LOWER-RISK STUDIES. THIS PROCESS COMPLIES WITH THE NATIONAL STATEMENT ON ETHICAL CONDUCT IN HUMAN RESEARCH.

FOR FURTHER INFORMATION ON THIS STUDY CONTACT THE RESEARCHERS NAMED ABOVE OR THE CURTIN UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE. C/- OFFICE OF RESEARCH AND DEVELOPMENT, CURTIN UNIVERSITY, GPO BOX U1987,

PERTH 6845 OR BY TELEPHONING 9266 9223 OR BY EMAILING HREC@CURTIN.EDU.AU.

YOU ARE ENCOURAGED TO ASK QUESTIONS OR RAISE CONCERNS AT ANY TIME ABOUT THE NATURE OF THIS RESEARCH OR THE MEANS OF THE INTERVIEW PROCESS.

YOU ALSO HAVE THE RIGHT TO WITHDRAW FROM PARTICIPATING IN THIS RESEARCH AT ANY TIME.

AHMED MOHSEN BASWAID
PHD RESEARCH STUDENT
CURTIN BUSINESS SCHOOL
CURTIN UNIVERSITY

Curtin University

Appendix I: Ethical research guidelines (Second Phase)

Thank you for submitting an annual report to the Human Research Ethics Office for the project **Develop and Asset Management Framework in the Australian Oil and Gas Industry**.

The Human Research Ethics Office acknowledges the project is ongoing and approval will remain current until 10-Oct-2018.

Any special conditions noted in the original approval letter still apply.

Standard conditions of approval

1. Research must be conducted according to the approved proposal
2. Report in a timely manner anything that might warrant review of ethical approval of the project including:
   - proposed changes to the approved proposal or conduct of the study
   - unanticipated problems that might affect continued ethical acceptability of the project
   - major deviations from the HREC approved protocol procedures and/or regulatory guidelines
   - serious adverse events
3. Amendments to the proposal must be approved by the Human Research Ethics Office before they are implemented (except where an amendment is undertaken to eliminate an immediate risk to participants)
4. An annual progress report must be submitted to the Human Research Ethics Office on or before the anniversary of approval and a completion report submitted on completion of the project
5. Personnel working on this project must be adequately qualified by education, training and experience for their role, or supervised
6. Personnel must disclose any actual or potential conflicts of interest, including any financial or other interest or affiliation, that bears on this project
7. Changes to personnel working on this project must be reported to the Human Research Ethics Office
8. Data and primary materials must be retained and stored in accordance with the Western Australian University Sector Disposal Authority (WAUSDA) and the Curtin University Research Data and Primary Materials policy
9. Where practicable, results of the research should be made available to the research participants in a timely and clear manner
10. Unless prohibited by contractual obligations, results of the research should be disseminated in a manner that will allow public scrutiny; the Human Research Ethics Office must be informed of any constraints on publication
11. Ethics approval is dependent upon ongoing compliance of the research with the Australian Code for the Responsible Conduct of Research, the National Statement on Ethical Conduct in Human Research, applicable legal requirements, and with Curtin University policies, procedures and governance requirements
12. The Human Research Ethics Office may conduct audits on a portion of approved projects.

Should you have any queries regarding consideration of your project, please contact the Ethics Support Officer for your faculty or the Ethics Office at hrec@curtin.edu.au or on 9266 2784.

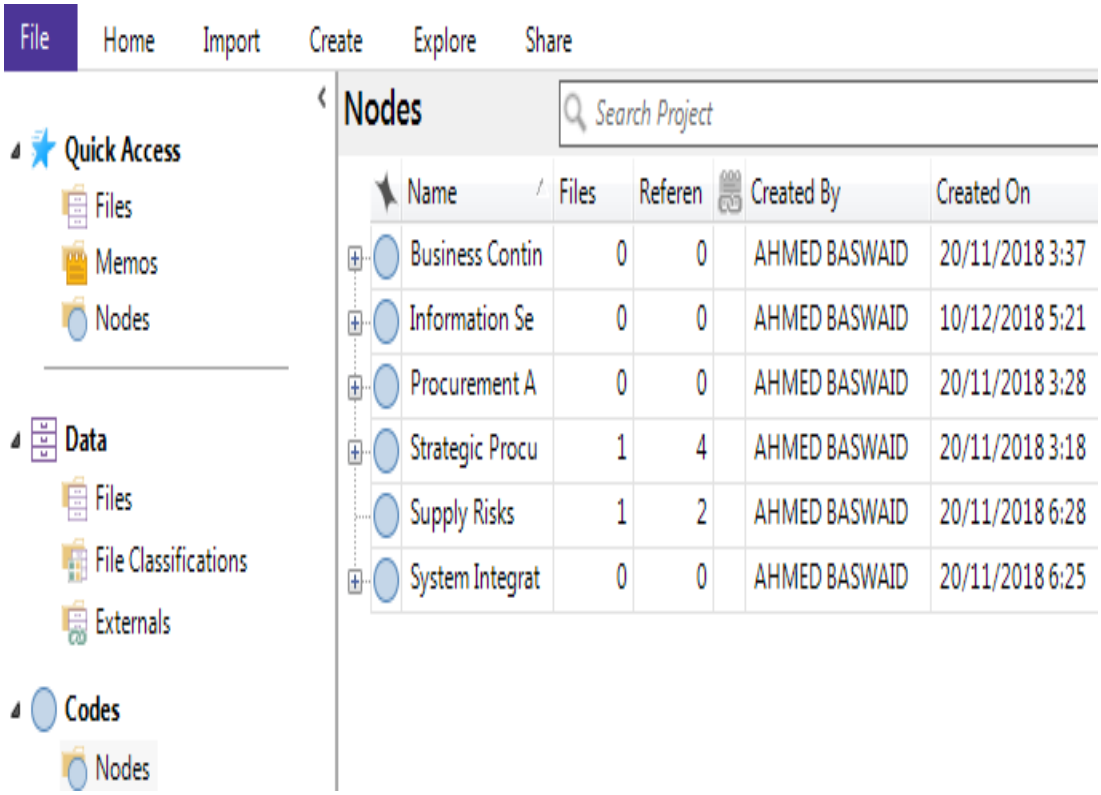
Yours sincerely

Catherine Gangell
Manager, Research Integrity

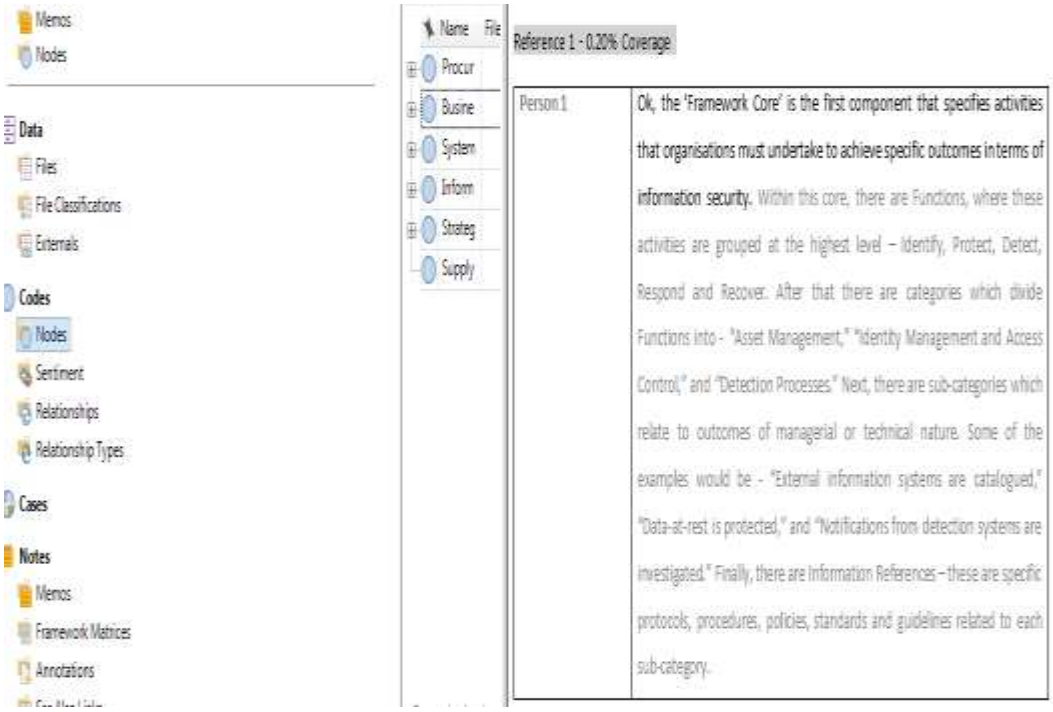
Appendix J: Focus Group Guideline

1. Can each member of the group please express their opinion of the biggest challenges of asset management in this industry?
2. Can each group member please take out the framework paper located in front of you(which was shared with your R&D coordinator prior to this session) – please now take ten minutes to review and consider this based upon our discussions?
3. What do each of you think of your initial overview of this framework?
4. What are your views on what has been found about this topic earlier? I will now cover the framework and explain in more detail the theory and expectation prior to any further discussion.
5. Would you agree with these findings? Are you satisfied with the current state of practice within your organisation?
6. Is the situation any different in your organisation? If yes, then how?
7. What are the practices that would like to have adopted in your organisation? What would it achieve?
8. What are the other aspects that you might have missed? Or the earlier respondent missed?
9. Would you agree with the response that in order to improve upon X dimension, Y action has to be undertaken? Would you add any more recommendation?
10. Can you provide a specific example of the steps that you stated your organisation has undertaken to improve X?
11. In closing, is there any other factors that any of the group members wish to add?

Appendix K: NVivo Screenshots (Second Phase)



q



Reference 1 - 0.58% Coverage

Person 2	Sure, I would like to start this discussion by talking about how and why we align business continuity planning and procurement. First, we try to involve our equipment vendors in the planning process so that risks are jointly identified and mitigation and control measures are implemented. **Our goal is to minimise our risk exposure and in this direction, we strive to involve the quality engineering function as well – top of the line quality in terms of equipment ensures business continuity.**

Reference 2 - 0.55% Coverage

Person 4	I would agree with what has been said about procurement and business continuity. Also, in my organisation we take cognisance of the fact that there are significant interrelationships between processes due to the inherently complex nature of the industry and equipment infrastructure. **One of the aim of aligning procurement processes with business continuity is to make sure that any dependency related to this does not cause adverse impact in terms of operational continuity.** We address these challenges by connecting business continuity with risk management, procurement and provisioning of insurance.

Drag selection here to code to a new node

Reference 3 - 0.58% Coverage

Person 5	I will add another important note here – although it is not directly related to procurement. **Information protection in terms of its integrity and availability is key to business continuity and therefore, we make sure that loss of data or documents does not hamper our operational sustainability.** Towards this, we measure the extent to which loss of information is acceptable within the larger context of business continuity.