Performance measurement framework for the oil and gas supply chain

by

Masha Nur Salsabiela Menhat

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ABSTRACT

This study examines performance measurement in the oil and gas industry. The aim is to identify the prevalence of performance measures and to provide evidence of the potential impact in the usage of performance measures on organisational performance. The study investigates the links between organisational strategies, choice of performance measures, and organisational performance.

The resource-based view (RBV) theory and Miles and Snow's organisational fit theory were, respectively, used to explain the research and as the basis for analysis of results. The organisational fit theory states that organisation's approach to competition can be classified into four main strategies. These strategies will influence the way they manage their organisations and lead to different performance outcomes. This may include the way they measure their supply chain performance. In addition, the resource-based view suggests that organisations can achieve superior performance through internal resources and competencies. Based on this theory, performance measurement framework is viewed as one of the important organisations' resources.

A literature review on supply chain performance measurement was carried out to identify performance measures that are relevant to the oil and gas industry. This resulted in an initial list of measures based on the review. Exploratory interviews were then conducted to confirm the measures, understand the contextual definitions of the measures, and to find out from practitioners what additional measures they consider important beyond those obtained from the literature. This resulted in a broader set of performance measures, which were then validated through a self-administered questionnaire survey. A total of 550 questionnaires were sent out to UK companies whilst 120 to Malaysian companies. A total of 100 responses were received from both countries, which accounts to 15% response rates.

The outcomes of the survey clarify the prevalence of performance measures in the industry according to the level of importance. Correlation and regression analyses indicate that there is a link between the choice of performance measures and organisations' strategies. Also, the results indicate a link between choice of performance measures and the actual performance of the organisations, suggesting that performance measures are critical resources of organisations used to support competitiveness in line with resource-based view theory. In addition, this study identifies the most influential strategy and performance measures in enhancing organisations' performance within the oil and gas industry.

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ABBREVIATION

A

ANOVA: Analysis of Variance

B

BOE: Barrels of oil equivalent

BP: British Petroleum

C

CEO: Chief Executive Officer

CSR: Corporate Social Responsibility

CSCMP: Council of Supply Chain Management Professionals

F

FAME: Financial Analysis Made Easy

G

GDP: Gross Domestic Product

GVA: Gross value added

IEA: International Energy Agency

J

JIT: Just-In-Time Production

K

KPMG: Klynveld Peat Marwick Goerdeler

K-S: Kolmogrov-Smirnov

L

LBS: Lancashire Business School

LPG: Liquefied Petroleum Gas

N

NGO: Non-Governmental Agencies

O

OPEC: Organisation Petroleum Exporting Countries

OECD: Organisation for Economic Cooperation and Development

P

PETRONAS: Petroleum Nasional Berhad

R

ROI: Return on investments

RBV: Resource based view

ROV: Remote operated vehicle

S

SC: Supply Chain

SCM: Supply Chain Management

SPSS: Statistical Package for the Social Sciences

SMEs: Small and Medium Enterprises

T

TDM: Total Design Method

TQM: Total Quality Management

TW: Terrawatts

U

UCLAN: University of Central Lancashire

UK: United Kingdom

UKCS: United Kingdom Continental Shelf

UN: United Nations

USA: United States of America

W

WTO: World Trade Organisation

CHAPTER 1

INTRODUCTION

1.1 Introduction

Oil and gas exploration started in the early nineteenth century when Imperial Russia produced around 3500 tons of oil. It then became a well-traded commodity by the end of the century. This was due to the discovery of kerosene production from crude oil and the invention of the petroleum-powered engine (Krylov et al., 1998). Despite the discovery of alternative energy, oil and gas remain the major sources of energy today (Energy and Environment in the European Union, 2006). In fact, to replace 100% of oil and gas sources will require a huge increase in the alternative energy production. The current global consumption of energy from fossil fuels (oil and gas) is around 15 terawatts (TW), whilst the present renewable energy alternatives, including large hydro, only produce around 1TW. This is not considering the projections of global energy demands in 2050, which will be around 25- 30TW (Lloyd and Subbarao, 2009).

The major consumption of oil is in the transportation industry, whilst gas is highly consumed for residential needs and industrial requirements (International Energy Agency, 2014). The demands for oil and gas have caused many organisations to perform exploration in the deep seas, further away from the land. For instance, the Libra offshore exploration in Brazil is 125 miles into the sea (Rui et al., 2017).

In comparison to other industries, oil and gas have many distinguishing characteristics, such as a bigger project size, higher technical complexities, involvement of diverse expertise, and high transportation and machinery costs (Chima and Hills, 2007; Varma et al., 2008; Rui et al., 2017). Therefore, oil and gas operations usually involve multiple companies to complete their project. The integration between these companies can be in a form of joint venture or by subcontracting part of their scope of work. This supply chain integration is required to share the risk, cost, expertise, or a combination of these (Ernst & Young, 2014b; Organisation of Petroleum Exporting Countries, 2015). In addition, the industry has very long supply chain links involving many parties, from the exploration of oil and gas to the ultimate customer. The parties involved in the supply chain include; oil and gas operators, exploration contractors, geologist, fabricators, engineering consultants, marine and transportation services, procurements, and commissioning (Dawe, 2000; Hyne, 2012; Havard, 2013).

Since the first exploration of oil and gas, the industry has witnessed alternating economic prosperity and decline due to the fluctuations in the world oil prices. Geopolitical disturbances, such as the war in Iraq, which started in 2001, industrial strike in the oil and gas sector of Venezuela in 2003, Gulf of Mexico Hurricane in 2005, and the ongoing Nigerian conflict in the Niger Delta region have greatly impacted the supply and demand pattern of the industry (Jobling and Jamasb, 2015; Khan, 2016). These eventually affect the world's oil prices. Other than that, oversupply and shortage of supply by major oil and gas producers also contribute to the price volatility (Jobling and Jamasb, 2015).

Recently, the drop in oil prices per barrel to below USD 35 (BBC News, 2016; Bloomberg Business, 2016) has severely affected the global oil and gas industry. This situation worsens the financial income of most oil exporter countries (International Energy Agency, 2012; Organisation of Petroleum Exporting Countries, 2015). Whilst the drop in prices was seen as beneficial to the end users (oil and gas consumers) and oil and gas net importers, it negatively impacted the oil and gas exporter countries, particularly in terms of their economic conditions (Hayes, 2015). In fact, previous study reveals that the oil price was a driving factor in the recent recession in the USA; one of the major oil producers (Jobling and Jamasb, 2015). This is caused by the decreasing investment received in this sector, which leads to fewer oil and gas development projects. This eventually reduces the employment in the country affected by this low oil prices period.

The complexities of the oil and gas supply chain, geopolitical issues, and fluctuation of oil and gas prices, all combined, can significantly affect the performance of oil and gas companies. Since these factors are controlled the least by oil and gas companies, one way to deal with it is by focusing on the internal management. This can be performed by enhancing their supply chain performance. In fact, supply chain performance is recognised as a major determinant of organisational productivity and profitability (Gunasekaran et al., 2004; Kannan and Tan, 2005; Youn et al., 2014; Chang et al., 2016).

1.2 Background of the study

Nowadays, with an increasing reliance on outsourcing activities, there is a need for companies to emphasise on the improvement in their supply chain performance (Lambert and Cooper, 2000; Fernandes et al., 2010; Wildgoose et al., 2012). In line with this, research on supply chain performance that focuses on various contexts of supply chain management has gained the attention of both the academics and practitioners.

To ensure the efficiency and continuous improvement of supply chain activities, it is important to measure their performance. This cannot be done without a proper performance measurement framework in place. Several studies were conducted to investigate and propose performance measurement framework for manufacturing and services industries (Bourne, 2000; Davis and Albright, 2004; Sambasivan et al., 2009; Khani and Ahmadi, 2012; Cheng et al., 2014; Lucato et al., 2014). However, performance measurement in the oil and gas context is under-researched. Some of the existing studies on supply chain performance for this industry concerned sustainability measures (Yusuf et al., 2013; Yusuf et al., 2014). Varma et al. (2008), in particular, explored the prevalence of performance measures in the oil and gas supply chain. However, the research only focused on the downstream petroleum-refining sector of the industry. More importantly, it did not investigate the choice of performance measures or the usage of performance measures and its impacts on organisational performance.

In addition, the need for this study also comes from the fact that performance measurement framework is influenced by the type of industry in which organisations operate (Otto and Kotzab, 2003; Gunasekaran and Kobu, 2007; Kumar and Markeset, 2007; Hsu et al., 2009; Kumar and Nambirajan, 2013). As such, this research attempts to study the prevalence of performance measures of the oil and gas supply chain and its implications on the organisational performance. In addition, it will also explore the link between organisational classifications and the choice of performance measures.

Resources based view (RBV) theory and organisational fit theory by Miles and Snow (1978) were used as the basis to explain this research. RBV theory concentrates on achieving a competitive edge by focusing on internal resources and capabilities (Coates and Mcdermott, 2002). RBV emphasises that competitive advantage can be sustained if the capabilities creating the advantage are supported by valuable, rare, non-transferable, and difficult-to-replicate resources (Peteraf, 1993; Hart, 1995). Moreover, Szymaniec-mlicka (2014) suggests that the management of resources are increasingly important in the rapidly-changing environment. In the oil and gas industry, the external factors such as oil and prices shock, and political instability are uncertain and least controlled by the oil and gas companies. In addition, the final products of the oil and gas companies have very minimal differentiation for them to attain competitive edge through it. For that reason, it is important for the companies to shift their focus to internal factors to distinguish themselves from their competitors. Such factors include resources and capabilities, which need to be examined and carefully managed to boost their competitive advantage. In line with this, there is a need for an appropriate approach in evaluating and managing firms' internal resources and capabilities. Therefore, in this research, the usage of performance measurement is viewed as a 'resource' in attaining competitive advantages.

The organisational fit theory, on the other hand, suggests that an organisation can be classified into four main strategies, namely Prospector, Analyser, Defender, and Reactor (Miles and Snow, 1978). Each strategy influences the way an organisation manages the business and may lead to different performance outcomes. In line with this theory, this research, therefore, intends to study the effect that organisational classification has on their choice of performance measures and organisational performance. Ruzita (2010) suggests that performance measurement framework can be an essential tool in explaining organisational strategy. The author added that the type of strategy adopted by an organisation would strongly influence their choice of performance measures. This research is also motivated by the fact that no research has been conducted to explore oil and gas industry from four strategic perspectives as proposed by Miles and Snow (1978). Previous research focused on health industry (Helmig et al., 2014), manufacturing industry (Ruzita, 2010; Khani and Ahmadi, 2012; Oyedijo and Akewusola, 2012) and retail industry (Moore, 2005). Therefore, this research aims to explore the nature of performance measurement framework from the strategic perspectives.

1.3 Research aims

The overall aim of this research is to develop a performance measurement framework for the supply chain management in the oil and gas industry. It also aims to explore the application of the performance framework.

1.4 Research questions

To achieve the aims of the research, the following research questions are addressed:

Q1. What is the prevalence of performance measures in the oil and gas industry?

Q2. What is the impact of the size of organisation on the organisational strategy?

Q3. What is the impact of organisational classifications on the choice of performance measures?

Q4. What is the impact of organisational classification on organisational performance?

Q5. What is the impact of the choice of performance measures on organisational performance?

1.5 Research methodology

This research adopted a mixed-method approach. This includes exploratory interviews with five supply chain experts and survey by questionnaires of oil and gas companies in the UK and Malaysia. The exploratory interviews were aimed at exploring the performance measurement in the oil and gas supply chain. It involves supply chain experts from the UK, the USA, Malaysia, and Indonesia. The interviews were conducted by telephone and each interview took around one and a half hours. The outcomes of the interviews, combined with the literature review, informed the design of the questionnaire.

The questionnaire was distributed to 550 oil and gas companies in the UK and 120 companies in Malaysia, with 100 completed survey forms returned. These companies were randomly selected from the oil and gas databases. Purposive sampling was adopted in selecting the participants from the selected companies. In this regard, chief executive officers (CEO) / Supply chain managers were chosen in this survey due to their ability to provide useful responses for this research. The questionnaires were mailed out to the selected UK companies. A self-addressed paid envelope was enclosed in the survey form to encourage participation. On the other hand, electronic survey was used to reach selected companies in Malaysia. A questionnaire form was emailed to these companies together with a link to a Google form. This link was provided to give the participants an alternative way to complete the questionnaire.

1.6 Implication of the study

This research is expected to make contributions to the development of performance measurement framework for the oil and gas industry. In addition, it will explore the application of performance measurement framework in determining organisational success. Resources based view theory (RBV), in particular, is used to explain the importance of the framework as a tool in gaining competitive advantages. Furthermore, the framework is studied from a strategic perspective, in which organisational fit theory by Miles and Snow is referred to. In this regard, this research will contribute to the literature on performance measurement within the oil and gas context, which is still under-researched.

From the practical perspectives, the developed performance measurement framework is expected to aid the practitioner in managing their supply chain performance. The findings on the application of this framework may enable the manager of the oil and gas industry to better apprehend the usage of performance measurement framework as an important resource in gaining a competitive advantage.

1.7 Structure of the thesis

This thesis consists of seven chapters as outlined in Table 1-1.

Table 1-1: Structure of the Thesis

Chapter	Focus of the Chapter
Chapter One Introduction	This chapter presented a brief overview of the research
Chapter Two Literature review	This chapter discussed the key concepts of the research
Chapter Three Conceptual Model	This chapter presented theoretical perspectives and development of conceptual model
Chapter Four Methodology	This chapter explained methodological approaches and methods adopted in this study
Chapter Five Exploratory Interviews	This chapter discussed exploratory findings of the interviews and performance measurement framework in the industry
Chapter Six Questionnaire survey	This chapter presented the findings from statistical analysis performed based on the survey by questionnaire.
Chapter Seven The development of PMF	This chapter discussed the development of PMF and theoretical implications of the findings.
Chapter Eight Conclusion	This chapter presented the conclusion of the study and recommendations for future research

Chapter Two discusses the literature on the key elements of the study. These include supply chain management, oil and gas industry, oil and gas supply chain, and performance measurement framework. These reviews establish the need for the study, form the research questions, and help in developing the conceptual model of the study. It also identifies a set of performance measures that are relevant to the oil and gas industry.

Chapter Three explains the conceptual model and theoretical perspectives of the study. The discussion on the theories underlying this research and the reviewed literature in Chapter Two are used as the bases to develop the conceptual model. The proposed conceptual model is used as the guiding principle of the research. It depicts the relationship between the major constructs in the study. It aids in understanding the direction of this research and in deciding methodological approaches in Chapter 4.

Chapter Four discusses the methodological approaches. The employed mixed-methods approach consists of exploratory interviews and survey by questionnaire. The data collection techniques for the interview and survey are also presented. It also explains the intended outcome of each stage of the research process.

Chapter Five provides findings of the exploratory interviews. Considering the lack of research on the supply chain performance measurement within the industry, the interviews are intended to be an exploratory study. They provide valuable insights into the nature of the industry, the challenges in managing performance, and influencing factors in developing performance measures for the industry. Furthermore, it also explores the commonly used performance measures in the supply chain field in terms of its application in the oil and gas supply chain. The chapter ends by proposing a set of performance measures developed from the literature review and interviews.

Chapter Six details the outcomes of the survey by questionnaire analysis. This chapter contains five main parts: questionnaire structure, preliminary analysis, descriptive statistics, inferential statistics, and relationship of the main constructs. It answers all the five research questions presented in Section 1.3 of the first chapter. In essence, it discusses the prevalence of performance measures in the industry, and the link between organisational classifications and the choice of performance measures and organisational performance. It also reveals the impact of the choice of performance measures on organisational performance.

Chapter Seven discusses the development of performance measurement framework for the oil and gas industry. It also presents the theoretical implications based on the findings

Chapter Eight outlines the overall research conclusion. It focuses on the main findings of the research and highlights the main contributions of the study. It also presents research limitations and recommendations for future research.

1.8 Summary

The history of the oil and gas industry is presented in the first section. It highlighted that the oil and gas energy is still the major source of energy despite the discovery of various alternative energy sources. Also, it presented the factors that influenced the oil and gas industry. These include political instability, fluctuation of oil and prices, supply and demand disruptions, and the complexities of its supply chain. This is followed by the background of the study, which briefly explained the existing literature on the supply chain performance measurement. It presented the existing research on performance measurement, which predominantly focus on manufacturing and services industry. Similar research, from the oil and gas context, was also discussed. These discussions raised the need to study performance measurement within the oil and gas industry. Accordingly, research aims, research questions and summary of methodology, and the implication of the study are illustrated to provide a general idea about this study. The final section outlined the structure of this thesis.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter provides a detailed review of the supply chain performance measurement. The chapter consists of three main themes supply chain management, oil and gas industry, and performance measurement. First, the definitions of supply chain management (SCM) are discussed. Following the definition, the initial understanding of SCM concept is presented to show the development of its usage in the industry, particularly how it replaced the previous management programmes. Accordingly, it presents the importance of SCM in today's business environment and the impact it has on organisational performance.

The second theme attempts to explain the nature of the oil and gas industry and its supply chain. It begins by introducing the oil and gas activities involved in the upstream and downstream sectors and the history of the industry including the involvement of major associations. Following this, the theme reports on the oil and gas industry in both countries, the UK and Malaysia. The nature of the industry was also discussed in order to demonstrate its distinguishing characteristics. This discussion will enhance the understanding of the oil and gas supply chain concept and forms the basis of this research.

The third theme describes the concept of performance measurement and its interlink with SCM. The initial discussion focuses on the importance and the application of performance measurement across various fields. Then, it elaborates on the performance measurement in the supply chain environment. Next, the existing type of performance measurement framework in the literature is examined by highlighting its origin and some debates around its usage. Adding to this discussion, some examples of developed performance measurement framework with its measures are presented.

Finally, definition and discussion on the relevant performance measures are presented. This chapter will, therefore, provides an understanding of SCM as a concept and its relation to performance measurement. In synthesising the nature of the oil and gas industry and SCM, the work also provides some insight on the appropriate approaches to examine performance measurement of the supply chain. Hence, this chapter will serve as the basis for the theoretical framework and conceptual framework which will be discussed in **Chapter 3**.

2.2 Supply chain management (SCM)

To have a better understanding of supply chain management, it is important to address the meaning of supply chain. Christopher (1992) defined supply chain as the link of organisations which is involved in both upstream and downstream, in different processes, and activities to deliver products and services to the ultimate customer.

After reviewing several definitions by various authors, Mentzer et al. (2001) have defined supply chain as “a set of three or more entities (organisations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer” (p.4). Another author, Hines (2004) describes supply chain as all the activities related to the transportation of information and goods (products and services) from the early design stage to the raw material stage to the ultimate customer. Agrell and Hatami-Marbini (2013) define supply chain as “a system involving organisation, people, technology, activities, information, and resources in delivering services/goods from supplier to the end user”.

The above definitions emphasise the key characteristics of a supply chain. It is a network involving multiple entities, involving various processes and activities with the aim of fulfilling the ultimate customer’s requirement.

According to Oxford Business English Dictionary (2005), management is “the act of running and controlling a business or similar organisation”. Therefore, SCM is the act of running and controlling the supply chain activities, which were described earlier. In line with this, the Council of Supply Chain Management Professionals (2017) describes SCM as planning and management activities consisting of sourcing and procurement, conversion, and all logistics management activities. These include coordination and collaboration with channel partners which include suppliers, intermediaries, third-party service providers, and customers. Other authors such as Stevenson and Sum (2014) describe SCM as; “The strategic coordination of business function within business organisation and throughout its supply chain for the purpose of integrating supply and demand management"

There are various definitions of SCM suggested in the literature. From the listed definitions, it can be observed that SCM refers to the management process which involves various functions and activities towards common goals in delivering goods or services to the customers. The SCM definition can be applied across different business activities, operations, and industries. The only difference between supply chain management of one business activities to another is the complexity of its supply networks or the number of entities involved in delivering the products or services to the ultimate customer. Section 2.9 will further elaborate the distinctive characteristics of the oil and gas supply chain.

2.3 The development of supply chain management (SCM)

The term, Supply Chain Management, was introduced in the late 1980s and was widely used over a decade later (Cooper, Lambert and Pagh, 1997; Gunasekaran, Patel and McGaughey, 2004). The initial idea of SCM was internally focused on logistic activities (Bechtel and Jayaram, 1997) and inventory management (Cooper et al., 1997) which have now evolved into bringing supply chain functions together. The aim of these functions is to achieve the common goals of efficiency and to enhance customer satisfaction (Narasimhan, Kim and Tan, 2008). The development of supply chain functions indicates that integration is no longer between two organisations but involves multiple internal and external functions.

Prior to the emergence of the SCM concept, the implementation of manufacturing management programmes such as Just-in-time (JIT), Total Quality Management (TQM), and Reengineering has acquired mixed success in the 1980s and 1990s (Kannan and Tan, 2005). Nevertheless, there are several shortcomings with these programmes. Despite excelling in certain functions, it does not cater for each business activity (Gunasekaran et al., 2004; Kannan and Tan, 2005). In other words, there is trade-off on other non-targeted functions (Bechtel and Jayaram, 1997). Nevertheless, this does not suggest that these management programmes have no impact on the organisational performance. In fact, Hsu et al., (2009) in their empirical study proved that JIT has a positive impact on the organisational performance through SCM practices. They argued that failure of JIT implementation to enhance performance was actually due to the lack of integration with the external supply chain such as suppliers. This example demonstrates the role of SCM in complementing other management programmes.

Another management programme that was used prior to SCM is logistics management. The Council of Logistics Management defined logistic management as: “The process of planning, implementing, and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods, and related information flow from point of origin to point of consumption for the purpose of conforming to customer requirement” (Cooper et al., 1997). This type of coordination is only relevant for the manufacturing of discrete products from raw material to customers. In essence, there is no involvement of second-tier suppliers and customers which is not common in today’s business environment. Lambert and Cooper et al. (1997) contend that logistic management and SCM were used interchangeably by the researchers and practitioners in the 1990s. In contrast to logistics management, SCM involves many internal and external business functions such as suppliers, customers, and stakeholders. In fact, one way to integrate various business functions together is through the SCM concept (Bechtel and Jayaram, 1997).

The differences in the SCM requirements which are beyond logistics management can be demonstrated in the development of new products. Many aspects of the business are involved in this process such as marketing to attract new customers, research and development for the design, manufacturing, logistics for the products’ distributions, and financial to acquire funding from investors (Lambert and Cooper, 2000). Moreover, there is also the need for external integration with customers and suppliers in the early stages of the development process (Kannan and Tan, 2005). This integration will hasten the process to market the newly invented products (Cooper et al., 1997; Hsu et al., 2009). The management process of these multiple business functions is referred to as SCM (Cooper et al., 1997; Lambert and Cooper, 2000).

The development of SCM is not only a result of the internal drivers but is also influenced by multiple external factors. Gunasekaran et al. (2004) suggest the external factors are contributed by an increase in business globalisation, growth of international trade, ease of access to information, and environmental awareness. Moreover, the authors highlighted that the local content requirement and the guidelines of World Trade Organisation (WTO) have contributed to the development of SCM.

In line with the extensive application of SCM in business sectors, the Council of Logistics Management, which was founded in 1985, decided to rebrand its association as the Council of Supply Chain Management Professionals (CSCMP) in early 2005 (Logistic online, 2004). This rebranding was undertaken to accommodate the current needs of SCM.

SCM has been viewed as a vital mechanism in attaining competitive strategy through organisational efficiency and profitability (Gunasekaran et al., 2004; Hsu et al., 2009; Wildgoose et al., 2012). Kannan and Tan (2005) argue that effective supply chain management is able to enhance firms' performances through managing lead-time, cost, product/service quality, and responsiveness. Moreover, the increase in reliance on outsourcing activities in the non-core functions of organisations stressed the importance of the role SCM (Wisner, 2003; Chen et al., 2004; Gunasekaran et al., 2004; Pillai et al., 2010; Youn et al., 2014; Yusuf et al., 2014).

According to Wildgoose et al. (2012), most organisations focus on minimising cost and improving efficiency by relying on their suppliers. The authors claimed that the reliance of firms on suppliers are in the forms of global sourcing, single sourcing, partnership, and JIT operation. Even though lowering cost is crucial in maximising profits, Gunasekaran et al. (2004) argue that manufacturers are more concerned about working with their suppliers in services improvements, technological innovation, and product design. Chen et al. (2013) discuss similar outsourcing trends in the hospital industry. They predict that initial expenses for hospital suppliers which consists of 45% of hospitals' operating budget might increase over time. Thus, management in hospitals has started focusing on the supply chain management than hiring staff.

The advantage of outsourcing activities is that it allows companies to focus on their core competencies. These are conducted through better management of their resources, enhanced flexibility in response to current demands while benefit from expertise and technology efficiencies offered by suppliers at the same time (Kannan and Tan, 2005).

In addition to the positive effects of effective SCM, there are several studies which highlighted the downside of improper SCM. For instance, ineffective SCM has been shown to be part of the failure of quality assurance in the Chinese dairy industry (Chen et al., 2014). This incident was described by WHO as the “largest food safety event it had to deal with in recent years” (Chen et al., 2014, p. 194). Comprehensive analysis after the event found that this incident was caused by weak quality monitoring of supply chain partners. Another example is shown in the analysis of 600 companies from 1998 to 2007 by PricewaterhouseCoopers. They revealed that companies which encountered supply chain barrier indicate a 9% drop in their share price in comparison to the control group (Wildgoose et al., 2012).

With the emergence of SCM concepts, much research has been conducted in this field. This research focuses on diverse aspects of the supply chain including supply chain strategy, performance management, supply chain integration, the impact of SCM on the overall organisational performance, management of information system, much recent research which focused on sustainable supply chain (Chenhall and Langfield-Smith, 2007; Gopalakrishnan et al., 2012; Zhao et al., 2017). Since supply chain management is also influenced by the industrial sectors (Otto and Kotzab, 2003; Gunasekaran and Kobu, 2007; Kumar and Markeset, 2007; Hsu et al., 2009; Kumar and Nambirajan, 2013), there are also studies which concentrated on various industries that initially targeted manufacturing industry. These sectors include the hospital industry (Chen et al., 2013; Zepeda et al., 2016), the fashion industry (Sukwadi et al., 2013), the petroleum industry (Varma et al., 2008; Pillai et al., 2010), the banking industry (Davis and Albright, 2004), and the food industry (Chen et al., 2014).

2.4 Supply chain strategy

Lee (2004) describes supply chain strategy as a set of objectives an organisation wants to accomplish by adopting specific SCM decision. This strategy has to be aligned with business objectives and customer requirements and is considered as a pre-requisite for the implementation of SCM (Varma et al., 2006). For example, an organisation might want to either focus on reducing cost, brand loyalty, or on producing high-quality products. In order to reflect their organisations' goal, an organisation needs to devise suitable supply chain strategies. Gap, an apparel company who owned Gap, the Old Navy, and the Banana Republic formulate their supply chain strategy based on the market segments (Brun and Castelli, 2008). They targeted Gap to the customer that purchase clothes according to the latest trends. The Old Navy specifically targets buyers with a moderate budget while the Banana Republic focuses on buyers that prefer top-notch products. Based on these three types of buyer, Gap adopted three different supply chain strategies. Old Navy is manufactured and sourced in China to ensure low operating cost while the Gap supply chain is placed in the USA to ensure speed and flexibility to produce the latest trend. On the other hand, Banana Republic products are created in Italy to maintain its high quality (Brun and Castelli, 2008).

In another instance, to support a company's low-cost supply chain strategy, Walmart acquires information system for their material management. This system will enable them to have actual demand forecasting which will directly lead to high inventory turnover and minimised inventory cost (Qrunfleh and Tarafdar, 2014).

Supply chain strategy is critical to determine long-term organisational performance. The strategy would not only enable better supplier and customer management but also improved business performance and their supply chain partners (Perez-Franco et al., 2016). Even though most of the current literature has discussed supply chain strategy from manufacturing, retailer, and fashion industry perspectives, the concept remains the same. Supply chain strategy reflects the nature of their organisations' goals. In this regard, supply chain strategy is structured to achieve the organisations' goals and the implementation of SCM will be tailored to the devised supply chain strategy (Qrunfleh and Tarafdar, 2014).

Following the same principles, this research focuses on four organisational strategies introduced by Miles and Snow (1978). The four strategies are Prospector, Analyser, Defender, and Reactor. The study will explore the impact that each type of organisational strategy has on their choice of supply chain performance measures. The detail of each strategy will be discussed in Chapter 3.

2.5 History of the oil and gas industry

Historically, oil and gas exploration started in the early 19^{th} century when Imperial Russia produced around 3500 tons of oil. It then became a well-traded commodity by the end of the century. This is due to the discovery of kerosene production from crude oil and the invention of petroleum powered engine (Krylov and Boksernan, 1998).

In 1960, the Organisation of Petroleum Exporting Countries (OPEC) was formed in Baghdad with only five members. Their aim was to standardise its members policies regarding supply and demand stability and capital return on investments. One of the founder countries is Saudi Arabia, the largest world's oil exporter to date. Currently, OPEC consists of 12-member countries among oil producers and developing countries with its headquarter in Vienna, Austria.

About a decade later, the International Energy Agency (IEA) was founded in response to the oil and gas crisis or embargo proclaimed by OPEC member countries in 1973. The initial aim of this organisation is to support countries affected by the oil and gas major disruption in 1973.Comprising of 29 countries as members, , IEA is focused more on oil consumption, developed countries, and passage energy policies to be adhered to its member (International Energy Agency, 2012). This is to ensure affordable and clean energy are given to its members.

Nowadays, there are many diplomatic conferences and cooperation initiatives being conducted between IEA and OPEC pertaining to the oil and gas issues. In particular, they focus on the research and development aspects including technological advancement and technical capacities, barriers, and other related issues for improvement purposes. For example, in the 2005 IEA and OPEC congress in South Africa, supply chain tightness has been claimed as one of the aspects that influenced the security of oil supply and market stability. Therefore, both parties have agreed to expand current investment in the downstream sector as well as to increase technological capacities in handling refineries in order to control oil and market securities (Organization of Petroleum Exporting Countries, 2013; International Energy Agency, 2014).

2.6 Understanding the oil and gas industry

The oil and gas industry is important to various sectors around the world. According to the International Energy Agency (2014), in 2012, 63.7% of the world's total oil consumption was used in transportation. In contrast, transportation sectors were found to consume the least percentage of natural gas consumptions at only 6.6%. Agriculture, commercial and public services, and residential were the largest consumers at 43.4% and are followed by industries at 36.5%.

The industry is categorised into three sectors, namely, upstream, midstream, and downstream. The upstream sector which is sometimes known as the exploration and production sector (E&P) and involves the exploration of potential oil and gas catchment, drilling activities, and also the process of pumping out the crude oil or natural gas from the well (Pillai et al., 2010). Due to the nature of operation in this sector, most businesses involve contractors and service companies which support the oil and gas operators (Oil industry International Exploration and Production Forum, 1997).

The midstream sector refers to the interconnecting part between the upstream and downstream sectors which involves processing, storing, and transportation of commodities including crude oil, natural gas, and liquids (Lima et al., 2016). Considering the small size of midstream sector, this research will consider it to be in the downstream sector.

Finally, the refining of crude oil, distribution of refined natural gas. and its product are collectively recognised as the downstream sector of the industry. Companies operating in the oil and gas industry may own their operations from upstream to downstream sectors (fully integrated) or just focus on one or two sectors. Figure 2.1 illustrates the oil and gas industry activities from upstream to downstream sector (Fernandes et al., 2010; Pillai et al., 2010).

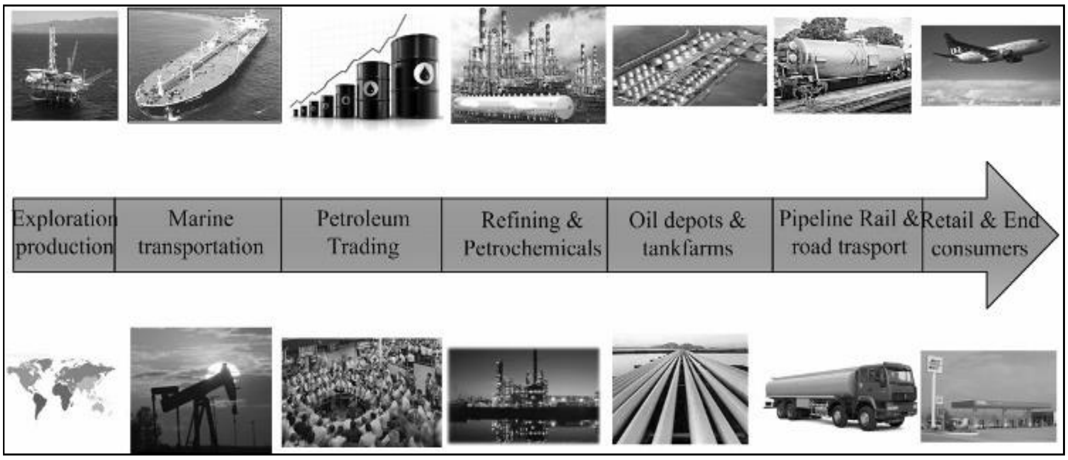

Figure 2-1: Oil and gas operations activities (Fernandes et al. 2010)

2.6.1 Upstream sector

2.6.1.1 Exploration

The oil and gas industry business begins with exploration. Geological companies are responsible for identifying oil and gas reserves for an adequate amount to be drilled, developed, and produced (Leffler et al., 2003). Exploration activities involve seismic, geophysical, and geological operations (Chima and Hills, 2007). Consent from local government is required before starting any exploratory works (Dawe, 2000). With this consent, the oil and gas operators are required to pay an agreed amount of royalties to the local government.

2.6.1.2 Drilling

Exploratory drilling is carried out after the investigation of oil and gas prospects (Ford, 2000). In most cases, the oil companies enter into a joint venture contract to manage the drilling and production operations where a drilling contractor operates these activities on behalf of the operator (Ford, 2000). Through this joint venture contract, drilling contractor is responsible for a fleet of drilling rigs and provides skilled personnel to carry out the services. There are various types of drilling rigs which can be used in the market. These include mobile drilling vessels such as jack-up, semi-submersible, or a drill ship (Ernst and Young, 2016). The selection of drilling rigs is very important as it comprises 25% of the total cost of the well (Ford, 2000). Amongst the factors to consider in selecting drilling rigs are water depth and well depth, pressure rating, remote operated vehicle (ROV) capacity, cost; day rate, mobilisation cost, maintenance cost, and length of contracts (Ford, 2000; Leffler et al., 2003).

2.6.1.3 Field development

Once the exploration wells from drilling activities provide sufficient evidence of economically viable oil and gas reserves at the field, the development works of the field will be executed (Leffler et al., 2003). This is conducted by installing either fixed production platform, floating tension-leg platform, compliant platform, or semi-submersible platform. Around 40 wells are drilled from one platform (Ford, 2000). The platform is normally fabricated at the onshore yard. This platform is then transported and installed at the field for the production works (Hyne, 2012). Pipeline risers are also installed to carry the gas and oil to the processing platform. Platforms are also installed or positioned in the field to provide living quarters for personnel during production works.

2.6.1.4 Production

After the field development has been completed, the production of oil and gas will take place. The contracting company is responsible for operating the petroleum production wells in the safest and most efficient way. Production refers to the process of extraction of crude oil and gas from the reservoir. The extracted resources are pumped to the platform facilities for the separation process (Texaco Northsea UK, 2000). Oil and gas production ranges from 100 barrel-a-day private wells to the large bore 4,000 barrels-a-day wells (Havard, 2013). During the production process, it is required to appoint offshore support in the form of vessel services air transport to supply food, transport personnel and mobilise equipment and material. The oil and gas produced by the operator or appointed production operator will then be transported for the refining process in the downstream sector.

2.6.2 Downstream sector

2.6.2.1 Transportation and storage of crude oil

The midstream sector consists of transportation and storage of crude oil and natural gas. The transportation works are conducted through pipelines and ships tankers. The length of pipeline varies from 1km to 5000km depending on the storage locations and are mostly made of steel (Cranmore and Stanton, 2000). This sector is not involved in producing any goods since it simply provides transport and logistic services to the production operator and customer in the refining phase.

2.6.2.2 Refining

The crude oil and natural gas will undergo several distillation processes at the refinery plant (Lima et al., 2016). This process will produce different types of final products depending on the distillation ranges. These products include; fuel gas, liquefied petroleum gas (LPG) automotive gasoline, kerosene, jet fuel, diesel, and fuel oil. In addition to the distillation process, the crude oil also needs to go through modern refinery processes to achieve the quality and quantity required. These processes include; separation based on size and boiling point, changing the molecular size of components, changing the molecular shapes and components, and removal of contaminants (Richardson and Ward, 2000). The production of these final products is largely influenced by demands from market sectors. Hence, inventory management and forecasting are critical for this sector (Lima et al., 2016).

2.6.2.3 Marketing

There is a need for distribution networks and storage for refined oil and gas before they reach final consumer (Richardson and Ward, 2000). This is especially important to minimise the cost of transportation. This is because most of the refinery plants are located on the coast and far from the centre of populations and industrial areas. The distribution is conducted by water or rail and pipelines (Lima et al., 2016). The usage of pipelines is more economical as it uses less manpower. This type of distribution is more practical for the larger industrial customer such as power generation industry (Richardson and Ward, 2000).

Private motorists and transportation companies are the vital market segment of the refinery company. The industrial base of these companies will determine the location of terminal depots and pipeline routes. Most refinery companies will focus on minimising cost in the distribution process to the marketing area to increase their profits (Lima et al., 2016). In some cases, refinery companies will appoint service providers for their distribution works to reduce administration activities and cost (Richardson and Ward, 2000).

2.6.3 Safety and environment concerns of the industry

The oil and gas industry is considered as a highly hazardous industry (Kvalheim and Dahl, 2016). Risks in offshore activities in the upstream sector include threats to structural integrity during installation, fire, explosion, accidents related to transportation of personnel and goods, and dangers during drilling activities (diving accidents and fall) (Mearns and Yule, 2009). Similarly, the refining activities in the downstream sector, transportation and storage are also exposed to hazards such as explosions due to the flammability of the oil and gas products (Varma et al., 2008). The Deepwater Horizon oil spill in the Gulf of Mexico and the California pipeline explosion in 2010 are examples of accidents that severely impact lives and the environment (Bigliani, 2013). Noting the exposure of risks in this industry, oil and gas companies are used to exercise stringent health and safety regulations to mitigate these risks and always have contingency plans in place.

Two major oil and gas associations, the Organisation of Petroleum Exporting Countries (OPEC) and the International Energy Agency (IEA) have agreed that more environmentally friendly processes and cleaner fuels need to be developed in view of climate change concerns. However, to meet these targets, many aspects need to be streamlined to realise this effort. These aspects include level of investment, supply and demand relationship, access into the upstream sector, alternative energy sources, and government participation. A lot of on-going research are conducted with the aim of providing environmentally friendly operations and working environment in the industry. For instance, carbon capture and storage and greenhouse gas research are part of the joint initiative research between OPEC and IEA (Organisation of Petroleum Exporting Countries, 2015).

2.6.4 Corporate social responsibility in the oil and gas industry

Corporate social responsibility (CSR) is known as the way an organisation integrates social, environmental, and economic aspects into their business activities (Kirat, 2015). Brown (2008) argued that CSR was historically initiated after several pollution crises around the 1960s emerged in the USA: "CSR arose, at least initially, not as a model example of organisational proactivity, but rather as reactions to crisis" (p.3).

The oil and gas industry places a great emphasis on CSR issue considering the nature of their operations and potential harm that it has, particularly on the environment (Spangler and Pompper, 2011; Kirat, 2015). On top of that, its large profits margin drew public attention to critically questions their CSR practice (Spangler and Pompper, 2011).

CSR efforts are motivated by two broad categories, altruistic and strategic (Udayasankar, 2008). From the strategic perspective, failure to implement CSR principle would tarnish the company reputation (Spangler and Pompper, 2011). This eventually diminishes stakeholder perception on the company. In fact, a majority of successful companies are those that integrate CSR into their business activities (Kirat, 2015). Other benefits of the strategic category include enhanced customer loyalty, improved company reputations, and penetration of new markets (Spangler and Pompper, 2011; Kirat, 2015).

CSR principles are sometimes adhered by the company in order to comply with the local content requirements set by the host country (Ngoasong, 2014). These requirements include purchasing from local manufacturer or supplier and to utilise local workforce (Kazzazi and Nouri, 2012; Ngoasong, 2014; Raufflet et al., 2014). Apart from the host country, other parties that drive CSR practices are public, media, and activists (Raufflet et al., 2014). Nevertheless, there is also company that incorporated CSR practice based on its internal motivation. These efforts could be motivated by strategic or also known as economic gain and altruistic (Udayasankar, 2008). In-depth interviews were amongst senior executives of oil companies in the US and the findings from the interviews depict that their CSR practices are driven by internal motivations where it does not only focus on economic gain, instead, its main focus in from an altruistic perspective (Spangler and Pompper, 2011). For instance, their concern on safety always outweigh profitable gain, and the development of CSR is designed from the focus of employees and community relations perspectives.

Kirat (2015) who studied oil and gas companies in Qatar claimed that there are CSR practices implemented by the companies that were examined. However, the study only concentrated on certain areas of CSR such as sporting events, health, education, and environment. He argued that other aspects of CSR such as human rights, workers' rights, and integrity are still very much lacking.

Raufflet et al. (2014) who observed the implementation of CSR in the mining and oil and gas industry and have proposed four main aspects of CSR practices for the oil and gas industry. These include ethics and governance, environmental management, community relations, and social, health and operational security issues. These aspects of CSR suggested by the author are also practiced by most multinational oil and gas companies such as British Petroleum, Exxon Mobil, and Saudi Aramco (BP p.l.c, 2016; Exxon Mobil Corporation, 2016; Saudi Arabian Company, 2016).

2.7 Oil and gas industry in the UK

Most of the operations of the UK oil and gas industry are located in the North Sea (Department of Energy and Climate Change, 2015). UK has been one of the major oil producers among the International Energy Agency (IEA) member countries (Oil and Gas UK, 2014). More than 70 per cent of the UK primary energy comes from oil and gas with oil mostly used for transportation and gas for heating (Oil and Gas UK, 2016). To date, United Kingdom continental shelf (UKCS) has produced oil and gas for over 40 years and it is estimated that approximately 42 billion barrels of oil equivalent (boe) have been extracted (Ernst and Young, 2014).

In terms of economic roles, the offshore oil and gas sector has proved to be the largest contributor to the national gross value added (GVA) among the industrial sectors in the UK (Oil and Gas UK, 2014). GVA is the measurement of the contribution to the economy of each individual producer, industry, or sector in the United Kingdom. It is also reported that in the year 2012, their supply chain has generated over GBP20 billion of sales from UKCS with GBP15 billion from the total sales are from the exporting activities (Oil and Gas UK, 2014).

Apart from the economic contribution, the UK oil and gas industry has provided provides employment opportunities for 450,000 people across the whole economy, with 36,000 in operating companies, 200,000 in the supply chain sectors, 112,000 jobs created by the economic activities, and about 100,000 employees are employed in the export sectors (Oil and Gas UK, 2014). Moreover, Department of Energy and Climate Change (2015) forecasted that by the year 2030, 70% of the UK's total energy will still depend on the oil and gas. This shows the significance of this industry to continue to be sustained and reliable in order to meet the demands.

Due to declining production of oil and gas, the UK has become the net importer in 2006. There are several reasons for this including fewer new fields have been discovered, a period of low investment during the low oil prices, as well as due to declining of production efficiency within UKCS (Ernst and Young, 2014).

As a result of the decline in production, the UK government has put so much effort since 2012 to encourage exploration and production of onshore oil and gas, including shale gas through tax reduction to reduce capital expenditure incurred by companies. This effort is aimed to overcome declining domestic production (International Energy Agency, 2012; Hutchinson, 2014). Not only that, the UK government is also focused on supply chain growth and bridging a growing skill gap which has been identified as one of the biggest challenges that is troubling the oil and gas industry (John, 2013).

2.7.1 The impact of the drop of oil prices on the industry

The drop of oil price since June 2014 has made a majority of international oil and gas companies to maximise their effort in cost savings and operation efficiencies (Ernst and Young, 2016; Khan, 2016). For example, Statoil's Johan Sverdrup in North Sea managed to reduce the breakeven price of development cost to around USD 25 per barrel which seems impossible in the high price oil environment (Biscardini et al., 2017). The cost saving efforts involved deferring or terminating projects that do not meet their profitable target and laying off their employees (Cunningham, 2014; Khan, 2016). The number of U.K offshore employees shown a reduction of 27% from year 2014 to 2016 (Oil and Gas UK, 2016). The adverse effect of this is that oil companies would have insufficient skilled workers to prepare themselves when the oil price rises again.

Other than the current low oil prices environment, Brexit (the departure of Britain from the European Union) also has an economic impact on the oil and gas industry in the UK. For instance, an additional cost was applied to import and export the goods or services to and from the European countries (Vaughan, 2017). In addition, there might be also restrictions of the movement of personnel in and out the European countries which might delay the industrial operations Throughout the low oil prices environment, it can be observed that oil and gas industry is working hard in managing their resources which stresses the relevance of studies on supply chain performance measurement.

2.8 Oil and gas industry in Malaysia

The drilling of the first oil well in Malaysia has started since 1910 and was officiated in the East Malaysia (PricewaterhouseCoopers, 2015). This operation produced only 83 barrels per day and then expanded to 15,000 barrels per day 20 years later. The oil and gas industry is a major economic contribution in Malaysia. It contributes to more than 20% of the total Malaysia GDP (Rajendran, 2015). The Business Monitor Institution Ltd. (2016) predicted a rising demand of oil consumption from 674,000 barrels per day in 2017 and will then observed an increase to 752,000 barrels per day by the end of the forecasted period which is in 2024. Meanwhile, domestic gas demand is forecasted to increase from 33.5billion cubic meter (bcm) to 38.1bcm over the same period.

For the explorations and productions activities, the operating locations have concentrated near to Kelantan and Terengganu, two states in the East Coast region of Peninsular Malaysia (PricewaterhouseCoopers, 2015). The other two operating areas are Sabah and Sarawak on the island of Borneo. The downstream sector currently has five oil refineries which provide a combined capacity of 492,000b/d. Three refineries are operated by Petroleum Nasional Berhad (PETRONAS) while Shell and Exxon Mobil operate one refinery each. Table 2-1 reports the amount of production in the five refineries (Energy Commission, 2014).

Table 2-1: Oil refinery capacity according to company (Energy Commission, 2014)

Oil company	Location	Thousand barrels/day
Shell Refining Co. (FOM) Bhd	Port Dickson, Negeri Sembilan	155
Esso Malaysia Bhd	Port Dickson, Negeri Sembilan	88
PETRONAS	Kertih, Terengganu	49
PETRONAS	Melaka	100
Malaysia Refining Company Sdn Bhd (PETRONAS/ ConocoPhillips)	Melaka	100

After decades of oil and gas production, Malaysian domestic resources are starting to deplete. To prepare for this, Malaysian government with PETRONAS are working together to strengthen other value creating activities in the oil and gas value chain. To do this, they are developing Malaysia into a leading oil and gas services hub in Asia. This is being conducted by expanding Malaysia's role in the oil storage, logistics, and trading and import LNG to serve latent gas demand and attract new gas-based industries. These efforts are made while developing energy efficiency diversification and a sustainable energy mix to meet future demands (Ministry of Energy Green Technology and Water, 2010).

2.8.1 Role of PETRONAS in Malaysia

PETRONAS was incorporated in 1974 as the Malaysian national oil company and is fully owned by the Malaysian government. Under the Malaysia Petroleum Development Act 1974, this organisation is entrusted with the entire ownership and control of the petroleum and natural gas resources in the country (PricewaterhouseCoopers, 2015; Business Monitor Institution Ltd., 2016). Thus, multinational companies such as Exxon Mobil, Shell, and British Petroleum are required to apply for the operating permits in this country. They also have to adhere to any regulations set by PETRONAS. This is conducted through product sharing contracts (PSC), where operated companies are accountable for the finance, management, and operations of the project, in exchange for the share of total productions values with PETRONAS.

PETRONAS has grown from merely being the manager and regulator of Malaysia's upstream sector into a fully integrated oil and gas corporation and is ranked among the FORTUNE Global 500® largest corporations in the world (Petronas Gas Berhad, 2016). It has scored various achievements locally and internationally since it was first built and is currently holding GBP107billion of assets (Petroleum Nasional Berhad, 2015b). Over the years, PETRONAS has developed local community with technical and operational competencies. This achievement promoted PETRONAS to become a strategic partner with international companies and the host countries where they operate. This realised PETRONAS's vision to become a "Leading Oil and Gas Multinational of Choice" (Petroliam Nasional Berhad, 2015b)

PETRONAS' business activities include both upstream and downstream sectors of the industry (Petronas Gas Berhad, 2016) as in Figure 2-1. These include:

- The exploration, development and production of crude oil and natural gas in Malaysia and overseas
- The liquefaction, sale, and transportation of Liquefied Natural Gas (LNG)
- The processing and transmission of natural gas, and the sale of natural gas products
- Refining and marketing of petroleum products
- The manufacturing and selling of petrochemical products; iii) the trading of crude oil, petroleum, gas and LNG products and petrochemical products.
- Logistic and distributions of its products

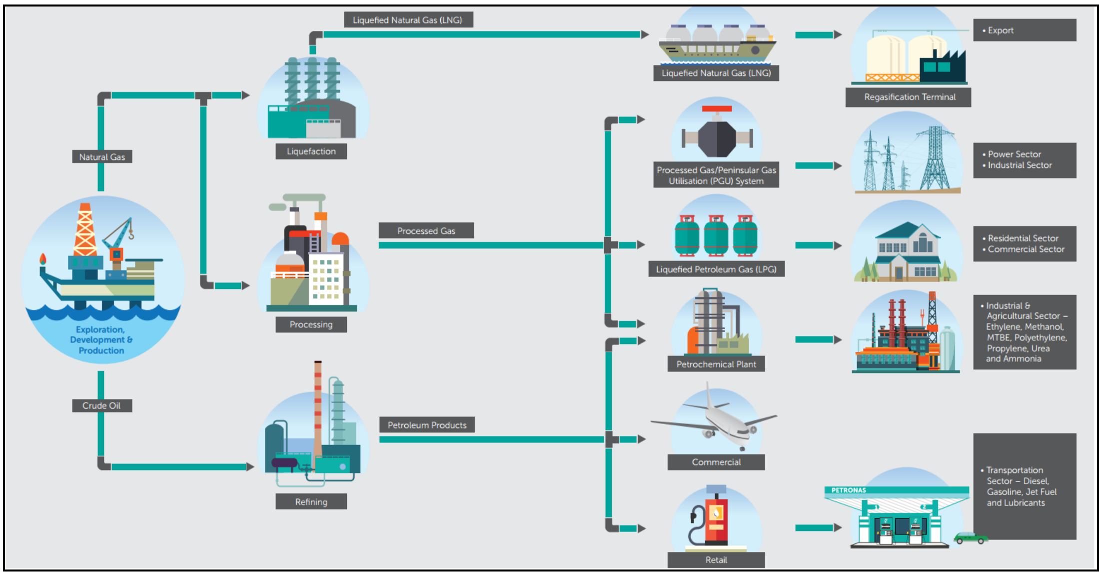

Figure 2-2: PETRONAS business activities (Petroliam Nasional Berhad, 2015b)

2.8.2 The impact of the drop of oil prices on the industry

The current drop of oil prices which has started since mid-2014 has severely impacted Malaysia’s oil and gas businesses. Several effects are delays in project execution for risk sharing contracts, potential reduction of future productions due to lack of investment in the low oil prices environment, and decrease in revenue (PricewaterhouseCoopers, 2015). This situation has led all major oil companies to exercise cost minimisation efforts while maintaining the production infrastructure at the same time (Kraal, 2016). These efforts are important to enable them to compete when the oil market recovers. In line with this, PETRONAS has led Cost Reduction Alliance or also known as CORAL amongst all major oil and gas operators as an effort to ensure this industry is still competitive and efficient (Hin, 2018). This CORAL programme focuses on 11 initiatives of cost reduction which are as follows:

- Capital expenditure (CAPEX) benchmarking
- Operational expenditure (OPEX) benchmarking
- Joint sourcing materials
- Late field life optimisation
- Low cost drilling
- Warehouse centralisation and control stocking
- Technical standard: fit for purpose wellhead platform design
- Technology replication thrust
- Logistic control tower: logistic planning collaborations
- Industry mutual hold harmless
- Data, system, and ICT infrastructure sharing

These initiatives which have been launched in 2015 have achieved cost reductions and amounted to USD 600million in the year 2015 alone (Pilong, 2016). Following the cost reduction achievement, this programme will be continued until the year 2019 (Petroliam Nasional Berhad, 2015a). Other than the above efforts, many oil and gas companies have laid-off their staff to reduce the operating costs. For instance, Petronas has laid-off around 1000 staff which are largely on contractual basis in the year 2016 alone (Sitheravellu, 2016).Similarly, Shell Malaysia would reduce 1300 of their employees in the upstream sector throughout 2017 to remain resilience in this low oil prices environment (Jalil, 2016; Offshore Energy Today, 2016). In addition, in terms of project execution, the CEO of Petronas stated that they decided to turn down any project that is not economically viable (Fuad, 2014). This decision is postulated considering the profits of the project would not only be affected by the low oil prices but also the cost imposed by the service provider. Thus, the impact of the low oil price would not only affect the oil and gas operators but will be transpired to all the service providers within the industry.

Similar to the situation of the oil and gas industry in the UK, many oil and gas companies in Malaysia are striving through this low oil prices environment by focusing on managing their resources efficiently (PricewaterhouseCoopers, 2015). The CORAL programme led by Petronas, minimising a number of staff by oil and gas companies, and review of project execution mirror this effort.

2.9 The oil and gas supply chain

Outsourcing has played a major role in the oil and gas supply chain due to its complex operation activities. Oil and gas firms normally outsource part of their functions to subsectors in order to minimise their operational costs, to overcome their limited manpower and expertise as well as to pass some of the supply chain risks to another party (Ernst & Young, 2014a).

The oil and gas supply chain is unique from other industries. Firstly, it has a very long link since it involves many parties from the exploration of oil and gas to the ultimate customer which is the oil and gas consumers (Varma et al., 2008). The functions involved in their supply chain include oil and gas exploration contractor, fabricator, engineering consultant, marine and transportation services. In line with this, HE Ali I. Naimi, the Saudi Minister of Petroleum and Mineral Resources, has pointed out that one of the challenges faced by the oil and gas supply chain is deliverability of the product. International collaboration efforts have been suggested in order to overcome this constraint across the supply chain (Organisation of Petroleum Exporting Countries, 2015).

Secondly, there is an involvement of expensive machinery and equipment and also specialised logistic services. Most of this equipment requires a specific maintenance and operation by skilled workers.

Thirdly, this industry is also influenced by political factors as most oil and gas industry businesses are controlled by the local government (Petroleum UK, 2013). Having said that, it is important to ensure the industry is well-managed as it will influence the financial status of oil and gas operating countries, public reputation as well as to maintain a sufficient supply.

Fourthly, for the upstream sector, the location of oil and gas drilling activities are determined by the natural oil and gas resources location. The oil and gas reservoirs' location vary and their existence underwater is beyond human intervention. In some cases, it might be far from basic amenities, which requires additional cost for the logistic services. In other industries such as manufacturing, the operating location might not part of their concern. In fact, an operating location near to distribution stores would minimise their cost in reaching the customer. Even though refinery process in the downstream sector might not need to be at a remote location as in the case of the upstream sector, there are some restrictions applied which are driven by environmental concerns. These restrictions include the location needs to be far from residential areas due to potential hazardous impact on people. Moreover, it needs to be operated in an area that has sufficient energy supply for their operation. In most cases, refinery plants are located near to a coast to make it easy to be accessed by the crude oil tanker (International Energy Agency, 2012).

Finally, the industry is subjected to thigh exposure of risks which require specific mitigation and measures to prevent accidents (Varma et al., 2008; Mearns and Yule, 2009). This factor needs to be considered in managing the supply chain to ensure all operations are safe for people, equipment, and the environment.

The diverse sectors (upstream and downstream) and the multiple business activities within the sectors require a comprehensive understanding of the industry to enable efficient supply chain management. The involvement of many business functions within the industry makes it a necessity for the oil and gas companies to outsource some of their non-core activities through their supply chain networks.

Varma et al. (2008) who investigated the downstream sector (petroleum refineries) supply chain argued that there are several characteristics of the industry which require a separate treatment. These include process industry, flammability, contamination, bulk volumes, high transportation cost, long supply chain, and fluctuation of raw material prices. Even though issues raised by Varma et. al. (2008) are focused toward the downstream sector of the industry, the uniqueness and characteristics of the supply chain in the upstream sector require the same if not more attention.

2.9.1 Supply chain link in the oil and gas industry

According to Chima and Hills (2007), the major supply chain link in the oil and gas industry includes exploration, production, refining, marketing, and consumers. The exploration sector involves seismic, geophysical, and geological operations. Production activities include drilling, crude oil production, and fabrication of exploration facilities. Marketing is considered as a downstream sector of the industry and is responsible for selling the final product of refined oil to the ultimate consumer. Figure 2-3 illustrates the supply chain link of the oil and gas industry.

The left side of the figure displays the five main activities involved in the oil and gas industry. Meanwhile, major supply chain parties involved in each activity are listed on the right side. As presented in Figure 2-3, exploration activities create values to the production operator, refining operator is the customer to the production operator. On the other hand, marketing is the customer to the refining and the ultimate customer is the consumer of refined products such as gasoline and petrol (Chima and Hills, 2007). They argued the weakness of the supply chain of this industry is that each company tends to work in its own best interest to optimise profit which may not take into account to satisfy the ultimate customer, refined oil consumers.

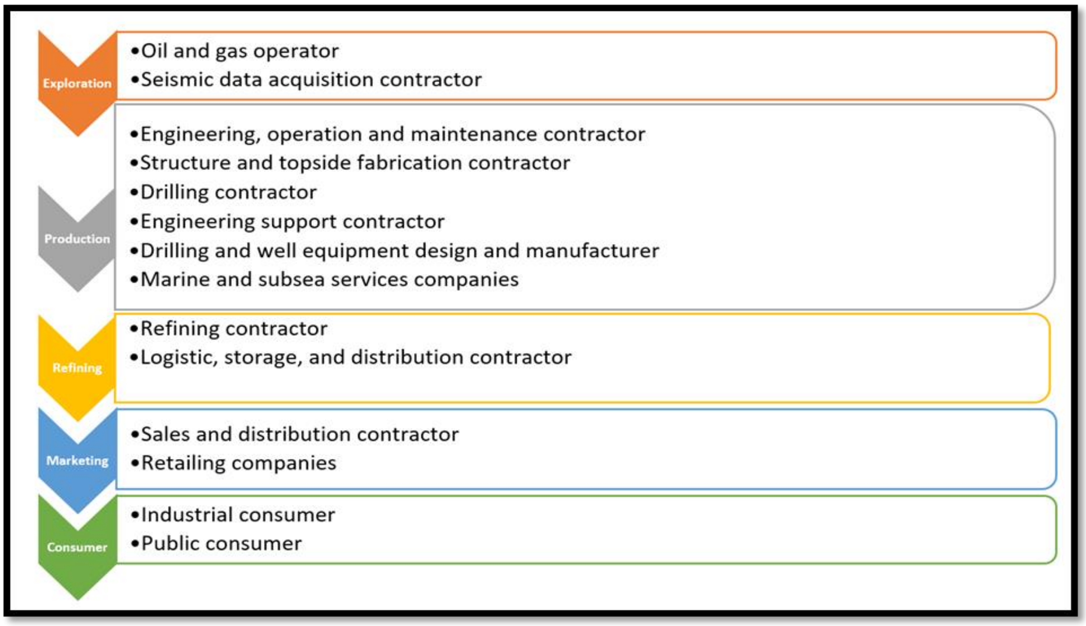

Figure 2-3: The oil and gas supply chain link (Chima and Hills, 2007; Ernst and Young, 2016)

In the current situation, the prices of end products are not determined by the ultimate customer, instead by the world's oil prices (Ernst and Young, 2014). Therefore, in most cases, oil and gas companies always try their best to satisfy the higher tier of the oil and gas supply chain at the lowest cost possible instead of focusing on the refined oil or gas consumers. There may be an exception in the retail sector.

2.10 Performance measurement

According to the Oxford dictionary, performance is defined as how well or badly task or operation is performed (Parkinson, 2005). Therefore, performance of tasks or individuals has to be measured in order to make improvements. The importance of measuring performance has been widely recognised in many fields. For instance, in the medical industry, there is a need to measure patients' health in terms of body mass index (BMI), the level of sugar in the blood, also other matters such as patients' cholesterol levels. This measurement is very important to track the individual health progress if any medical intervention is applied. The results of measurements are then compared to the previous patients' record and guideline values are derived throughout research in this field. On the other hand, many self-development books emphasise on the need to track and measure self-performance (Covey, 2004; Pavlina, 2008).

In business management, a lot of research has been conducted to measure company performance. All organisations are measuring performance whether systematically or informally (Parker, 2000). The importance of performance measurement in an organisation encompasses multiple functions including engineering, marketing, finance, logistics, operations, accounting, information technology, and human resources (Bai and Sarkis, 2012). This pervasive organisational interest makes the use and application of performance measurement a strategically and operationally vital activity.

The using of measurement in the business operation (manufacturing industry) began in late 19th and early 20th century. The idea came from Frederick W. Taylor who is known as the father of applying the scientific method in running businesses. In the early stage, this idea led to exaggerated controlling and monitoring of the individual employee. Over time, the workplace view of measuring performance increased in its maturity whereby it focuses more on business performance than individual performance. This development has also been highlighted by Cox (1989) where he claimed that performance to schedule criteria should evaluate groups instead of individuals.

There are many research emphasis on the need to evaluate team performance of an organisation (Cowen et al., 1987; Scott and Tiessen, 1999; Franco-Santos et al., 2012). Team performance usually has the advantages over individuals considering various knowledges that each individual has within a team (Scott and Tiessen, 1999). In fact, measuring individual performance is considered as traditional measuring system and might discourage individuals to work as a team (Neely et al., 1997). Moreover, Vickery et al. (2010) asserts that supply chain can only be strategically managed as a single entity. To achieve this, there is a need to integrate individual functions as one business entity in enhancing performance. A study by (Yusuf et al., 2014) showed that a strong team work positively influence non-financial dimension of an organisation such as better customer loyalty and enhance performance relative to competitor. Scott and Tiessen (1999) claimed that an organisation increasingly relying on team as complexity of business operations increases. Therefore, measuring team performance has a greater importance in a complex business environment such as the oil and gas industry, which requires innovation and problem-solving skills.

The outcomes of performance measurements are normally compared to their past performances and their organisations' targets. This is to ensure that all the organisations' missions are achieved within the stipulated time. In certain cases, company performance is compared to their equivalent competitor to ensure it is sustainable through the constantly changing business environment. The performance of Toyota and Honda is a good example of this benchmark comparison (Liker et al., 1996; Sara, 1998). This analysis is important for an organisation to improve in the areas where they are underperforming and to focus on their strengths for better performance. In management research, performance measurement is defined as the process of quantifying action where measurement is the process of quantification and action leads to performance (Neely et al., 1995). It is also described as "the process of determining how successful organisations and individuals have been in attaining their objectives and strategies." (Evangelidis, 1992). Selection of appropriate performance measures is crucial in managing a business as we cannot manage what we cannot measure (Sink and Turtle, 1989). Beamon (1999) claimed that difficulty in selecting appropriate measures includes the issue of scope on either to consider a single organisational measure or multi-organisational measures, or it shall include one product or the whole products.

2.11 Supply chain performance measurement

In todays' market, most organisations rely on their supply chain network to deliver their services and products. This situation requires the organisation to focus their efforts on supply chain management. To ensure the organisation can achieve competitive advantage through their supply chain, measuring performance is very important (Gunasekaran et al., 2004; Agrell and Hatami-Marbini, 2013). A set of standard measures needs to be introduced to allow comparison between planned and actual performance. The outcomes of performance measurement could help organisations in activating rectification action and for the implementation of the improvement plan. In fact, research suggests that the poor performance of supply chain is due to the lack in their performance measurement framework which is an important tool in managing efficiency and effectiveness (Gunasekaran et al., 2004; Varma et al., 2008).

2.11.1 The definition

In order to understand issues in performance measurement, it is vital to know the distinction between performance management and performance measurement. The performance management involves the process of assessing between the planned and the actual performance, the understanding of why shortcoming take places, and the process of implementing rectification action (Melnyk et al., 2014).

On the other hand, performance measurement is the tool to gather performance information of an organisation (Bititci et al., 1997; Melnyk et al., 2014). This tool will enhance the effectiveness and efficiency of the performance management process. Neely et al. (2005) refer to effectiveness as organisational capacity to meet customers' requirements. How economically an organisation utilises their resources in meeting customer requirement is regarded as their efficiency. For instance, in terms of effectiveness, strong product reliability would be able to enhance customers' satisfaction. At the same time, from the efficiency aspect, it might decrease the cost incurred by the organisation through the reduction of warranty claim (Neely et al., 2005). From these examples, Neely et al. (2005) proposed several definitions around performance measurement. They defined performance measurement as the process of quantifying the effectiveness and efficiency of a given task. Meanwhile, performance measures are defined as a metric used to quantify effectiveness and efficiency of the given task (Neely et al., 2005). Finally, performance measurement framework is considered as the set of metrics used to quantify both the efficiency and effectiveness of a given task (Neely et al., 2005). Maestrini et al. (2017) further expand the definition of performance measurement framework based on the need to include external functions such as customers and suppliers. They defined performance measurement framework as "a set of metrics used to quantify the efficiency and effectiveness of supply chain processes and relationships, spanning multiple organisational functions and multiple firms and enabling supply chain orchestration" (Maestrini et al., p. 301). Assessing the whole supply chain functions requires information sharing which might be challenging, particularly with external functions.

2.11.2 Research on supply chain performance measurement

Academic interest in supply chain performance measurement can be viewed from the high number of research discussions on this subject. The research on this subject has started in the early 1980s when the authors expressed the need for the development of balanced and comprehensive performance measurement (Bourne et al., 2000). They argued that the new frameworks should be designed to encompass the need to evaluate both financial and non-financial measures (Kaplan and Norton, 1992; Bourne, 2000).

Traditional performance measurement framework which focused on costing and accounting has received a lot of criticism as only being suitable for short-term success (Kaplan and Norton, 1992; Bititci et al, 1997; Bourne, 2000). Similarly, Parker (2000) argues that the focus on financial measures are inward looking and discourage inter-organisation comparison. He also contends that the framework does not include intangible factors such as product or service reliability and are lagging indicators as it reports past events. On the same tone, Bititci (1997) claimed that organisations that only focus on financial measures might discourage continuous improvements.

Gunasekaran and Kobu (2007) stated that the performance measurement style around the 1990s used total absorption costing where overhead cost is assigned based on the working hours. Nowadays, the machine hours are used as a basis in computing overhead cost. Nevertheless, they claimed due to the application of outsourcing in the current business, activity-based costing is no longer relevant since this can be replaced by value-based costing or performance measurement system.

Apart from that, most of the traditional PMF focuses on the internal aspects of organisations and does not take into account the external functions such as suppliers and customers which are also important (Maestrini et al., 2017). In addition, Overton (2014) claimed that measuring the supply chain is not a straightforward process. He contends some of the quantification parts such as order fulfilment are easier to measure than employee skills or effective communications across the supply chain. In other words, an organisation needs to measure the performance of the whole supply chain process and not only concentrate on the end product such as order fulfilment (Varma et al., 2008).

2.11.3 The need for measuring supply chain performance

Measuring supply chain performance is very important in today's business environment. A comprehensive PMF would help organisations in various management issues. These include;

- Identifying current performance (Parker, 2000; Gunasekaran et al., 2004; Bai and Sarkis, 2012)
- Increasing employees motivation (Kaplan and Norton, 1992; Neely, 2005; Groen, Wouters and Wilderom, 2012)
- Identifying customer satisfaction (Parker, 2000). Moreover, it also helps organisations in tracking the effectiveness of improvement plans (Parker, 2000; Gunasekaran et al., 2004)
- Aids the decision-making process (Parker, 2000).

Despite the fact that research interest in supply chain performance measurement has gained popularity throughout the years, Matresini et al. (2017) argued that it is still new and incomplete for various reasons. Firstly, the SCM scope began to evolve from being identified as integrated logistic functions just two decades ago (Lambert and Cooper, 1997). Secondly, different functions such as operation management, information management, and accounting usually use different labels. Similar to the supply chain concept, performance measurements are unique and different from one industry to another (Bai and Sarkis, 2012). This makes the research in performance measurement on industry-specific necessary. There are a number of empirical studies which have been conducted on PMF in various fields. Nevertheless, some industries such as oil and gas are still considered underexplored. Table 2-2 sets out the empirical studies on the performance measurement according to industry.

It can be observed from the table that there is a lot of research on performance measurement has been conducted on specific industries. Manufacturing industry seems to receive a lot of attention by researchers. Similar studies on other industries are still very limited. Even though there is a study on the oil and gas performance measurement as conducted by Varma et al. (2008), it focuses only on the downstream industry. The upstream sector which is more complex is not considered in their study. This raise a question on what are the prevalence performance measures to represent the oil and gas industry as a whole. Moreover, Varma et al. (2008) work proposes the prevalence of the performance measure and do not consider its applications.

Table 2-2: Research on performance measurement according to industry

Industry	**Authors**
Manufacturing	-Khani and Ahmadi (2012) -Bourne (2000) -Sambasivan et al., (2009) -Lucato et al. (2014) -Cheng et al. (2014) -Martínez Sánchez and Pérez Pérez (2005)
Hospital	-Chen et al. (2013)
Oil and gas	-Varma et al. (2008)
Food industry	-Groen et al. (2012) -Shafiee et al. (2014)
Public sectors	-Spekle and Verbeeten (2014) -Zin et al. (2013) -Greatbanks (2007)
SME	-Bhagwat and Sharma (2007)
Banking organisation	-Davis and Albright (2004)
Construction industry	-Halman and Voordijk (2012)
Agriculture	-Sharma et al. (2017)
Garment	-Sukwadi et al. (2013)
Mixed industries	-Lee and Yang (2010) -Bititci et al. (2015) -Gunasekaran et al. (2004) -Li et al. (2011) -Elrod et al. (2013)

2.12 Supply chain performance measurement framework

Performance measurement framework is defined as a set of performance measures used to assess organisational performance (Neely et al., 2005). "The term framework refers to the active employment of particular sets of recommendations" (Folan and Browne, 2005). There are several dimensions of performance measurement frameworks proposed by different authors as a tool for measuring performance as shown in Table 2-3.

Table 2-3: Type of performance measurement framework

Author and type of PMF	PMF dimension
Balanced scorecard (Kaplan and Norton, 1992)	-Financial -Internal process -Innovation and improvement -Customers
Component of performance measures (Beamon, 1999)	-Resource utilisation -Output -Flexibility
Supply chain process SCOR Model (Supply chain council, 2013)	-Plan -Source -Make -Deliver -Return
Hierarchical level (Gunasekaran et al 2001)	-Strategic -Tactical -Operational
Measurement based (Beamon, 1998)	-Quantitative -Non-quantitative

2.12.1 Balanced scorecard

Due to the inadequacies of traditional performance measures, Kaplan and Norton (1992) introduced a performance measurement framework called balanced scorecard. This framework consists of four main perspectives which are financial perspectives, customer perspectives, internal business perspectives, and innovation and learnings perspectives. This framework is the one most widely cited frameworks in the performance measurement literature (Gunasekaran and Kobu, 2007; Gopal and Thakkar, 2012). Despite that, Neely (2005) argued that the balanced scorecard is missing one essential element which is competitor perspectives. Nevertheless, Neely (2005) does not deny its benefit in measuring performance. In fact, it is a very good starting point for the development of the research in performance measurement. For instance, one research by Fan et al. (2013) expanded the dimension by proposing supplier dimension as the fifth dimension of this framework.

2.12.2 Component of performance

Driven by the need to have a comprehensive PMF, Beamon (1999) proposed a framework consisting of three main elements, namely resource, output, and flexibility. This component of measures can be classified based on the characteristics of the supply chain. For instance, resource utilisation could be the information system such as enterprise resource planning (ERP) which provides the right information for to assist in the decision-making process. This will eventually enhance organisations' competitive advantage(Gunasekaran and Kobu, 2007). Beamon (1999) argued resource, which is generally focused on cost, while output which emphasises customers, have been widely used by many organisations. There is a need to cater a non-directly quantified measurement which is flexibility. Despite not being very popular at that time, this measure that looks at how well an organisation respond to uncertainty which has many advantages to the overall supply chain.

2.12.3 Supply chain process

The supply chain council proposed a framework; the supply chain operation reference (SCOR) model (Shepherd and Gunter, 2006). This model consists of five supply chain processes, namely, plan, source, make, deliver and return. Even though this model is widely used in practice, it received little attention in the academic field (Taticchi et al., 2013)

2.12.4 Hierarchical level

The hierarchical performance framework is designed to reflect performance measures pertinent to the level of decision makers (Gunasekaran et al., 2001; Perera et al., 2013). The strategic level measures focus on top management decisions, which usually capture the organisations' policies, overall financial goal, competitiveness, and level of compliance with organisation goals. For instance, in the oil and gas industry, safety is stressed as their first priority (Mearns and Flin, 1995). Thus, the performance measures in the strategic levels ensure that this goal is included as part of their policy. Then, these performance measures cascade down to the tactical level. Thus, a manager at this level deals with resources management and measuring performance to meet the objective set at the strategic level.

The operation level deals with day-to-day business activities and ensures all the performance of these activities is measured. This enables the performance measures set by the tactical level is met. This framework was presented by integrating it with the SCOR model dimensions which are plan, source, make, deliver and return (Gunasekaran et al., 2001). Gunasekaran and Kobu (2007) argued that some research either concentrated on process-based metrics or strategy-based measures. They contend that both aspects are supposed to complement each other in attaining the goals at various levels of the decision-making process.

2.12.5 Measurement based

Beamon (1998) proposed to categorise performance measures based on quantitative and qualitative functions. The author argued that qualitative measures focus on the area that has no direct numerical measurement. These include;

- customers' satisfaction
- flexibility
- information and flow integration
- effective risk management
- supplier performance

On the contrary, the quantitative performance measures are those that can be quantified in numerical forms. The quantitative measures are categorised into objectives that are based directly on cost and profit and objectives that are based on some measure of customer responsiveness. Chan (2003) expands this concept to derive PMF by proposing additional qualitative aspects such as visibility, trust, and innovativeness.

The dimensions of PMF presented earlier acts as a guiding principle with the aim of having a balanced approach in measuring supply chain performance. Performance measurement framework is considered successful when the framework is valid and provides the right picture. It should also be complete and covers all important issues in an organisation with an adequate number of measures and possesses accountability for every measure (Laisasikorn and Rompho, 2014). These performance measurement dimensions are not necessarily used separately. In fact, there is some research that integrates the different dimensions of PMF in designing their measurement system (Gunasekaran et al., 2001; Shepherd and Günter, 2006).

2.12.6 Developing performance measurement framework

Bourne (2000) proposed four phases in developing a performance measurement framework;

1) The design of a performance measurement framework
2) The implementation of a performance measurement framework
3) The use of a performance measurement framework
4) The review and update of a performance measurement framework

The design phase involves identifying key objectives and initiating the measurement design. The second phase deals with the implementation and procedure used to collect data. Maestrini et al. (2017) argue that the use of a reliable information system is important, particularly in gathering data to assess the external functions. In the usage phase, managers apply the PMF in collecting performance information. The review and update are necessary for the last phase to ensure the PMF reflects the current needs (Bai and Sarkis, 2012). Maestrini et al. (2017) argued that a lot of research has concentrated on the design and implementation of supply chain performance measurement. The other two later phases, the use of PMF and the review and update received very minimal attention by the researchers. One of the reasons for the lack of research in this area is the difficulty of getting access to information from companies.

This research explores the first phase which is the design of PMF. Bititci et al. (1997) claimed that there are two critical elements in the performance measurement framework which are integrity of framework and deployment. The integrity of the framework refers to its ability to integrate various business functions. On the other hand, deployment is to ensure that performance measures used throughout the various levels of management are aligned with the organisations' policies and objectives. Table 2-4 provides some examples of performance measurement framework in the literature.

Table 2-4: Performance measurement frameworks

Authors	**Type of framework**	**Performance measures**
Gunasekaran et al (2001)	Hierarchical level	Strategic: Total supply chain cycle time Total cash flow time Customer query time Level of customer perceived value of product Net profit vs productivity ratio Rate of return on investment Range of product and services Variations against budget Order lead time Flexibility of service system to meet particular customer needs Buyer-supplier partnership level Supplier lead time against industry norm Level of supplier's defect free delivery Delivery lead time Delivery performance Tactical: Accuracy of forecasting techniques Product development cycle time Order entry methods Effectiveness of delivery invoice methods Purchase order cycle time Planned process time Effectiveness of master production schedule Supplier assistance in solving technical problem Supplier ability to respond to quality problems Supplier cost saving initiatives Supplier's booking in procedures Delivery reliability Responsiveness to urgent deliveries Effectiveness of distribution planning schedule Operational: Cost per operation hour Information carrying cost Capacity utilisation Total inventory as: -Incoming stock level -Work in progress -Scrap level -Finished goods in transit Supplier rejection rate Quality of delivered goods Achievements of defect free deliveries

(Continue) Table 2-4: Performance measurement framework

Authors	Type of framework	Performance measures
Varma et al. (2008)	Balance scorecard	Customer perspectives: Purity of products Steady supply of finished product Financial perspectives: Raw material prices Length of supply chain Physical risks Market share Internal business perspectives: Steady supply of raw material Transportation cost Inventory costs Integration with supply chain partners Optimisation of enterprise Volume flexibility Innovation and learning: Use of IT Postponement
Beamon (1999)	Component of performance measures	Resource: Total cost Distribution cost Manufacturing cost Inventory cost Return on investment Output: Sales Profit Number of items produced Production time Number of on-time deliveries Customer response time Manufacturing lead time Shipping errors Number of customer complaints registered Product quality Flexibility: Volume flexibility Delivery flexibility Mix flexibility New product flexibility
Gunasekaran and Kobu (2007)	Process based measures	Plan Return on investment Selling price Labour efficiency Perceived value of product Product development cycle time Bidding management cycle time Compliance to regulations Forecasting accuracy Perceived value of product Supply chain response time Source: Scrap cost Selling price of goods/ services Labour efficiency

(Continue) Table 2-4: Performance measurement framework

Author	Type of framework	Performance measures
(Continue) Gunasekaran and Kobu (2007)	Process based measures	Product development time Procurement lead time Delivery reliability Product and service variety Make: Scrap cost Inventory cost Selling price of goods/ services Value added Labour efficiency Conformance to specifications Capacity utilisation Lead time for manufacturing Production flexibility Process cycle time Accuracy of scheduling Product and service variety Deliver Overhead cost Value added Inventory cost Stock-out cost Transportation cost Warranty cost Labour efficiency Delivery reliability Perceived value of product Product and service variety Perceived quality

The examples of PMF listed in Table 2-4 can be used as a guideline in measuring performance in various industries. However, applying these measures on individual companies might need further considerations. Managers need to understand the key performance measure based on their organisations' strategies. For instance, in the automobile industry, inventory turnover might be a key performance measures for the industry to minimise inventory cost and delays in productions (Gunasekaran and Kobu, 2007). In contrast, flexibility in terms of product variety could be the key measure for the fashion industry. These examples indicate the need for further research on performance measures for industry specifics (Gunasekaran et al., 2004; Shepherd and Günter, 2006; Gunasekaran and Kobu, 2007; Taticchi et al., 2013).

2.12.7 Several considerations in designing and implementing PMF

The literature addresses several considerations in designing and implementing the PMF. Understanding these issues enables practitioners to prevent problem arising after the implementation of PMF

2.12.7.1 The considerations in designing PMF include;

- Performance measures need to be derived from the organisations' strategy (Parker, 2000; Gunasekaran et al., 2004; Neely, 2005). For instance, organisations' strategy to either focus on local or international markets will also influence the selected performance metrics. In one empirical study conducted by Wee et al. (2010) on outsourcing strategy in the Taiwanese industry, 45.4% of the target industries export more than half of the national gross production and 66.6% of the companies which focus on local markets deploy outsourcing strategy. This scenario shows that organisations strategy will influence their outsourcing rate as well as other management approaches. Therefore, it is important for a supply chain manager to align their performance measures with their strategy.
- PMF needs to be easy to understand by supply chain members and should limit the possible opportunity for manipulation (Gunasekaran et al., 2004; Neely et al., 2005; Gunasekaran and Kobu, 2007). This can be conducted by using few measures that are critical in determining the success of an organisation (Gunasekaran et al., 2004).
- The performance measures used should be able to capture the true picture of organisational performance (Bai and Sarkis, 2012).
- PMF should be balanced between financial and non-financial measures (Gunasekaran et al., 2004).
- Taxonomic consideration: PMF may need to be designed according to hierarchical level (strategic, tactical and operational) (Gunasekaran et al., 2004) and functional differentiation (Bai and Sarkis, 2012). This is to address accountability of measures on specific level of authorities.
- All supply chain parties should be involved in developing PMF to ensure their expectations are addressed and reflected in the measures (Gunasekaran et al., 2004; Bai and Sarkis, 2012).

- The information must enable decision-making process (Bai and Sarkis, 2012).
- There are too many measures and the organisation continue to add further measures based on suggestions from employees and consultants. They failed to acknowledge that performance measures would work better using only a few critical measures (Gunasekaran et al., 2004; Neely et al., 2005; Gunasekaran and Kobu, 2007; Bai and Sarkis, 2012)
- Intangibles measures can be adopted at the higher decision level (i.e.: strategic level) while measures that can be directly quantified are suitable for the operational and tactical level. Financial measures are suitable to be used at the strategic level as their information is useful in the decision-making process (Gunasekaran and Kobu, 2007).

2.12.7.2 Several considerations in the literature with regards to PMF implementation are:

- There is a need to apply a proactive approach rather than reactive in performance improvement. Information technology is a good tool to reduce time between performances' assessment and rectification works (Gunasekaran and Kobu, 2007)
- Communication through meetings and information sharing is the key in overcoming behavioural and political barriers in managing performance (Gunasekaran and Kobu, 2007).
- The PMF needs to be updated from time to time in response to market environment and organisations' strategies (Gunasekaran and Kobu, 2007).
- There are a growing need for measuring sustainability factors such as environmental (Perera et al., 2013; Youn et al., 2013), safety, and social responsibility measures (Chenhall and Langfield-Smith, 2007; Gunasekaran and Kobu, 2007).

2.13 Performance measures

This section discusses some performance measures that are widely cited in the literature. These include delivery speed, delivery reliability, quality, flexibility, and forecast accuracy. Moreover, it also discusses financial measures, process compliance, and safety measures. In addition, other sustainable measures that have received much attention from researcher and practitioner nowadays are social responsibility and environmental measures which are also included.

2.13.1 Delivery speed

Delivery speed is a metric used to assess the ability of an organisation to deliver services or goods within the agreed time (Ketchen and Hult, 2007). Delivery speed is regarded as one of the organisations' competitive priorities (Chen and Paulraj, 2004; Yusuf et al., 2014). For activities that involve various business functions, delay in one area might affect the consequent events. This eventually will affect customer satisfaction and increase the inventory cost. There are various factors that influence this performance including vehicle speed, driver reliability, frequency of delivery, and depots' location (Gunasekaran et al., 2004)

2.13.2 Delivery reliability

Delivery reliability is a criterion regarding the performance of a company/supplier in delivering the ordered goods/ services to the right place, at the agreed time, in the required quantity and quality (Huang and Keskar, 2007). The delivery reliability measures are the combination of delivery performance, fill rate, and perfect order fulfilment (Cagnazzo et al., 2010). This measure was ranked as the second important competitive priority after quality in the oil and gas industry (Yusuf et al., 2014). Moreover, Ho (2007) claimed that this measure is critical in assessing the performance of supply chain members. Another author, Kim (2009) claimed that delivery reliability can be achieved by supply chain integration.

2.13.3 Quality

Quality is defined as the ability of an organisation to deliver services or goods to meet the minimum standard required by the customers. The management of suppliers' quality has a direct association with high level of overall quality, reduced variation in quality performance, and minimisation of costs (Cagnazzo et al., 2010). Kannan and Tan (2005) who investigated the link between JIT, TQM, and SCM with business performance found that quality indicates a positive correlation with all business performance measures except return on asset (ROA). In a similar note, due to an increase in reliance on outsourcing activities, there is a growing area of research around quality management and supply chain management focusing on suppliers' quality (Soltani et al., 2011). The authors claimed that focusing on suppliers' quality is very important as it can affect the overall cost of products/ services. Moreover, poor quality performances could impact their revenues and diminish customer and stakeholders' trust (Li et al., 2011; Soltani et al., 2011). For instance, due to improper supply chain quality assurance, a world renowned automobile manufacturer had to recall millions of its vehicle due to issues with the brake and floor mat (Li et al., 2011).

Another example of poor quality control is the event of adulterated milk in China (Chen et al., 2014). The finding shows that this incident was caused by improper quality control at the supply chain network. Some studies suggest information technology can improve quality standards through data accuracy, timely communication, and integration of information (Li et al., 2011). However, the reliance on automated systems or guidelines should not undermine employees' own observations and decisions. In their case study, Vanichchinchai and Igel (2011) imply some problems arise when employees practice stringent quality compliance without a proper understanding of SCM urgencies. Thus, when quality problems arise, they have no standardised guidelines to follow in order to resolve the problem. This will eventually result in longer lead times and higher costs. Therefore, Vanichchinchai and Igel (2011) concluded that training on quality awareness is very important. The examples of quality measures include product quality, services quality, quality of delivered goods, and quality of documentation.

2.13.4 Flexibility

Flexibility in SCM is very important as it assists the responsiveness of a company to uncertain demand in today's business environment. A flexible supply chain can be regarded as having the capacity to meet the changing demands of customers (Gunasekaran et al., 2004; Ketchen and Hult, 2007). This includes flexibility in the supply chain process and with the end products or services delivered to customers. A flexible supply chain is important, particularly to meet special requirements by providing a variety of service or goods. It is also critical in supporting new products introduction (Chan, 2003). From a manufacturing perspective, flexibility is defined as; “the capability of a manufacturing system or facility to effectively address uncertainty from a wide variety of sources, yet continue to produce efficiently different products or product volumes of acceptable quality, cost, and timeframe”(Boyle and Scherrer-Rathje, 2009). The importance of flexibility has been widely discussed in the supply chain literature. Amongst the earliest research that recognised flexibility as one of the important elements in supply chain performance was undertaken by Beamon (1999). The need for flexibility in the industry is driven by uncertainty in the business environment (Boyle and Scherrer-Rathje, 2009).

Boyle and Scherrer-Rathje (2009) who investigated flexibility with lean management argued that some flexibilty in activities might contradict the lean philosophy adopted by organsiations. For instance, back-up machines or materials in the case of urgency might be a way to enhance flexibility through uncertainty management, however, it decreases the lean practice goals of waste reductions. Nevertheless, Boyle and Scherrer-Rathje (2009) found that flexibility can best be achieved by reducing uncertanties through lean practices. From the lean perspectives, interviewed managers proposed some practices to improve flexibility including measuring performance, providing visual displays, and performing data collection and analysis. Some examples of flexibility measures are (Gunasekaran et al., 2004);

- product development cycle time
- order lot size
- machine set up time
- number of inventory turns

2.13.5 Forecast accuracy

Forecast accuracy is the ability to accurately estimate some unknown future events (Fleischmann and Meyr, 2003). This measure is important in reducing inventory levels and eventually increase organisations’ cost savings (Ramanathan, 2014). Oil and gas associations such as OPEC and IEA emphasise forecasting accuracy to ensure that their productions are able to meet markets’ demand. Moreover, they also forecast the capacity of natural resources in the country of operation to estimate the energy futures in the long run. Fleischmann and Meyr (2003) argued that accurate forecasts allow organisations to tailor their productions based on the forecast instead of orders which speed up the process. Moreover, they contend that some goods have seasonal demand patterns. Hence, the inventory level, products quantities, working times, cost and potential revenues need to be planned in advance using the forecast information. In the implementation of make-to-order strategy, contingency stocks need to be introduced to deal with unavoidable forecast error.

2.13.6 Process compliance

Process compliance is focused on the ability of business functions to work according to the standard process requirements set by the organisation (Becker et al., 2012). Employee compliance with the business process is important from the organisations' policy and management efficiency perspectives (Hadasch et al., 2016). In fact, non-compliance with the business process might lead to financial law suits. Legal guidelines such as business process compliance are designed to overcome the issue of financial manipulations. Hadasch et al. (2016) investigated the effect of directive explanation on employees' compliance with business processes.

Directive explanation gives workers guidelines rather than forcing them to comply with certain process. This study was motivated by previous literature that indicates process rigidity negatively affects productivity. The findings indicate that directive explanation improves employees' overall compliance performance. This study shows that compliance measures need to be designed in a way that enables them to meet regulatory requirements and does not diminish overall productivity at the same time.

El Kharbili et al. (2008) proposed four process compliance management cycles. These include compliance measures definition, compliance policies design, compliance policies implementation, and compliance policies controlling. They also claimed that there are two types of compliance checking, namely, passive and active. The active compliance checking is when the business operations control process compliance while the passive compliance is when their operations are controlled by the process compliance.

What the compliance checking methods have in common is that they have rule patterns, such as Task A must go through certain processes before proceeding with Task B. This rule is then compared with the actual scenario. In the actual situation, this compliance assessment has two major challenges which are a large number of conceptual model techniques and the complexity of regulations and compliance rules (Becker et al., 2012). The authors also found the use of performance measurement approach to assess business process compliance. This assessment is normally conducted by internal and external auditors (El Kharbili et al., 2008). Nevertheless, the needs of employees and management understanding of the business process compliance requirement of an organisations is very important. This is because the outcomes of auditing activities would only provide past event results which might be too late to be rectified.

2.13.7 Financial

Financial measures focus on the monetary goals of an organisation. Examples of financial measures include cost savings, return on investment, and return on asset. These measures were recognised as the most important element in measuring performance long before non-financial measures such as operation measures were introduced (Kaplan and Norton, 1992). Varma et al. (2008) argued that focusing on financial measures alone is only suitable for simple SCM applications. Nevertheless, these measures are required for measuring organisations financial situations and especially important to provide information for stakeholders and potential investors. Gunasekaran and Kobu (2007) contend that financial measures are still the most widely used criteria in measuring organisations' performance. This shows that they have a major role in supply chain performance, especially with regards to the decision-making process.

2.13.8 Innovation

Innovation is the ability of an organisation to innovate its strategies, services or products, or operations to attain a competitive advantage over their competitor (Chima and Hills, 2007). Increase in customers' expectation is one of the key drivers of services and products innovation (Bhagwat and Sharma, 2007). The earliest literature on innovation concentration is on the advancement in technological information. This focus then expanded to creating value-added innovation (Lin et al., 2010). Despite its importance in improving supply chain management, Gunasekaran and Kobu (2007) found only 27% of organisations consider this measure in assessing supply chain performance. Two possible reasons for this are this measure is neglected by the researcher or this measure is still lacking in practice in the industry (Gunasekaran and Kobu, 2007)

In addition, a study shows that innovation activities are more prevalent in larger companies than in SME. Technologies and information barriers as well as capital and labour constraints hinder SMEs' innovations (Thakkar et al., 2009). A performance measurement study in the house building industry found that the lack of continuous supplier integration is the main reason which limits innovations (Halman and Voordijk, 2012). They also suggest some performance measures such as new product introduction may be not relevant to their industry as it might not be one of their main concerns.

Other innovation measures suggested by them include building development time, building development cost, new techniques and material, and improving competences. In the same vein with Halman and Voordijk (2012), another study indicates a positive association between innovation with supplier integration and organisations' competitive advantage (Lin et al., 2010). Moreover, Lin et al. (2010) claimed that innovation can be achieved through supply chain activities. Bhagwat and Sharma (2007) proposed a few examples of innovation measures, which include supplier assistance in solving technical problems, supplier ability to respond to quality problem, supplier cost saving initiatives, and level of customer perceived value of products.

2.13.9 Safety measures

Safety measure is the most important criterion for a high risk industry (UNEP, 1997; Zhao et al., 2017). This measure is required to ensure the workplace/ operations are safe for the people, equipment, and environment (Zhao et al., 2017). Some examples of safety measures include safety compliance, accident rate, injury rate (Dahl and Olsen, 2013), number of safety and development programmes (Mearns and Flin, 1995). One of the important safety measures, safety compliance, refers to "core safety tasks that have to be carried out by individuals to maintain safety at work" (Kvalheim and Dahl, 2016). Poor safety compliance is recognised as the main cause of accidents in the workplace (Dahl and Olsen, 2013). In the oil and gas industry, safety precautions are highly regulated and all of the work operations are guided through safety rules and procedures (Kvalheim and Dahl, 2016).

In their study, Kvalheim and Dahl (2016) found links between knowledge on safety (safety competence) and safety compliance, safety supervision and safety compliance, and safety system and safety compliance. In contrast, work pressure is found to negatively impact safety compliance. Thus, safety training and development measures are very important in enhancing safety performance and overall organisational success. A study by Dahl and Olsen (2013) found that leadership involvements have a significant positive association with safety compliance. In other words, the level in which leaders participate in planning work, monitoring the work execution, and demonstrating good collaboration with team members has a positive impact on safety compliance. One way to manage this is through the usage of performance measurement framework.

2.13.10 Environmental measures

Nowadays, environmental awareness among most organisations has increased as seen in their environmental management throughout their operations. The drivers for environmental awareness include scarcity of resources, legislation changes pertaining to environmental issues, and natural disasters (Perera et al., 2013). The concerns on environmental issues started in the 1990s in the manufacturing industry (Boon-itt and Wong, 2011). Similarly, the integration of development and environment within the oil and gas industry was the central theme in the United Nation's Conference on Environment and Development (UNICED) in the year 1992 (Oil industry International Exploration and Production Forum, 1997).

This indicates that environmental concerns have also started in the oil and gas industry about the same time as in the manufacturing field. Moreover, the United Nation Environment Programme (UNEP) was established in 1975 with the aim of collaborating between government and industry on environmental management. Its goals are to encourage the incorporation of environmental criteria in industrial development plans, to facilitate the implementation of procedures and principles for the protection of the environment. to promote preventive environmental protection through cleaner production and other pro-active approaches. and to stimulate the exchange of information and experience all over the world (Oil industry International Exploration and Production Forum, 1997). UNEP and E&P joint forum has developed environmental protection measures for each potential source of environmental impact on upstream oil and gas operations (Oil industry International Exploration and Production Forum, 1997).

These environmental measures focus on assessing the environmental aspects in managing business operation. Additionally, they also provide a guideline for waste management plan. These measures demonstrate that this joint forum has approached environmental issues from preventive and reactive management aspects. Youn et al. (2013) argued that poor supply chain partner management is the main cause of most environmental incidents. Failure in critical environment areas have a huge impact not only on the environment, but also on the organisations' finance and company's' brand. In some cases, it might lead to fatality as in the case of Bhopal disaster (Youn et al., 2013).

This has increased organisation efforts to improve environmental supply chain management. Environmental measures need to be designed to facilitate desired outcomes. These measures must be easily understood by non-scientists, support environmental and social objectives of organisations, and provide information needed by the stakeholders (Perera et al., 2013).The environmental measures include the recycling rates, reduction of waste, preparing environmentally friendly work place or operations (Youn et al., 2013). In their study on environmental performance measurement framework, Perera et al. (2013) proposed four main dimensions in designing the framework. These dimensions are product and process design, packaging, transportation and collection, and recycling and disposal. By using Analytical hierarchy process (AHP), they found that product and process design have the highest importance in performance measurement.

This outcome indicates the need to manage environmental measures during the product and process design. Youn et al. (2013) who investigated environmental supply chain management in SME manufacturing firms in Korea found that supply chain integration enables the implementation of environmental SCM and the implementation of environmental supply chain management have improved performance outcomes in the form of the firms' reputations and an increase in sales and growth. The environmental management practices studied include eco-design principle, using environmental management criteria on supplier selections, and the use of 3R models (reduce, reuse, recycle).

2.13.11 Social responsibility measures

Social responsibility measures the ability of an organisation to invest in voluntary activities to improve social conditions (Zhang et al., 2013; Cheng et al., 2014). These social activities involve employees, customers, suppliers, and local communities at large (Chenhall and Langfield-Smith, 2007). The examples of social activities include to develop local suppliers, investment in charitable projects to help less fortunate people, and provide scholarships for outstanding students and other environmental aspects as discussed earlier. Apart from organisations' internal motives regarding social responsibility, it has gained greater attention in recent years due to the pressure from local government, non-governmental organisations, and the public. Government's policies to promote sustainable supply chain is conducted through incentive and punitive mechanisms (Zhao et al., 2017). The incentive approach includes subsidy, tax preferences, and price regulations. On the other hand, the punitive approaches include economic sanctions and legal supervision

The external pressure for social responsibility aspects drive organisations to be concerned with the incorporation of social responsibility values in their business operations. Moreover, the increase in socially responsible operations are also driven by the potential in attaining competitive advantages. Social responsibility behaviour indicates that organisations are not only focussed on making profits but consider the consequence of their decisions on stakeholders and the public (Zhang et al., 2013). Organisations apply social responsibility programmes to enhance their reputations, manage risks, and increase customer loyalty (Zhang et al., 2013).

For instance, a case study on the adulterated milk incident in China indicates that one of the companies decided to focus on socially responsible behaviour to gain customer trust and loyalty. It introduced 'low-carbon milk' by making sufficient efforts in their supply chain activities to reduce the carbon foot-print of its dairy products. One study by Zhang et al. (2013) found that an organisation that has higher socially responsible behaviour has the advantage of better relationships with stakeholder groups and will eventually achieve economic benefits. Another study conducted on around 200 Taiwanese manufacturing firms indicates that socially responsible activities improve inter-organisational performance. With the reliance on outsourcing activities in the current business environment, most organisations expand their social responsibility policy to their supply chain networks.

From resource based view perspectives, an organisation that actively incorporates socially responsible behaviour would have the benefit of obtaining competitive advantage. This capability is difficult to be replicated by their competitors as they are elusive character, socially complex, and socially ambiguous in nature (Gold et al., 2010). The implementation of socially responsible activities along the supply chain requires stronger inter-organisation collaborations, and flexible interactions between supply chain partners (Gold et al., 2010). Therefore, there is a need to introduce related performance measures as a means to achieve this goal.

Some organisations have included social responsibility measures in their performance framework. These include Novo Nordisk and Shell (Chenhall and Langfield-Smith, 2007). Novo Nordisk has added customer, society, organisation, and business process dimension which consists of social and environmental performance measures. Large oil and gas organisations such as Shell, Exxon Mobil and British Petroleum incorporate sustainability development factors which cover social, environmental, and safety concerns in their business operations (Chenhall and Langfield-Smith, 2007; Shell Royal Dutch, 2009; BP p.l.c, 2016; Exxon Mobil Corporation, 2016). In line with growing needs of social responsibility measures, Gopal and Thakkar (2012) recommend further research to incorporate environmental and social responsibility measures as discussed in in their review of supply chain performance measures.

2.14 Conclusion

The first section of this chapter discussed the definition and development of supply chain management. It answered the fundamental questions of how the concept is developed and why it is important in today's business environment. It suggests that the reliance of outsourcing activities on non-core competencies requires companies to focus on improving their SCM. Not only that, the first section discussed specific examples of how SCM roles served as a better alternative to other management programmes.

The second section illustrates an overview of the oil and gas industry, the nature of the industry in both the UK and Malaysia. Despite the introduction of renewable energy, oil and gas are still the primary sources for transportation and industrial activities. The discussions suggest that there are several distinguishing characteristics of the oil and gas SCM. These include long supply chain links which require the involvement of multiple business sectors, the use of expensive machinery requires specialised logistic services, influence from political factors and regulations by local government, the location of business activities in the upstream sector are influenced by locations of their natural resources, and the high exposure of risks. Hence, there is a need to consider these factors to ensure oil and gas supply chains can be managed efficiently.

The third section present relevant literature on performance measurement, supply chain performance measurement, and performance measurement frameworks. It also highlights several debates around performance measurement framework and elaborates the definitions of widely cited performance measures. The discussion on performance measures indicates the growing need to incorporate sustainability measures such as environmental, social responsibility, and safety. This is a critical section as the generic performance measures in the literature will be used to form the conceptual model which will be discussed in the following chapter.

CHAPTER 3

CONCEPTUAL MODEL

3.1 Introduction

This chapter provides the underlying explanation on the theoretical perspectives and conceptual model in this research. First, the two main theories in this study; organisational theory and resources based view theory will be explained. Following the discussion on these theories, the performance measurement framework of this research, which will be part of the conceptual model, will be presented. Accordingly, the conceptual model of this research and the link between the research constructs will also be presented.

The conceptual model in this research was devised from the supply chain and performance measurement literature in Chapter 2 and the theoretical perspectives presented in this chapter. The significance of this model is to present the conceptual idea and direction of this research. Exploratory interviews were also conducted to provide additional information in the development of the conceptual model. The detailed analysis of the interviews will be presented in Chapter 5.

In this study, the main elements of conceptual models are the organisational classifications, performance measures, and organisation's performance. The model will be used to validate the research questions, which will be conducted in the form of questionnaire surveys in Chapter 6.

3.2 The research questions

The conceptual model was developed as a guiding principle of this research. It is devised from an extensive review of the literature and theoretical considerations. Prior to presenting the conceptual model, it is important to restate the research questions to provide the right context for this chapter. The research questions in Table 3.1 are used as the starting point for the conceptual model development.

Table 3-1: Research questions

1)	What is the prevalence of performance measures in the oil and gas industry?
2)	What is the impact of the size of organisation on the organisational strategies?
3)	What is the impact of organisations' classifications on the choice of performance measures?
4)	What is the impact of organisations' classifications on organisations' performance?
5)	What is the impact of performance measures on organisations' performance?

The following sections will present the theoretical perspectives and literature that form the conceptual model in answering these research questions.

3.3 Theoretical perspectives

The two management theories that were used as the reference in the development of the conceptual model are;

i) Organisational fit theory (Miles and Snow)
ii) Resources based view (RBV) theory

The definition of the theories and how they motivate this research will be further explained in the following section.

3.3.1 Organisational fit theory

According to Miles and Snow (1978), an organisation can be classified according to its strategy. These strategies are: Prospector, Analyser, Defender and Reactor. The following is the characteristics of each strategy as elaborated by Miles and Snow (1978).

Prospector: This strategic type is usually the leader in introducing products and services in the market. To them, innovation is the key to maximising profits. Mobile phone and other electronic products manufacturers are some examples of the organisations that apply this strategy. This strategy works well in a rapidly-changing environment, in which market study, and research and development are very important. They normally have a wide range of products/services to meet the current demands and trends.

Analyser: This strategy lies in between the Prospector and Defender strategies. They tend to focus on two types of market environment; stable and dynamics. They operate efficiently in a stable market through formalised structure and process. In the dynamic market, they would follow their competitors' ideas closely and often produce better inventions or modifications. In other words, they have dual technology core with moderate efficiency.

Defender: These organisations normally provide limited services or products and tend to focus on narrow segments of the market. They are perceived as the experts in the field and will most likely choose to develop through market penetration within their niche. They rarely make any efforts to analyse the market environment, instead, they tend to focus on enhancing efficiency and cost reductions. Defender competes through pricing and superior products or services. This type of strategy works best at performing in a stable market, where change is not the critical factors in attaining a competitive edge.

Reactor: This type of organisation is always uncertain with regards to their management strategy. They do not have a clear strategy and would manage their organisations by reacting to the change in the market environment. In fact, most of the time, Reactor would be unable to respond effectively to the environment. It is quite difficult to survive in the market by adopting this strategy, except in the case of highly-regulated industry where changes are a bit restricted.

Miles and Snow stated that organisation strategies influence the way organisations are managed. This may also include their choice of performance measures. Each of this strategy, therefore, is likely to approach performance measures differently and eventually, lead to different organisation performance outcomes (Wronka-Pośpiech and Frączkiewicz-Wronka, 2016). Many studies derived from organisation typologies by Miles and Snow (1978) suggest that the type of strategies adopted influence the organisations' performance (Miles and Snow, 1978; Gimenez, 2000;

Afiff et al., 2013). Furthermore, the market environment is believed to be one of the influencing factors in determining the organisations' success through strategy adaptation. Miles and Snow (1978) argued that Prospector tends to succeed in an innovative and dynamic environment. Defender, on the other hand, would outperform the other strategies in a more stable and mature environment. The third strategy, Analyser, is great in performing in the mix markets; stable and turbulent. All these three strategies can lead to better organisation performance, provided that there is a strong alignment between their structure and process (Gimenez, 2000). However, attaining the competitive advantage would be rather difficult for Reactor due to the unclear strategy they are known for. Despite that, there are some studies suggesting that Reactor can outperform the other strategies in a certain environment. They contend that a monopolised and highly-regulated environment may be suitable for a Reactor (Wronka-Pośpiech and Frączkiewicz-Wronka 2016; Gimenez 2000).

The different performance outcomes based on the market environment makes research on the oil and gas industry worth exploring. Therefore, by adopting this theory and the literature around it, this study will investigate the influence of strategy typology on the choice of performance measures. In addition, this research will investigate the impact of organisations strategy on the organisations' performance. These two causal relationships are used to form the conceptual model to answer the research questions.

3.3.1.1 Organisational size

In the previous section, organisational fit theory has been discussed, where it suggests that organisation can be classified into four types of strategic adaptation. Other forms of organisation classification are industrial sector, geographical locations (Kumar and Markeset, 2007; Yusuf et al., 2014), and the size of organisation (Mehran, 1995; Newsome et al., 2013). In addition to the classification based on strategy, this research will also focus on organisation classification based on the size of organisation (Ruzita, 2010). The size of organisation can be indicated by the number of employees, turnover rates, and project budget (Asrilhant et al., 2007; Laudal, 2011). This research focuses on the size of organisation based on the number of employees and turnover rates. The size criterion is based on the guidelines from Department for business and innovation skill (2012) for the UK and (Bank Negara Malaysia, 2005). The ranges of size criterion will be presented in Chapter 6.

There is a considerable number of research investigating the effect of organisational size on various managerial aspects. For instance, Orlitzky (2001) studies the effect of size on the relationship between CSR performance and organisational performance. Ruzita (2010) investigates the link between organisational size and performance measures of manufacturing firms in Malaysia. Other authors, Terziovski and Samson (2000) look into the effect of firms size on the relationship between TQM strategy and organisational performance. This research will study the link between the size of an organisation with strategic adaptation, performance measures, and organisational performance for the oil and gas industry.

3.3.2 Resources based view (RBV) theory

The resource-based view theory has been explored by many scholars in the field of management. To understand the concept of RBV, it is essential to first know the definition of a firm's resource through the operation management lenses. Resources are defined as tangible and intangible assets of a firm that can be used to gain competitive advantage. These include but are not limited to brand names, in-house technological knowledge, skilled personnel, machinery, efficient and complex systems (Wernerfelt, 1984; Rivard et al., 2006).

The earliest study on RBV was recorded in 1959 by Penrose in her book, *The theory of the growth of the firm*, where a firm is described as a bundle of resources (Wernerfelt, 1984; Rivard et al., 2006). RBV focuses more on the internal resources management throughout the firm and not the one acquired externally by outsourcing mechanism (Coates and Mcdermott, 2002). Nevertheless, the resource-based perspective gained more attention from researchers and practitioners only by the 1980s through Wernerfelt's work on the resource-based view of the firm (Wernerfelt, 1984; Hart, 1995). Until today, there are still a lot of on-going studies on the resource-based view perspective which are presented in various approaches and its associations with other firm's strategies, such as how it works with environmental aspects, integration with other forms of competitive advantage, the relationship between resources and other external factors (Rungtusanatham et. al., 2003; Williamson et al., 2012).

It is known as a paradigm that helps many industries to gain competitive advantage through three characteristics of resources; valuable, non-transferable, and difficult to imitate (Peteraf, 1993; Hart, 1995). This is achieved by understanding resources position and how to manage resources over time in determining the firm's profitability and in gaining superior performance (Wernerfelt, 1984).

3.3.2.1 The concepts of competitive advantage

Competitive advantage is the ability of a firm to position themselves as superior to other competitors in terms of capabilities or competencies (Anatan, 2014). The concepts of competitive advantage have been discussed by many researchers in the business and management field (Barney, 1991; Cockburn et al., 2000; Powell, 2001; Wen-Cheng et al., 2011).

Among the concepts suggested by the authors above are;

- Cost leadership, where low-cost positions allow the incite of pricing and high sales volume (Sirmon et al., 2011; Cheng et al., 2011).

- Differentiated product or services, whereby this competitive advantage enables the creation of brand loyalty and amicable reputation which ultimately allows firms to introduce premium pricing (Gustafsson and Witell, 2011; Sirmon et al., 2011; Cheng et al., 2011).

- Pre-emptive action, in which the concept gives firm more focus to dominate a particular competitive advantage either through a large-scale move or early move where sometimes it is possible to pre-empt competitors by setting new standards or gaining preferred access to critical raw materials, locations, production capacity or customers (Sánchez and Pérez, 2005; Cheng et al., 2011).

Above all, RBV improvises the competitive advantage idea by emphasising that competitive advantage can only be sustained if the capabilities in creating the advantage are supported by valuable, rare, non-transferable, and difficult to replicate resources (Sirmon et al., 2011; Barney, 2012).

3.3.2.2 Basic characteristics of resource-based view in creating competitive advantage

While the market-driven perspectives are shaped by economic and external factors, the resource-based view focuses on how the firm manage their internal capabilities (resources) (Rivard et al., 2006). In order for the resource-based perspective to sustain a competitive advantage, it needs to have three main characteristics; valuable, rare or unique, non-transferable and difficult to replicate (Peteraf, 1993; Hart, 1995). Even though different authors have defined these characteristics in slightly different ways, it is widely understood as similar to the four characteristics mentioned earlier.

Generally, valuable resource means that in order to sustain a competitive advantage, resources must have significant value to the firm. Next, the resource must be rare or not available to the competitors. The non-transferable resource is the condition where the resource is not easily transferred or widely distributed in the industry or in other terminology, having imperfect mobility (i.e. have an exclusive logistic arrangement or complex system). The fourth characteristic is rather difficult to replicate where the resources are either using high technology or expert skills or socially complex and involving an extensive area of expertise which would not easily be imitated by competitors (Hart, 1995). The following sections will explain the examples of each RBV characteristics that have been presented in the research so far.

3.2.2.1 Valuable resources

An example of valuable resources is presented in Coates and Mcdermott (2002) exploratory studies of RBV in micro electro mechanical system (MEMS). The study found that the ability to create a high-volume production of MEMS design is a valuable characteristic of that firm. This is based on the view of one of the consultants in the MEMS field who stated that it is common to find many MEMS design and application prototypes in the market, but very few are able to industrialise it. These competencies are recognised as intangible firms’ asset that can be demonstrated in expertise, skills, and problem-solving ability of firm (Reddy and

Rao, 2014). At the same time, it is also considered a socially complex resource as it can only be obtained through the process of experimentation, comprehension and would require a considerable amount of time to acquire (Spanos and Lioukas, 2001)

3.2.2.2 Rareness resources

Competitive advantage can be achieved by having rare resources and capabilities. In other words, the resources are possessed by a very small number of organisations to create a perfect competition (Newbert, 2008). This also means that these resources must be rare in the market, specific to the firm, and must not be widely distributed in the industry. These include corporate image, brand or exclusive supply arrangement (Hart, 1995). Nevertheless, this does not mean organisations have to own a rare resource or have sets of capabilities to attain superior performance. Newbert (2008) contends that an organisation, whose patented complex process restricts other organisations from accessing a common raw material, is one of the ways rareness works in creating a competitive edge. In the pharmaceutical industry, patents are considered as both valuable and rare resources as they provide an exclusive right to the firm. This exclusive right gave them the rights to sole-proprietary, restricting other competitors to replicate or copy their products/ systems (Markman, 2004).

3.2.2.3 Non – transferable resources

Product stewardship strategy in natural resource-based view research by Hart et al. (1995) is an example of non-transferable resources. Through this strategy, external factors (stakeholders' perspectives) are integrated into production design and processes. The strategy allows the firm to gain a competitive advantage through socially complex resources, involving appropriate inter-function communication, department, and across organisational boundaries. This strategy involves exiting an environmentally hazardous business, redesigning existing product system to reduce liability, and developing new products with lower life-cycle cost (Hart et al., 1995; Gold et al., 2010). Accordingly, it would not only result in a superior performance among other competitors but would not be easily transferable to other firms as it involves many parties internally and externally, and it would require tacit skills to develop and implement such strategy (Barney, 2012).

3.2.2.4 Difficult to replicate resources

Integration of competencies is considered as a difficult to replicate resource (Coates and Mcdermott, 2002). For instance, in the development of the MEMS technologies, the firm needs to integrate knowledge and expertise in the area of mechanical, optical and material sciences as well as electrical and biomedical engineering. These integration competencies are believed to have started from the process of developing new MEMS devices and technologies. Consequently, these complex skill sets would create a competitive advantage, which is difficult to be imitated by other firms.

The previous examples highlighted some strategies implemented by firms in sustaining a competitive advantage according to resource-based view perspective. As firms are heterogeneous, their uniqueness according to RBV perspectives plays an important role in identifying their strategies (Wernerfelt, 2013). This also means different firms and industries require a different approach in gaining a superior performance. For instance, in the pharmaceutical industry, one of the critical drives for superior performance is the ability to develop and commercialise new medicinal related drugs, devices, or systems. After each discovery, a firm needs to strive in patenting their product to have proprietary rights to their research and development expenditures and technological advancement (Markman, 2004). This is important in order to provide firms with exclusive rights on products, processes, systems, and eventually, attain the competitive edge. In this case, proprietary rights are considered as the barrier for other firms to imitate.

3.3.2.5 The importance of resources management to create competitive advantage

Amlt and Schoemaker (1993) argue that capabilities, referred to as a firm's capacity to deploy resources, are important determining factors for the firm's performance. In support of this, Makadok (2001) and Newbert (2008) claimed that firm's resources and capability can only achieve its great value of competitive advantage by integrating one's resources and capabilities into maximum potential. The key here is to exploit firms' current resources and capabilities and not treat it separately.

According to Coates and Mcdermott (2002), the RBV theory views resources management as dynamic. It is believed that the management of resources is the ones generating competitive advantage and not the resources. In advocating this concept, it is important to understand the integration of human, physical, tangible, and intangible resources to create a value of competitive advantage.

More recently, Newbert (2008) claimed that it is not always the case that firms need to have rare resources and capabilities to win over their competitors. Newbert (2008) provides a clear example of how patented chemical process can be designed to manipulate the accessible raw material. In this case, the firm will be able to attain the competitive advantage by exploiting the common resources in a different manner as compared to other firms. Therefore, it is clear that common resources can be enhanced to obtain competitive advantage as long as the firm is able to integrate resources and has the capabilities to distinguish themselves from others.

Newbert (2008), in his empirical studies on RBV among micro and nanotechnologies firms, found that value and rareness of firm's resources and capabilities integration enhance the competitive advantage of the firm. This competitive advantage leads to firms' performance. To date, most studies have concentrated on firms' resources as a basis of competitive advantage and not on stimulating the approach of the resource-based view in strategising firm which is far more important (Szymaniec-mlicka, 2014). Similar to other authors, Szymaniec-mlicka (2014) emphasised the need for firms to re-evaluate their own resources and competencies and learn how the integration of these two elements would help in attaining competitive advantage.

Chae et. al. (2013) investigated the supply chain analytic (SCA) of resource-based perspectives in the manufacturing industry. In their study, SCA is defined as the integration of three sets of resources: data management resources, information technology-based supply chain planning resources, and performance management resources. Their research showed that the SCA was positively affecting operational performance and there is a need to integrate all these three resources to attain such performance.

The previous discussion highlights that attaining competitive advantage is more than just having the valuable, rare, non-transferable, and inimitable resources, but instead the exploitation of resources to get the most out of it. Hence, it is timely to implement the constructivist theory to highlight the importance of measuring and evaluating how the resources are managed. Considering this factor, performance measurement framework is believed to be an important tool or 'resource' in attaining the competitive edge. To further understand this concept, we need to view the performance measurement framework from the lens of resource-based theory. The following section will explain this perspective.

3.3.2.6 Performance measurement framework characteristics from RBV perspectives

Szymaniec-mlicka (2014) stated that resources management is increasingly important in the unpredictable market situation. In this market environment, maximising the potential of intangible resources, such as management strategy, and knowledge management, is particularly important. In the case of oil and gas industry, external factors such as the market situation, environmental conditions, high transportation cost, exposure to high uncertainties, and fluctuation of oil price (Varma et. al., 2008) are the least controlled factors by the firm. In addition to that, the end product of the oil and gas has a very minimal differentiation from other competitors (Chima and Hills, 2007) in order to attain competitive advantage. For that reason, it is important for an oil and gas firm to shift their focus into internal factors to distinguish themselves from their competitors. Such factors include resources and capabilities, which need to be examined and carefully managed to boost its competitive advantage. In line with this principle, there is no doubt that there is a need for a systematic approach to evaluating and managing the firms' both internal and external factors and their impact on the performance in the oil and gas industry. Therefore, this research aims to explain RBV theory through the usage of performance measurement framework as a 'resource' in managing resources and capabilities of a firm.

Unlike the oil and gas industry, there were extensive studies conducted to comprehend the performance measurement for manufacturing and automotive industry (Chan et al., 2003; Gunasekaran et al., 2004; Huang and Keskar, 2007; Chen et al., 2014). Considering the unpredictable external factors in oil and gas industry (Chima and Hills, 2007; Varma et al., 2008), this research will present performance measurement of the supply chain for oil and gas industry from the resource-based view perspective.

The importance of managing supply chain performance or internal resources as the core for competitive advantage has been extensively illustrated in the previous section. Nevertheless, in order to deploy performance measurement framework as a basis for competitive advantage, it is essential for the framework to be designed in a way that is valuable, rare, non-transferable, and difficult to replicate.

3.4 The performance measurement framework of this research

The performance measurement framework (PMF) of this research is designed based on the literature discussed in Chapter 2. There are many performance measurement frameworks in the literature focusing on diverse aspects of measures. In particular, the following PMFs in the literature are referred to as a basis for the development of PMF of this research;

Table 3-2: Performance measurement framework

Title of framework	Author
Formulation of AHP framework applied to BSC to determine supply chain performance	Varma et al (2008)
Environmental performance criteria	Perera et al. (2013)
Performance measurement for green supply chain	Hervani et al. (2005)
Evaluation of the building materials supply chain framework	Halman and Voordijk (2012)
Performance measures for small and medium sized enterprise	Bhagwat and Sharma (2007)
Lean supply chain performance metrics	Arif-Uz-Zaman and Ahsan (2014)
Supply chain performance metrics framework	Gunasekaran et al. (2004)
A framework on metrics for the performance evaluation of a supply chain	Gunasekaran et al. (2001)
Performance metric for supply chain management	Elrod et al. (2013)
Performance evaluation of food supply chain	Shafiee et al. (2014)

The first framework by Varma et al (2008), which focuses only on the downstream sector of the oil and gas industry, is used as a reference. Despite looking only into the downstream sector of the industry, some of the performance measures proposed in this framework are relevant to the rest of the industry. It also outlines unique characteristics of this industry, which warrants a separate treatment from other industries. These include the issues of inflammability and contamination of oil and gas products. Nevertheless, the framework proposed by the authors does not include safety and environmental measures to reflect these two characteristics – inflammability and contamination of oil and gas products. Due to the high exposure of risks to the people and environment, safety and environmental measures will be included in the proposed PMF of this research.

Considering the needs to include environmental measures in managing oil and gas supply chain, the framework proposed by Perera et al. (2013) and Hervani et al. (2005) are used to develop the framework for this research. The framework by Perera et al. (2013) and Hervani et al. (2005) focused on four main dimensions in evaluating environmental performance in the manufacturing supply chain. These dimensions are product and process design, packaging, transportation and collection, and recycling and disposal. Amongst the performance measures proposed in this framework, the reduction achieved in green gas emissions appears to be of the highest importance. The framework, however, focuses specifically on environmental measures but does not include other important measures in supply chain management such as operation and financial measures. In proposing the preliminary list of performance measures, generic measure (environmental measures) will be used. The specific measure will be explored through the interviews with oil and gas practitioners in Chapter 5.

The third framework, by Halman and Voordijk (2012) is used as a reference considering the nature of the house building industry, which involves construction activities. The characteristics of the building industry are considered similar to the oil and gas industry in terms of the project executions. This means it involves various parties in the project operations. There are five main dimensions included in Halman and Voordijik (2012) framework, which are financial, customer, internal business, external business, and innovation. The framework also includes one of the important measures, safety, which was neglected in most performance framework literature. Similarly, as discussed in Chapter 2, safety measures were also recommended by Gopal and Thakkar (2012) for future research in the performance measurement of the supply chain.

Apart from the environmental and safety measures, there are many studies and corporate reports that emphasise the need for sustainable measures as a part of the performance framework (Chenhall and Langfield-Smith, 2007; Shell Royal Dutch, 2009; Yusuf et al., 2013; BP p.l.c, 2016; Exxon Mobil Corporation, 2016). These sustainability dimensions, which include safety measures, social responsibility measures and environmental measures, are also listed in the preliminary list of measures for this research.

The rest of the framework in Table 3-3 focuses on the manufacturing industry. Since the list of measures proposed in each framework is vast, most common measures are identified to be included in the preliminary list of performance measures. These measures are cost/ price, quality, flexibility, delivery reliability, delivery schedule, and innovation. The discussion on each of this measure was presented in section 2.13 of Chapter 2.

The PMF is designed based on the RBV theory, and supply chain performance frameworks literature, which were discussed in **Chapter 2**. The proposed set of performance measures will be validated through the interviews with supply chain experts. In particular, supply chain experts will be asked about the relevance and application of the proposed measures in the oil and gas industry. Furthermore, the interviews also aimed to identify other important performance measures for the industry and relevant performance management issues. The final set of performance measures from the interview will be presented in **Chapter 5**. Table 3-3 presents the preliminary list of performance measures proposed for this research.

Table 3-3: Preliminary list of performance measures

List of performance measures
1. Cost/ price 2. Quality 3. Flexibility 4. Delivery reliability 5. Delivery schedule 6. Innovation 7. Safety measures 8. Environmental measures 9. Corporate social responsibility measures

3.5 The conceptual models of this research

After considering the theoretical perspectives of this research and the literature on supply chain performance measurement, links between the constructs can be projected. The relationship between the constructs forms the conceptual model that is used to test the theories of these relationships in Figure 3-1. This is the preliminary conceptual model. The outcomes of the interview will inform the set of performance measures in the third box (from the left) and will finalise the list of organisational performance attributes in the fourth box (from the left) of this model.

According to Chan et al. (2003), a conceptual model details the general functions and relationship among the components in a system. The model proposed for this research is devised from the organisational fit theory and RBV theory. The literature on performance measurement framework was also examined in devising the conceptual model. The organisational theory by Miles and Snow indicates that an organisation can be classified into four main strategies. These strategies influence the way an organisation manages their performance through their choice of performance measures, which will then lead to various performance outcomes (organisational performances).

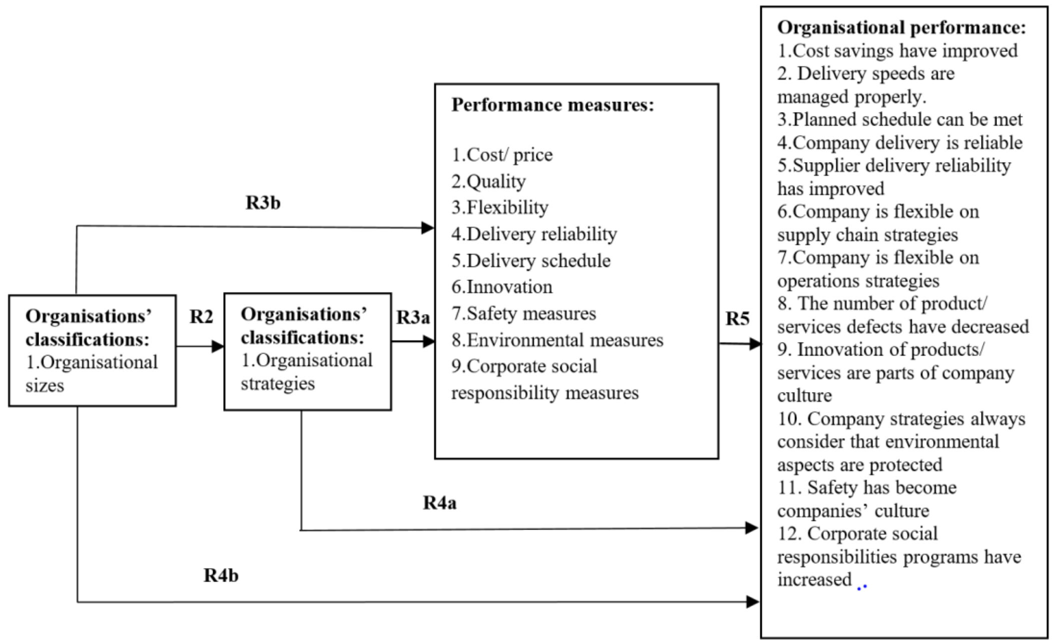

Figure 3-1: Preliminary conceptual model

The preliminary conceptual model of this research (Figure 3-1) is represented by four boxes, which are the organisational classifications (organisational sizes and organisational strategies), performance measures, and organisational performance attributes. The arrows pointing to and from the boxes represent the directions for the causes and effects between the constructs. The labels R2-R5 indicate the research questions that correspond to the causal relationships.

The first box represents organisational classification based on the size of organisation (number of employees and turnover rates). The second box corresponds to organisations' classification based on the types of strategy adopted. These strategies are from Miles and Snow organisational fit theory, which are Prospector, Analyser, Defender, and Reactor. The direction of the arrow (R2) to the second box (organisational classification based on organisational strategies) indicates that the size of organisations might influence the strategy adaptations. This corresponds to the second research question, R2: What is the impact of the size of organisation on the organisational strategies?

The direction of the arrows R3a and R3b to the third box (Performance measures) indicate that the organisational classifications would influence the way an organisation manages their performance. In essence, the classification of organisations would influence which performance measures matter most to them. This relationship is derived from Miles and Snow (1978), who stated that organisation strategies influence the way organisations are managed. It is also supported by the literature that suggest the link between the size of organisations and the choice of performance measures (Ruzita, 2010). This corresponds to the third research question of this research, R3(a-b): What is the impact of organisational classifications on the choice of performance measures?

Accordingly, the direction of the arrows from the first and the second box from the left to the last box from the left (organisational' performance attributes) indicates that organisational classifications may influence their performance outcomes. This organisational performance is represented by twelve attributes. The list of organisational performance attributes is derived from the proposed list of performance measures. The list will be expanded based on the outcomes of the exploratory interviews in Chapter 5. The link between organisational strategy and organisational performance is derived from the literature on organisational strategy as discussed in section 3.3.1. This literature suggests that the type of strategy adopted by an organisation influences its performance (R. Miles and Snow, 1978; Gimenez, 2000; Afiff et al., 2013). In addition, this study also investigates the impact of organisational size on the organisational performance. In other words, this research aims to investigate the relationship between these two constructs: organisational classifications based on the size of organisation, and organisational strategy, with organisational performance within the oil and gas industry. The study of this relationship will answer the fourth research question: R4(a-b): What is the impact of organisational classification on organisational performance?

The second box shows the list of performance measures for the industry. The list is developed from the performance measurement framework in the literature. There are nine performance measures in the list. This set of performance measures will be expanded based on the interviews with supply chain experts, which will be presented in Chapter 5. The final set of performance measures from the literature and exploratory interview will then be validated by questionnaires survey with a larger group of respondents. The purpose of this survey is to identify the prevalence of the listed measures in the industry. The outcomes of the survey are detailed in Chapter 6. Accordingly, it will answer the first research question, R1: What is the prevalence of performance measures in the oil and gas industry?

The direction of the arrow from the third box from the left (performance measures) to the last box from the left (organisational performance attributes) is to explore whether the choice of performance measures will influence performance outcomes. This relationship was developed based on RBV theory and supported by the previous literature on performance measurement framework. In essence, RBV theory states that competitive advantage can be achieved through managing organisational resources and competency. In this regard, this research is an attempt to position performance measurement framework, which contains the list of performance measures, as an important ‘resource’ to explain RBV theory. This is further supported by a number of studies suggesting that the usage of performance measurement would lead to a better organisational performance (Davis and Albright, 2004; Gunasekaran et al., 2004; Garengo et al., 2005; Lee and Yang, 2010; Agrell and Hatami-Marbini, 2013). Therefore, this research would answer the fifth research questions, R5: What is the impact of performance measures on organisational performance?

The last box from the left contains the list of organisation performance attributes. These attributes provide the measure of business success in the area related to the performance measures in the second box. It comprises four main areas of performance, namely financial, operational, safety and environmental, and social responsibility. This construct is not a part of the predictor of this research but instead acts as the outcomes for other constructs.

3.6 Conclusion

This chapter outlines the research questions that form the context of conceptual model development. Then, it highlighted the two main theories in this research; organisational fit theory and RBV theory. The organisational fit theory is used to explain the link between organisational strategies with the choice of performance measures and organisational performance. These links will serve as the answer to the third and fourth research questions.

The RBV theory is used to explain the usage of performance measurement framework as a ‘resource’ in this research. It demonstrated the competitive characteristics, from RBV perspective, that a resource must have in achieving superior performance. The literature on PMF, as discussed in **Chapter 2** and this chapter, is referred to in constructing the preliminary conceptual model for this research. In addition, the relationship between the proposed PMF (list of performance measures) and organisational performance was demonstrated in the conceptual model. This relationship was motivated by RBV theory and literature on PMF in the supply chain environment. The study of this relationship will answer the fifth research question. The basis of each construct in the model was presented followed by the conceptual model of this research. The model is the guiding principle of the research process, philosophical approaches and methodologies adopted, which will be presented in **Chapter 4**.

CHAPTER 4

METHODOLOGY

4.1 Introduction

This chapter reviews methodologies and methods used in this research. It starts off by discussing research paradigms in the social sciences field, which consists of ontology and epistemology. This section defines the philosophical ideas and some research methodologies related to the philosophical stance. It then discusses types of research approaches in this field: quantitative, qualitative, mixed methods, and some of their differences and similarities. The next section explains the types of research, which are also known as methodologies. This is followed by methodologies adopted for this research, their justification, and the details of the research approaches. The final section illustrates the overview of the research process.

4.2 Research paradigms

Research in social sciences is usually performed based on certain disciplines of theoretical and methodological views (Blaikie, 2007). These disciplines are known as research paradigms (Blaikie, 2007). Research paradigms are the source of theoretical ideas, ontological, and epistemological assumptions. The understanding of research paradigms will inform the researchers' decisions on the approach they are going to choose (Blaikie, 2007). Hence, the following sections discuss some ontological and epistemological positions in social sciences research.

4.2.1 Ontology

Ontology is the initial point of all research and with its existence the epistemology and methodological positions come into play (Grix, 2002). Ontology is defined as how the social phenomenon or social entities are being seen (Matthews and Ross, 2010; Gray, 2014). Among these social phenomena are social groups, such as family, gender, ethnicities, religious groups, and institutions. Ontology is a claim or perception about the nature of social phenomenon, what it looks like, what entities comprise it and how these entities interact and relate to one another (Grix, 2002). In social research, ontological claims are concerned with how the researcher or research participants perceive each social phenomenon. There are various ways ontological position can be considered. The following section presents two main ontological considerations; objectivism and constructivism.

4.2.1.1 Objectivism

Generally, objectivism is an ontological position, which implies social phenomena and its meaning exists outside the individual and consists of specific entities (Grix, 2002; Bryman, 2016). For instance, it means that we can discuss organisations as tangible objects where they have rules and regulations, policy, mission statement, and an adopted hierarchy system. An organisation is, therefore, viewed as external to the individuals that inhabit it. Additionally, it perceives organisational reality as something fixed with rules and regulations and the individuals have to comply with the requirements. In other words, organisation acts as a constraining force that restricts its members (Bryman, 2016).

The same can be said of natural science research where a scientist studies the physical elements such as animal, cells, plants, nuclei, and chemical characteristics. This perspective values objectivity and independence of the researcher in investigating the social world in terms of entities (Matthews and Ross, 2010).

4.2.1.2 Subjectivism

Subjectivism explains that social phenomena, which create our social world are only real provided that there are constructed ideas being revised and reconstructed by the social actors that are involved in it (Matthews and Ross, 2010). It claims that there is no social reality apart from the meaning of social phenomena from the lens of the participants. But, the meaning and understanding of social phenomena such as organisation, industry, community and social care, which are developed by social actors, is subject of their study. For instance, in hospital organisations, the social order is in a constant state of change where a great number of agreements are constantly being revised, improvised, and some of less relevant matters will be terminated. To put it simply, this is the hospital at the moment: this is its social order

(Bryman, 2016). Through this ontological position, it is argued that if we put too much emphasis on the formal structure of an organisation (rules, regulations, and policies) we might lose sight of the importance of how to incorporate that structure through our daily interaction. Nevertheless, this does not deny the usefulness of that formal structure in the organisation.

4.2.2 Epistemology

Epistemology presents the view and justification on what can be regarded as knowledge in certain fields –what the criteria are to call it valid ‘knowledge’ instead of belief (Matthews and Ross, 2010; Gray, 2014; Bryman, 2016). Understanding of epistemological stances is very important as it can help to clarify issues in research design (Gray, 2014). These include design of research tools, structure of the research, types of evidence that are being gathered, and methods of interpretation. Three different epistemological positions, namely positivism, interpretivism, and pragmatism, will be described in the following sections.

4.2.2.1 Positivism

Epistemology presents the view and justification on what can be regarded as knowledge in certain fields – what the criteria are to call it valid ‘knowledge’ instead of belief (Matthews and Ross, 2010; Gray, 2014; Bryman, 2016). Understanding of epistemological stances is very important as it can help to clarify issues in research design (Gray, 2014). These include design of research tools, structure of the research, types of evidence that are being gathered, and methods of interpretation. Three different epistemological positions, namely positivism, interpretivism, and pragmatism, are described in the following sections.

4.2.2.1 Positivism

This philosophical assumption was founded by Auguste Comte in the 19th century. His view on positivism involves observation and reason for the purpose of understanding behaviour (Cohen et al., 2011). At the beginning of Comte’s research, he regarded positivism view as all genuine knowledge based on sensory experience and can only be obtained by means of observation and experience (Cohen et al., 2011). Positivism approach came from objectivist ontological position, where social reality is independent of the researcher and research subjects. Thus, by following certain research procedures, the research participants and research subject can be investigated without bias. There are several distinct elements of positivist approach (Sekaran and Bougie, 2013; Gray, 2014):

- Knowledge is defined as something that can be observed by the senses.
- Knowledge of social phenomena is based on what can be seen and recorded instead of merely subjective understanding.
- Data are collected to assess hypotheses which have been generated from existing theories (deductive approach).
- The researcher is independent and has no connection with the data (the researcher is objective).

Usually, in conducting research through the positivist approach, quantitative methods are adopted. Moreover, aspects of social phenomena are quantified and causal relationships between different aspects of the study are determined (Sekaran and Bougie, 2013). In most cases, large data sets and statistical analysis are used.

4.2.2.2 Interpretivism

Interpretivism is an epistemological position that contrasts with positivism (Bryman, 2016). It advocates that a social phenomenon is not necessarily those which can only be observed by the senses, rather it can be interpreted by human beings (social researchers) (Gray, 2014). This position acknowledges people's subjective interpretation and understanding of social phenomena and their own actions, and can be associated with the ontological position of subjectivism.

The interpretivist approach typified by the following elements (Gray, 2014; Bryman, 2016):

- Knowledge gathered includes people's interpretation and understanding of an issue.

- It focuses on how people perceive the social world and social occurrences, allowing different perspectives to be explored.
- The researcher is interpreting the research subjects' interpretation in terms of theories and concepts of the research area. In this case, social researchers investigate social phenomena through the eyes of the social actor being researched. In other words, there is double interpretation involved.
- The researcher gathers data to develop theory (inductive).

The interpretivism researcher normally opted for qualitative approaches. Focus groups and unstructured interviews enable them to gather rich data, oriented to the context of the subject being studied (Sekaran and Bougie, 2013). In fact, qualititative approach emphasises understanding of a specific case rather than providing a generalisation of the findings.

4.2.2.3 Pragmatism

Pragmatism was developed by Charles Sanders Peirce (1839–1914). His idea was then expanded by William James who wrote an influential book, Pragmatism: A New Name for Some Old Ways of Thinking in 1907 (Ormerod, 2006). Pragmatism philosophy accepts a concept only if it supports action. Thus, it is practical and not idealistic (Cohen et al., 2011). This philosophy claims that there are two dimensions of truth in a reality, which sometimes subjectifies and sometimes objectifies (Cohen et al., 2011). This philosophy is not constricted by either qualitative or quantitative approaches, instead it focuses on whether the data and methodologies are able to answer research questions (Cohen et al., 2011; Sekaran and Bougie, 2013). In addition, it supports empirical method, which is also known as the scientific method (Ormerod, 2006).

Pragmatism assumes methodologically diverse, multiple approaches to research, extending positivist, and interpretive epistemologies towards the criteria of fitness to enable practicality (Cohen et al., 2011). Furthermore, it considers 'reality' as both objective and socially constructed. Hence, it endorses eclecticism and pluralism (Sekaran and Bougie, 2013). In essence, this philosophical assumption emphasises approaches that are effective in answering research questions (Sekaran and Bougie, 2013). Pragmatism does not focus on whether the study of social science research fits into certain abstract philosophical positions, it focuses more on the practical applications of ideas (Gray, 2014; Morgan, 2014). Morgan (2014) claimed that Pragmatism changes the study of social research into questions, such as:

- How do researchers make choices on the way they conduct their research?
- Why do they make that choice?
- How do researchers make choices about the way they undertake research?
- What is the impact of making one set of choices rather than another?

In essence, researchers need to have a strong understanding behind their decisions. Research approaches under a pragmatic view could be a combination of experiments, surveys, case studies, interviews, or other methods to improve the quality of research.

4.3 Research approaches

Quantitative and qualitative methods are two major approaches to research in social sciences. Quantitative research focuses on experiments and other methods that place emphasis on controlling and quantifying measures (Hoy, 2010; Sekaran and Bougie, 2013). Measurement and statistics are the critical elements underlying this method. This is due to the usage of mathematical expressions in explaining the relationships between theories and eventually deriving generalisations (Hoy, 2010).

Qualitative research emphasises on in-depth understanding of social phenomena and the underlying reasons that construct the phenomena (Hoy, 2010; Bryman, 2016) The data analysis of qualitative methods is based on the researcher's perceptions of the issues. The source of this research method are gathered through ethnographic analysis, fieldwork, and case studies (Hoy, 2010).

Another approach is called mixed method approach, where quantitative and qualitative method, concepts, and languages are integrated in conducting a single research (Burke and Onwuegbuzie, 2004). One of the mixed-method approaches can be conducted by combining a quantitative method through a questionnaire survey and with a qualitative method such as in-depth interview (Cresswell, 2003). In essence, the purpose of mixed-method is to ensure that some aspects that are unable to be answered by one single method can be complemented by another method (Burke and Onwuegbuzie, 2004; Blaikie, 2007).

The following sections elaborate on quantitative, qualitative, and mixed-method research.

4.3.1 Quantitative approach

Quantitative research involved collection of numerical data, a deductive approach to theories, and an objectivist assumption of reality (Bryman, 2016). This approach is concerned with development of the hypothesis and its validation as well as the generation of models to explain theories. For this reason, most quantitative research entail large-scale, representative sets of data from the wider populations (Blaxter et al., 2006; Sekaran and Bougie, 2013; Bryman, 2016). To have a better understanding about quantitative research, the process flow is illustrated in Figure 4-1. This figure presents one of the examples of the main processes of quantitative research extracted from Bryman (2016). A quantitative research project begins with the theory that a deductive method is used in order to investigate the relationships concerned (Sekaran and Bougie, 2013). The next step entails hypotheses generated from theories. In some cases, quantitative research does not deduce specific hypotheses from theories but instead uses them as a guided idea for data collection.

The third step involves selection of the research design. This process is important for various reasons, such as external validation of the findings and the researcher's ability to construct causal relationships between findings. The next step includes the process of developing measures of the concept. The following two steps entail the selection of research sites or areas of study and selection of participants. The selection of research areas and participants must be conducted in a way that enables the researcher to answer the research questions. Step 7 encompasses the process of administering the research instrument. The forms of the research instrument depend on the type of research, such as experimental research, survey research, or structured observation (Bryman, 2016).

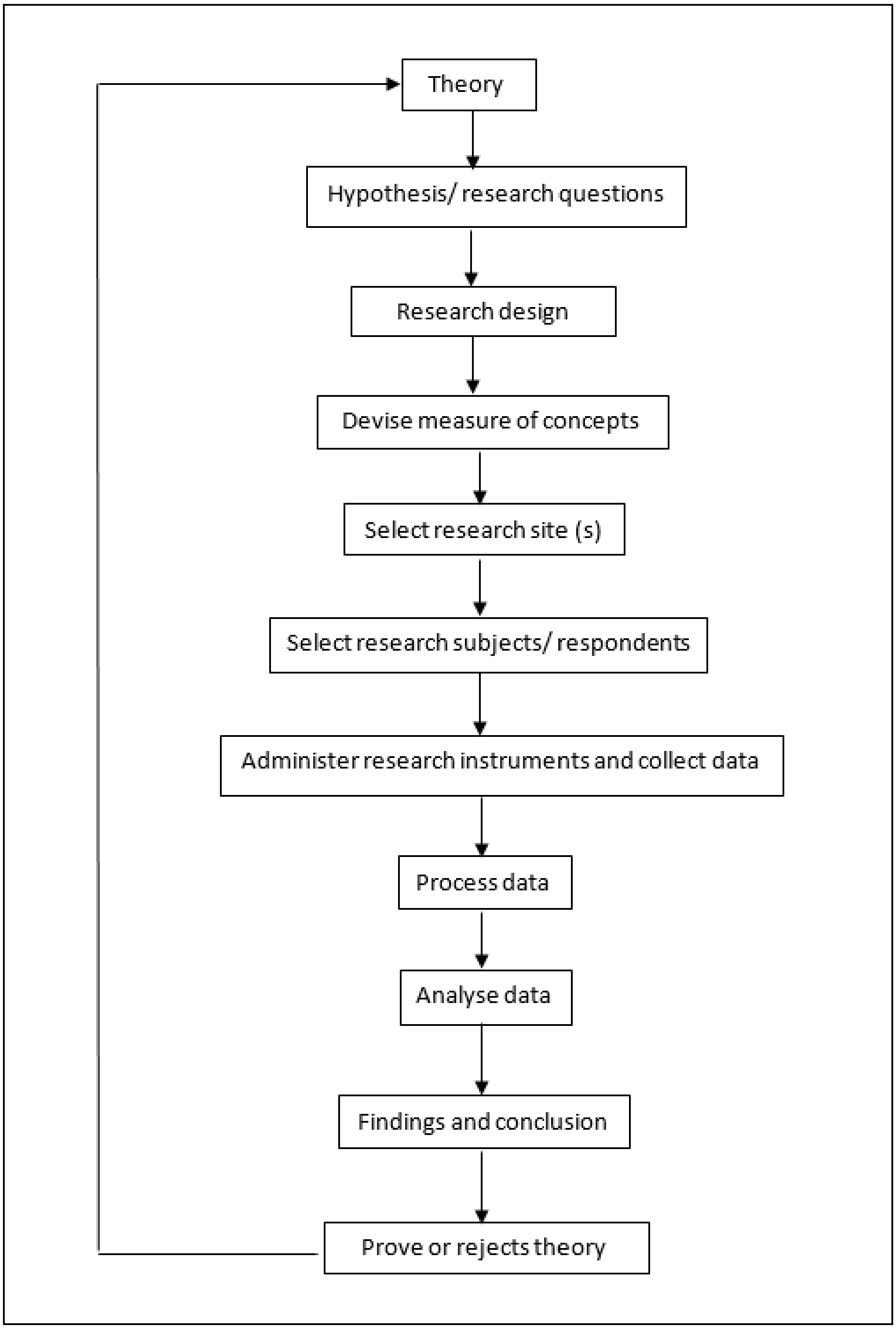

Figure 4-1: Quantitative approach process (Bryman, 2016)

A common process in experimental research involves pre-testing subjects, manipulating the independent variables for experimental groups, and finally conducting post-tests on the subjects (Blaikie, 2007; Sekaran and Bougie, 2013). Survey research involves either a face-to-face administered questionnaire, phone survey, or self-administered questionnaire. In structured observation research, one or more observers are appointed to observe the setting or behaviours and assign it to relevant categories.

The next step represents the transformation of information into quantified data. Some information can be easily quantified, such as age, year of experience, and income level (Field, 2009). Other data might need to be recoded into numbers. This is especially important if the analysis is to be done using computers or statistical software (Pallant, 2016). Analysis of the data in Step 9 entails the data cleaning process, describing profiles of the data, and demonstrating the relationship between variables. If there is a hypothesis, the researcher has to determine if it is supported or rejected. The outcome of the analysis is used to draw a conclusion in Step 10. In this process, the researcher has to demonstrate the significance and robustness of findings. Once the findings have been written and published, they become part of the literature or 'theory'. The element of deductivism (Step 2) and inductivism (feedback loop) implies the positivist perspectives of quantitative research.

4.3.1.1 Quantitative data collection methods

The most common data collection strategies are self-administered questionnaires and questionnaires assisted by interviewers (Cresswell, 2003; Bryman, 2016). Both approaches leave the researcher independent from the actual processes. Even though these two approaches are sometimes used interchangeably, they are very different particularly in the format of the instrument. The self-administered questionnaire needs to be designed in a way that can be completed by the participant without assistance from the researcher. On the other hand, the questionnaire assisted by interviewer requires interviewer involvement in giving instructions to the participant throughout the data collection process (Blaikie, 2007). Another data collection approach known as structured observation, is less common in the quantitative setting. Examples of this approach are observing the response of participant after certain periods of isolation or observing a group of children at play. The observation will be coded into the numerical form (Cresswell, 2003). These studies normally use video recording to aid the analysis process, so that the video can be checked again if coding of observations is missed or delayed in the coding of observations (Blaikie, 2007).

4.3.2 Qualitative approach

Qualitative research adopts different philosophical assumptions, strategies of inquiry, data collection techniques, analysis, and interpretation. Even though the general process is similar, this method depends on text and image data, has different steps of data analysis and possesses wide ranging strategies of inquiry (Cresswell, 2003). Table 4-1 summarises the most common features of qualitative approach.

4.3.2.1 Qualitative data collection

Participant observations are sometimes regarded as superior performance of qualitative research (Blaikie, 2007). This approach involves the researcher engaging in the life of the people being investigated. This method is known as field research or ethnography. Participant observations can be undertaken in a variety of ways ranging from observation to total participation. It involves the researcher observing and recording the event being studied (Blaxter et al., 2006). However, in common practice, the researcher would not use a single approach, instead they would triangulate the data collection process using various methods.

Other data collection methods that have been widely used in literature are unstructured or semi-structured interview, in-depth interview, and focus-group interview. These interviews put the researcher outside of the natural setting, where the interaction will be reported rather than observed (Blaikie, 2007). This method involves the researcher asking questions and discussing issues with participants (Blaxter et al., 2006). In some cases, the interviewing process is combined with participant observation to provide alternative perspectives.

Table 4-1: Common features of qualitative approach (Cresswell, 2003)

Features	**Details**
Natural setting	Qualitative data collection is normally conducted in the field at the site where participants are facing the issues or experiences (Cresswell, 2003). The researcher does not bring the subject to the laboratory or send the survey instrument for participants to complete. Collecting information by speaking to the participants and observing them directly is one of the major characteristics of qualitative research.
Researcher as key instrument	With the qualitative approach, the researcher has to collect the data themselves either by interviewing participants, observing their behavior, or examining documents. Even though there is a need to follow certain protocols as an instrument to collect data, the researcher is the one that is involved in this process. This also means the researcher would not rely on questionnaires or instruments prepared by other researchers.
Multiple sources of data	In most cases, multiple sources of data collection are involved including interviews, observations, and analysis of documents. After investigating all these sources, the researcher would then construct themes and categories to suggest their findings.
Inductive data analysis	Themes, patterns, and categories of qualitative research are designed from the bottom up, by structuring the data into more abstract information. This means, the researcher is required to revisit their themes and sources of information back and forth throughout this inductive process. This process is conducted until a comprehensive set of themes are established.
Emergent design	This research process is emergent. In essence, it is loosely prescribed in the early phase and develops after the researcher begins the study and has started the data collection activities. For instance, there might be the need to refine research questions, the methods of data collection, changes of field, or participants. The underlying principle of qualitative research is to understand the issues of the study and to tailor the research to obtain that information.
Theoretical lens	Qualitative research often involves a lens to envisage its study. Some examples of these are concept of culture, ethnographical focus, racial, or social status differences from theoretical perspectives. Sometimes, the research is structured around a social, political, or historical view of the issues studied.
Interpretive	This research involves interpretive inquiry, where the researcher interprets the information that they see, hear, or understand. This interpretation cannot be separated from preconceived ideas that the researcher has about the issue. After a research report is issued, the readers and participants provide other interpretations. These various perspectives of interpretations usually emerge from the initial view of the research.
Holistic approach	Qualitative research attempts to build a complex picture of the issue under study. This entails multiple perspectives, identifying various factors involved in the situations, and outlining the larger picture that develops from the study (Sekaran and Bougie, 2013).

One of the example of unstructured interviews are conducted by recording oral history (Blaikie, 2007). This process involves the participant narrating their life story and discussing their perception of the events. The sources gathered from this method can either stand on their own or may need some type of qualitative analysis. Another method of collecting life history data is by using secondary data. In this method, diaries or autobiographies are used as the main sources.

A focus group is also an interview method that has been the subject of much research (Blaikie, 2007). This method is more popular in marketing research and is normally used in evaluation research. The advantage of this method over individual interviews is it allows interactions between participants. This method is used when the researcher needs the participants to focus on a specific topic within the research subject (Quinlan, 2011). By doing this, the researcher is able to seek in-depth insights on why certain thoughts are held from a group of participants simultaneously (Blaikie, 2007; Quinlan, 2011). This is because people are more aware of their perceptions and thoughts when being provoked by alternative views (Blaikie, 2007).

The use of documents in the qualitative method involves identifying factors in which themes and connections are developed. The same source can be used in the quantitative method by assigning the information into certain categories.

4.3.3 Differences between qualitative and quantitative approaches

Table 4-2 summarises some features of qualitative and quantitative approaches discussed earlier. The main features that distinguishing qualitative and quantitative approaches include: data collection method, data analysis method, and preoccupation, which have been discussed in the previous section. From the preceding discussion, the advantages and disadvantages of each approach are identified. The decision on whether to use the quantitative or qualitative approach can be based on various reasons. These include;

- Research duration
- Social phenomena of research
- Accessibility to information
- The research questions that a researcher wants answering

Table 4-2: Basic features of quantitative and qualitative approaches **(Blaikie, 2007)**

	Quantitative	**Qualitative**
Data collection methods	-Questionnaire (self-administered) -Structured interview -Structured observation -Content analysis of documents	-Participant observation -Semi-structured and structured observation -Focused interview -In-depth interview -Oral/ life histories -Focus group/ group interviews -Content analysis of documents
Data analysis method	-Descriptive (univariate): Distribution- numerical and graphical Central tendency and dispersion -Descriptive bivariate: Correlation - simple partial and multiple correlation Analysis of variance and co-variance -Explanatory: Factor analysis -Path analysis Regression-simple, partial and multiple -Inferential: Sample statistics to population parameters Sample differences to population differences	-Descriptive -Theory generation: Analytic induction Grounded theory-open and axial coding Categorising and connecting Classification to typologies
Preoccupation	-Measuring concepts -Establishing cause and effect relationship -Generalising -Replicating -Focusing in individuals	-Using social actors -Focusing on social processes -Adopting flexible approach -Developing concept and theory

4.3.4 Similarities between quantitative and qualitative methods

Apart from their differences in terms of philosophical positions, preoccupation, data collection, and analysis methods, there are some similarities between these two approaches. Firstly, both approaches use empirical observations to address research questions. In other words, they describe the data, and provide justification and possible explanations of their findings (Onwuegbuzie and Leech, 2005). Secondly, both approaches observe some precautions to minimise potential bias and lack of rigour in their research (Burke and Onwuegbuzie, 2004).

4.3.5 Mixed methods

Another research approach is mixed methods. This method involves data collection and analysis by combining quantitative and qualitative approaches (Blaikie, 2007). It was originated in 1959 when Campbell and Fisk adopted this approach to determine validity of psychological traits (Cresswell, 2003). The term triangulation was initially referred to the use of combination methods. Tashakkori and Teddlie (2003) proposed the use of terms to differentiate various types of combinations. They suggest that 'multi-method' is referred to the studies that adopt more than one method of the same type; either a combination of qualitative or quantitative approach. On the contrary, 'mixed method' is referred to research that combines quantitative and qualitative methods. They also define the combination of different ontological and epistemological perspectives as 'mixed model'.

The mixed method research is adopted for the following reasons (Cresswell, 2003; Blaikie, 2007);

- Strength of one method can complement the weakness of the other
- Provide more detailed evidence
- Aid in answering research questions that are unable to be answered by a single method
- Provide the researcher with multiple skills
- Encourage the use of multiple paradigms

The advantages of mixed-method approaches outlined earlier have led many researchers to propose types of mixed-method strategies. Amongst the common strategies in the literature proposed by Creswell (2003) are sequential mixed-methods, concurrent mixed-methods, transformative mixed-methods.

4.3.5.1 Sequential mixed-methods

This procedure involves the researcher expanding the outcomes of one method with another method (Cresswell, 2003). An example of this strategy is by performing a qualitative interview for exploratory purposes and following it by a quantitative survey method with a larger group of participants. On the other hand, the research may begin by conducting a quantitative survey and following up with detailed exploration either with a few cases or individuals.

4.3.5.2 Concurrent mixed-methods

This method involves merging of qualitative and quantitative data for the purpose of providing comprehensive analysis of the research issues (Cresswell, 2003). Researchers who employ this approach would collect both types of data concurrently and integrate the information during the final interpretation process. This approach is also used to answer different types of research questions. In this regard, quantitative data discuss the outcomes, while qualitative discuss the process.

4.3.5.3 Transformative mixed-methods

This strategy involves the usage of theoretical perspectives as a comprehensive lens within a research design (Cresswell, 2003). This means, theoretical perspective is used to provide framework for research interest, methods for data collection, and the need to shift methods which is anticipated throughout the study. Within this perspective, the data collection methods could be concurrent or sequential.

4.4 Types of research

There are various types of research in the current literature. These types of research are also known as methodologies (Cohen et al., 2011). This section discusses some examples of methodologies used in the research field.

4.4.1 Action research

Action research is a suitable approach in a context where a problem involving people, tasks, and organisations requires a solution (Bell and Waters, 2014). This is an applied research where the practitioner has to identify areas for potential improvements within the institution (research setting). This research emphasises seeking information on attitude and perception from the practitioner in the field. It may involve qualitative or quantitative approaches or the combination of both methods (Gray, 2014). In some cases, external support may be needed. The main aim of this research is to provide recommendations for better practice or to enhance the performance of the institution or individual (Bell and Waters, 2014). This is conducted by altering some procedures, rules, or routines in the case of an organisation (Lloyd and Subbarao, 2009). This research normally entails a long period of study. In essence, when the research has finished and the recommendation has been implemented, the practitioner continues to evaluate and improve the practice (Bell and Waters, 2014).

4.4.2 Case study

This is an appropriate research style for an individual researcher because it provides an in-depth study of some aspects or contexts. Case studies may be carried out before or after a survey has been carried out. The post-survey case study normally intends to seek key issues that are worth further investigation. Yin (2009) suggests that a case study research is useful when the research needs to answer a lot of questions on how and why some social phenomena work. The data collection for this research style varies between interview, observation, and other methods that are appropriate to answer the research questions (Bell and Waters, 2014). This research is chosen based on the notion that all organisations or individuals possess certain features. Thus, a case study is carried out to identify those features such as to study various interaction processes in an organisation or/and to study how implementing certain processes influences the way an organisation works. Some criticisms of this style are a study of a single event may hinder the researcher if they need to cross-check information. This style might lead to selective reporting, which may mislead the findings. Moreover, one of the major concerns is that generalisation is not always promising (Bell and Waters, 2014).

4.4.3 Ethnography research

Ethnography research attempts to investigate how culture works. To do this, various data collection methods are employed. One of the methods, i.e., participant observation allows the researcher to be involved in the research setting and share the same experience as the participants (Leonard-Barton, 1990). This gives better understanding of the reason behind certain participants' actions. The disadvantages of this method are time consuming and the researcher has to be accepted by the individual or groups being studied, which might take time. One criticism of this research style is that it is similar to case study where it restricts comparison with other groups of the same nature (Lillis et al., 2008). To overcome this, the researcher may choose to conduct multiple case studies if time permits. Nevertheless, if the study is well-structured, it may have practical implications in the form of problem solving approaches and implementation to be applied to other members or groups within a similar setting (Bell and Waters, 2014).

4.4.4 Grounded theory

This research style was developed by Glaser and Strauss around the 1960s during their field observational study of how hospital staff deal with dying patients (Cohen et al., 2011). The grounded theory adopts the qualitative approach and seeks to develop theories (Charmaz, 2011). In other words, there is no theory at the beginning of the research; it is developed during the study. Most grounded theory research start with the research question and not the hypothesis. In fact, they do not begin with an extensive literature review related to the subject. Instead, a researcher builds a theory from the data in the analysis stage, which will begin immediately after the data collection started and not after its completion as in other research (Cresswell, 2003). This is to allow analysis of findings before additional data is collected. Throughout the analysis, there will be more findings and analysis until it reaches theoretical saturation (Charmaz, 2011). When this happens, additional data will not be useful in developing new theories. The data analysis process of grounded theory is rather complex. It requires skills to identify concepts, codes, categories, and relationships to provide useful findings (Cresswell, 2003; Bryman, 2016).

4.4.5 Survey research

Survey is a research style where the same set of questions is asked to the selected population. The increase in popularity of survey research in operation management lies in the value of empirical research in that field (Forza, 2002). Survey research is conducted for either exploratory, descriptive, or confirmatory (Forza, 2002). The exploratory survey is normally conducted in the early stage of research where the objective is to understand the preliminary idea of the subject (Forza, 2002). This type of survey does not have concepts or models but is performed to explore the concept to be measured within the phenomena. A descriptive survey is concerned on specific characteristics of phenomena either at a specific time or over varying times for comparison purposes. This type of survey is aimed at describing the population within the phenomena studied (Forza, 2002; Ghauri and Gronhaug, 2005). The confirmatory survey requires pre-conceived knowledge about the subject of research (Forza, 2002). This survey is aimed at validating the proposed model derived from theories. In the confirmatory survey, independent and dependent variables are controlled through statistical techniques such as multiple regression (Ghauri and Gronhaug, 2005).

The outcomes of the survey research from the selected population will then represent the whole population by providing generalisation (Cresswell, 2003). One of the critical elements of this method is ensuring the sample is truly representative of the whole population (Cresswell, 2003; Vaus, 2014). To do this, the researcher has to identify characteristics of total population to ensure the selection of sample enables representation. Details need to be given when designing the survey instrument to encourage participation and improve response rates (Kanuk and Berenson, 1975). Information can be sought by self-administered survey by mail or online, face-to-face with the help of interviewers or by phone (Bryman, 2016). This research style will enable the researcher to describe, compare the characteristics, and identify links between variables.

4.4.6 Experiment research

An experiment research that involves measurable phenomena is more easily performed. An example would be the setting up of two groups to investigate how eating fish affects protein levels. One group would be the control and eat none; the other group would eat fish (Bell and Waters, 2014). In this experiment, the two groups were identical in terms of age and gender. Their protein level was computed prior to the test and detailed instructions about the procedures were given. After a certain period, the level of protein was computed for both groups and the conclusion was drawn (Bell and Waters, 2014). From this study, a causal relationship can be established. This kind of experiment is easy to conduct and is straightforward (Cresswell, 2003). However, an experiment to test behavioural changes would be more difficult (Bell and Waters, 2014; Bryman, 2016). This experiment may also demonstrate causal relationship provided that the design is sound and potential ambiguities can be controlled (Bell and Waters, 2014). This test might not be time consuming as it may only take few hours but there is a need to consider all possible factors in order to justify the causality (Bell and Waters, 2014).

4.5 Methodologies adopted for this research

In operation management research, a common ontological position is objectivism (Flynn et al., 1990; Micheli and Mari, 2014). This means that the industry or organisation studied by the researcher exists separately from the researcher (Matthews and Ross, 2010; Bryman, 2016). Objectivism encourages the researcher to obtain scientific knowledge by considering diverse data collection methods. The focus of this research is to explore what is happening and how. In other words, it explores the prevalence of performance measures of the industry and studies its association with organisational strategies and performance. Hence, it involves causal relationship. Thus, corresponding epistemology to this ontological position is positivism and usually deploys the quantitative approach. However, this research holds a different epistemological perspective: pragmatism.

Pragmatism assumes methodologically diverse, multiple approaches to research, extending positivist and interpretive epistemologies towards the criteria of fitness to enable practicality (Cohen et al., 2011). This perspective fits well with mixed-method approaches of this research. There are some arguments made by quantitative researchers about the lack of scientific methods being used in qualitative research. On the other hand, quantitative researches were viewed by the qualitative researchers as being unable to capture voice, experiences, and perspectives. This research viewed these two as a complementary and chose mixed method approaches to answer the research questions (Osborne, 2008). Pragmatism supports operation management research (Ormerod, 2006). This can be explained by its views that advocate empirical study. It emphasises outcomes and consequences such as the application of statistical analysis to the research survey. In statistical analysis, probability theory allows statements to be made about the fallibility of our forecasts and predictions. This is important to answer the research questions on causality between variables as presented in the conceptual model of this research in **Chapter**

3. Moreover, pragmatism supports the nature of operational research, which is time and context dependent (Ormerod, 2006).

In line with the pragmatism view, this research combined both qualitative and quantitative approaches to answer the research questions. The mixed-method strategy selected was sequential mixed-methods (Cresswell, 2003). This strategy involved the exploratory interview (industrial interview) in the early stage of the research, followed by survey research using self-administered questionnaires. There are three types of survey research; exploratory, descriptive, and confirmatory (Forza, 2002). This research employed confirmatory survey to test the conceptual model derived from theories and literature. The use of these two methods, i.e., industrial interview and questionnaire survey, was to achieve research triangulation and eventually increase the quality of the research. These methods are explained in the following sections.

4.6 Industrial interviews

At the preliminary stage of research, most researchers choose to conduct exploratory study in order to develop research questions before entering into further investigation (Stebbins, 2001). In this research, a detailed exploratory study was conducted in the form of semi-structured interviews among supply chain experts in the oil and gas industry. The experts were chosen from supply chain managers in the industry, who have been involved in local and international projects. For this purpose, five industrial interviews were conducted with supply chain managers, who are based in the United Kingdom, the United States, Indonesia, and Malaysia. The reasons for choosing these countries were based on the accessibility and contact that the researcher has with the interviewee when she was working in the oil and gas industry. Voss et al. (2002) mentioned that the ideal person to approach for interviews is the person who could provide necessary access. To encourage participation, interviewees were informed that a brief outcome of this study would be shared with them (Voss et al., 2002).

4.6.1 Sample selection and access

Random sampling was adopted for the interviews (Matthews and Ross, 2010). For this purpose, five phone interviews were conducted among supply chain managers who are based in the United Kingdom, the United States, Indonesia, and Malaysia. These four countries were chosen because of the accessibility and contact that the researcher had with them when she was working in the oil and gas industry. Voss et al. (2002) stated that the ideal contact for a case study is the person who can best provide necessary access. To encourage the interviewees to participate in this study, they were informed that the results would be shared with them (Voss et al., 2002).

In compliance with ethical requirements, all the interviewees and the companies they work with were anonymised, which is described in the next section.

4.6.2 Interview processes

The interviews were conducted by phone. First, participants were contacted by email asking for their cooperation to be interviewed. An introduction letter was attached to the email providing information about the research. This letter is important to help them to decide on participating in this interview. Upon their agreement, they were required to fill in the consent form. Accordingly, an agreement about the date and time for the tele-conversation interview were discussed with them. The interviews were conducted between March 2015 and July 2015 depending on participants' availability. Each interview took between one and one and a half hour. After the interview, a full transcription was sent to the interviewees by email for their verification. Any need for clarification after the interview was conducted by email. Yin (1994) gives guidelines on case study interview which were adopted in performing the industrial interviews. Yin (1994) described a set of skills are required by the researcher when conducting interviews:

- Ability to ask good questions and in interpreting the answer
- Ability to be a good listener and not to be trapped by personal preconceptions
- Ability to be adaptive and flexible by viewing a newly encountered phenomenon as opportunities and not threats
- To have a clear understanding of the issues being investigated

- To be unbiased by pre–conceived theory, and thus receptive and sensitive to contradictory findings

The analysis of the interview is reported in **Chapter 5**. The outcomes of these interviews were extended to the next phase of this research, i.e. survey by questionnaire.

4.6.3 Interview questions

The industrial interviews were conducted using semi-structured interview. A semi-structured interview means that a list of interview questions has been developed in advance as a guideline for the interview session (Blaikie, 2007). These questions have been developed based on the extensive literature review. The basis of this interview was the minimal literature on supply chain research that particularly focused on the oil and gas industry.

The literature on supply chain performance measurement are studied and discussed in **Chapter 2**. A list of interview questions was carefully designed with reflection to the supply chain performance measurement issues existed in the literature.

The interview questions consisted of introductory questions about the background of participants with other six questions related to the importance of performance measurement in the oil and gas industry, characteristics of oil and gas supply chain, the needs to design PMF based on hierarchical level, factor influences the choice of performance measures and challenges in managing supply chain performance. In addition, the interview was conducted to seek supply chain experts' perspectives regarding the application of commonly used performance measures cited in the literature of the oil and gas industry. The list of interview questions is shown in Appendix III.

4.6.4 Data collection

This section includes the data collection process used for the exploratory interview. A semi–structured form of interview was used in this study. This means that the list of interview questions was developed in advance as a guideline for the interview session. This developed set of interview questions was constructed based on the extensive literature review studied earlier. The interview questions consisted of seven main questions with an additional nine questions on the performance measures that are commonly used in the industry.

Other than that, the participants were also asked to give their opinion on any subjects which was not discussed during the session. This was to give them the opportunity to highlight any important parts of performance management in the supply chain, which might have been overlooked by the researcher. The interviews were conducted by phone and were kept semi-formal, and the communication was in the form of discussion. This style of interview was used to ensure that the data collected was more representative of the real situations in the oil and gas supply chain. Also, the discussions with all participants were audio recorded to ease the process of analysing the findings.

4.6.5 Analysis of data

The analysis began with the transcribing of the interviews which took about seven days for each interview of one-hour duration. This period involved listening, transcribing, as well as clarifying the audio recorded data with the participants.

The process of coding and constructing themes began by categorising the similarities and differences in the interview data (Matthews and Ross, 2010; Yin, 2009). This process, which is known as thematic analysis (Braun and Clarke, 2006) was conducted using Microsoft Excel.

Due to the fact that the interview transcriptions were based on semi–structured questions, some of the answers were difficult to categorise as they were broad and lengthy and subjected to interviewees' opinions and perceptions. For this reason, the researcher gave a primary focus on the research questions while at the same time not ignoring the useful additional information arising from the interview sessions.

The participants involved were renamed as A, B, C, D, and E to protect the confidentiality of the information. The brief summary of participants and their involvement in the oil and gas supply chain are presented in **Chapter 5.**

4.7 Survey by questionnaire

A questionnaire is a set of written questions, which is designed for participants to record their responses (Sekaran and Bougie, 2013). Survey by questionnaire is the most widely used data collection method in management research due to its structured data gathering instruments (Ghauri and Gronhaug, 2005; Quinlan, 2011). The most important issue in employing questionnaire survey is to fully understand the questions the research is going to answer (Ghauri and Gronhaug, 2005). This is because the information gathered from the survey will be used for either exploratory, descriptive, or confirmatory research.

The exploratory survey is normally conducted in the early stage of research where the objective is to understand the preliminary idea of the subject (Forza, 2002). Descriptive surveys, on the other hand, are focused on recognising phenomena to describe variance (Ghauri and Gronhaug, 2005). It is concerned with specific characteristics of a specific population either at a specific time or over varying time for comparison purposes. This type of survey concentrates on a representative sample of population and the accuracy of findings to draw generalisations (Ghauri and Gronhaug, 2005).

Confirmatory surveys enable theory testing by investigating the relationship between variables. This research performed a confirmatory survey, which places great emphasis on specifying independent and dependent variables (Ghauri and Gronhaug, 2005). Hence, the conceptual model was developed prior to the questionnaire survey design. Thus, the review of literature is very important to conceptualise this research.

A major consideration of the questionnaire survey in this research was the need for testing causality relationship. This research studied the link between organisational classifications, choice of performance measures, and organisational performance. Furthermore, this is a very practical method of obtaining information from participants who are in a distant location (Quinlan, 2011). This method was also chosen taking into consideration the fact that the participants were drawn from the CEO and the supply chain managers, who normally have a very tight schedule. A questionnaire survey is very efficient as it can be completed in a short time and participants can take the survey at their convenience (Sekaran and Bougie, 2013).

Moreover, survey by questionnaire is an appropriate method of producing generalisation on a large population (Quinlan, 2011). In this research, the questionnaire survey was adopted to study the performance measurement framework of the oil and gas industry. This also means it involved different types of companies from the upstream to the downstream sectors of the industry. The usage of other methods such as in-depth interview to answer the research questions would be very time consuming as it involved a large group of respondents. Moreover, it may not be able to produce a generalisation as the responses might be broad and diverse. This questionnaire survey was conducted to test the proposed conceptual model of this research.

4.7.1 Sampling technique

Since this questionnaire survey was aimed at making generalisations about the oil and gas industry, it was critical to consider which sampling techniques to use. Sampling of population was conducted as collecting responses from all the companies within the industry was not possible. Even if it could be conducted, it would be very costly and time consuming (Sekaran and Bougie, 2013). Sample selection is a very important element in conducting a research. In quantitative research, sample selection processes need to be conducted in a manner that represents the population as the processes enable inferences to be drawn, determine causal relationship, and to draw generalisation (Kumar, 2014). The number of samples has a great influence on the outcome of a quantitative research.

A sampling frame is a physical representation of all attributes in the population from which the sample is extracted. This research involved supply chain companies from upstream and downstream sectors of oil and gas companies in the UK and Malaysia. Pegasus Energy (www.pegasusenergy.co.uk) and Subsea Oil and Gas Energy (www.subsea.org.uk) databases were adopted as sources for UK samples. All the companies selected were verified by using Financial Analysis Made Easy (FAME) to ensure the companies are still operating and to validate their current address. On the other hand, the sample from Malaysia was selected from oil and gas association databases including Malaysia Oil and Gas Service Council (www.mogsc.org, my), Malaysia Gas Association (http://www.malaysiangas.com/portal/), and Malaysia Oil and Gas Engineering Council (http://www.mogec.org.my). This research adopted the random sampling technique where all companies in the industry had an equal chance of selection (Sekaran and Bougie, 2013). Around 550 companies were selected from the UK and 120 from Malaysia. The number of UK companies selected was higher considering the size of oil and gas productions in the UK almost double the production in Malaysia (US Energy Information Administration, 2017). Purposive sampling technique was employed in determining participants from the sample companies. In this regard, the CEOs or the supply chain managers of the companies were chosen as they are in better positions to provide the required information in the questionnaire (Quinlan, 2011). The response rates and demographic profile of the respondents are presented in **Chapter 6**.

4.7.2 Questionnaire design

A questionnaire provides a tool to collect information which can be classified, analysed, and discussed. It is the most common method used in survey research. This method allowed the researcher to gather information without personally approaching respondents. There has been much research discussing the design of self-administered questionnaires (Braun et al., 2012). Before designing a questionnaire, it is important to first identify what evidence is needed to meet the research aims (Taylor-Powell, 1998). This research aimed at studying the performance measurement framework of the oil and gas industry. It explored the prevalence of performance measures in the industry and investigated the link between performance measures with organisations' strategy and performance. Moreover, it also investigated the challenges and factors that influenced the choice of performance measures. The aims of the research were translated into the four-page self-administered questionnaire form. In designing this questionnaire, several aspects were taken into consideration to ensure that it would be able to answer the research questions. The aspects of good questionnaire design according to the literature (Ghauri and Gronhaug, 2005; Braun et al., 2012; Sekaran and Bougie, 2013) are discussed in the following sections.

4.7.2.1 Research aims

An introduction letter that explained the identity of the researcher and conveyed the purpose of the study is very important. This was meant to establish good cooperation with the respondents and encourage them to be involved. A cover letter with UCLAN logo was enclosed with the questionnaire survey addressed to participants in both the UK and Malaysia. Assurance of confidentiality was included in this letter. This assurance was expected to elicit less biased responses (Sekaran and Bougie, 2013).

4.7.2.2 Sequence of questions

A questionnaire should also be designed in an appropriate sequential order (Braun et al., 2012). In essence, it should begin with general questions and then be followed by more specific ones (Sekaran and Bougie, 2013). This funnel approach will encourage participants to complete the questionnaire as it demonstrates easy and smooth progress. This principle was applied in this research where the questionnaire began with demographic information and then continued with the respondents' perceptions on performance measures and other related matters.

4.7.2.3 Social desirability

Social desirability refers to the respondents' desire to create a good impression with their answers. To avoid this issue, it is advisable to emphasise the anonymity of the survey and to avoid asking much personal information. Assured anonymity will increase participants' willingness to disclose information (Braun et al., 2012). To achieve this, the questionnaire was accompanied by a cover letter that stated the information provided would be confidential. In addition, it also explained that the name, email, and company information were optional. This was meant to increase participants' confidence and willingness to participate.

4.7.2.4 Question wordings

Questions should be structured precisely by including terms that are familiar to the target respondents (Ghauri and Gronhaug, 2005; Braun et al., 2012). Ambiguous, abstract, or unclear words were avoided. Apart from that, no double barrel questions should be included as they would confuse the participants. A double-barrelled question is one which covers more than one aspect (Ghauri and Gronhaug, 2005). Thus, it may be difficult to respond to the question if only one characteristic in the questions is relevant to them (Braun et al., 2012). In addition, the questions should be designed in a way that can be easily understood by the practitioner (Sekaran and Bougie, 2013). For instance, the design of organisational strategy questions was rephrased in simple rather than using academic language.

4.7.2.5 Leading and loaded questions

Leading and loaded questions were avoided in the questionnaire to minimise potential bias (Ghauri and Gronhaug, 2005). A leading question is where the question is worded to provide responses based on researcher preferences. A loaded question, on the other hand, is emotionally charged (Sekaran and Bougie, 2013).

4.7.2.6 Length of questions

The length of questions was kept to a minimum. The rule of thumb for the question or statement is that they should not be more than twenty words (Sekaran and Bougie, 2013). Most of the questions were in a Likert-scale form and in an objective form. Only a few optional parts were in a subjective form where participants were allowed to give their opinion.

4.7.2.7 Frequency scales

It is important to use only positive numerical values within response scales. Respondents are less likely to choose negative values on the scales as they lead them to different interpretations. For instance, if the question asked about competence and the response scales are from "-3" to "3", the participant will interpret -3 as very incompetent while +3 as very competent (Braun et al., 2012). Conversely, if the scale is from 1 to 5, participants will interpret it differently where 1 is less competent and 5 is very competent. In most cases, people will avoid rating someone as incompetent and rather choose to describe them as less competent (Braun et al., 2012). In this research, only positive numerals were used. The Likert-scales used were from 1 to 5 ranging from ‘very low’ 1 to ‘very high’ 5, and ‘strongly disagree’1 to ‘strongly agree’ 5.

4.7.3 Questionnaire survey administration

There are various techniques in administrating a questionnaire survey. These include mail, electronic, personally administered questionnaire, and telephone survey (Sekaran and Bougie, 2013; Vaus, 2014). This section discusses these four types of techniques and then explains the technique adopted for this research.

The advantage of mail, electronic survey, and telephone survey is their ability to reach respondents located in far distances. These techniques allow participants to complete the questionnaire at their own time. The downside of this technique is it usually produces low response rates (Sekaran and Bougie, 2013; Vaus, 2014). Also, they limit the opportunity for participants to clarify any part that they do not understand. In addition, the low response rates may lead to difficulty to ascertain the representation of the sample. Nevertheless, there are some techniques which can be employed to encourage participation. These include sending notification emails and phone calls to remind participants. In addition, enclosing a self-addressed paid envelopes will also improve response rates (Sekaran and Bougie, 2013). If the participants are unable to respond, they might still use the pre-paid envelopes to let the researcher know why. This may help the researcher to understand the reason for the low response in their survey.

The usage of electronic survey has gained much popularity since the 1990s (Vaus, 2014). Apart from its ability to cover a wide range of geographical areas, it is very cost effective (Sekaran and Bougie, 2013). In fact, there are various media which can reach participants without involving any cost. These include email, Survey monkey, and Google form. The effectiveness of electronic survey is largely dependent on participants’ preferences. Some participants may not be comfortable answering online or by email and prefer a traditional way (on paper) (Vaus, 2014). This factor needs to be considered to ensure that the survey meets a satisfactory response rate.

A personally administered questionnaire is very suitable when the survey is confined to a local area (Braun et al., 2012). It is particularly effective in minimising delays in receiving responses from participants. Moreover, any clarification required by participants can be addressed at the time and the researcher has the opportunity to encourage participation. This technique, however, might create bias if the researcher unintentionally explains the questionnaire differently to different participants. Thus, they have to take this into account in adopting this technique.

Telephone interviews involve making telephone calls with the selected participants and asking the question by phone (Vaus, 2014). Their responses are recorded by the interviewer. This method requires a skilled interviewer to create rapport with the participant. Nevertheless, technological development has made this method less practical (Bryman, 2016). This is due to the decline of fixed line telephony, widespread usage of mobile phones, and the usage of answering phones in most companies have created difficulty in reaching participants (Vaus, 2014).

This research adopted mail survey for the UK participants and electronic survey for the Malaysian participants. The questionnaire was posted directly to the CEOs of the selected companies. Each envelope posted to them contained a cover letter with the UCLAN letter head, questionnaire, and self-addressed pre-paid envelope. The usage of mail survey for the UK companies was because the researcher was based in the UK during the data collection process. Moreover, it was difficult to obtain CEO or supply chain manager email addresses for the UK companies. The only disclosed email of most UK companies was the general email or sales inquiry. Sending the questionnaire to this email may not reach the right person. To increase the response rate, Dillman's (1991) method was applied. This means phone calls were made and emails were sent to encourage participation in this survey. In the follow up email, a questionnaire form was enclosed and a link to participate in the online survey was given to provide them with alternative ways to respond.

For the survey in Malaysia, electronic questionnaire was used. This was performed by sending the questionnaire through emails to the selected organisations. In addition to that, a link to the on-line survey form was also included in the email. The online survey form was constructed using Google form. A reminder email was also sent to participants to encourage their participation. The details of response rates and the structure of the questionnaire are explained in **Chapter 6**.

4.7.4 Questionnaire validation and pilot testing

Pilot testing is an important part in the questionnaire survey research. This process ensures that the questionnaire can be easily understood by the participants and most importantly that it is able to answer the research questions. Furthermore, it ensures reliability and validity of the questions. Besides, it provides feedback in case any amendment is required. This was conducted by pre-testing the questionnaire to two types of people; academics and industrial practitioners. The role of academics was to ensure that the questions were able to capture necessary responses to answer the research questions. On the other hand, input from the industrial practitioners was also important to highlight certain areas that might be overlooked by the researcher (Forza, 2002). The comments received from this review include:

i) To ensure that the average sales turnover questions are in line with turnover classification in the UK
ii) To include researcher and supervisor email in the questionnaire to enable the participants to contact them should they need further clarification
iii) For Malaysian survey, it was suggested to make the email and company name optional questions. This is because some participants may not feel comfortable disclosing their personal information. There was no need to change the questionnaire in the UK based on the previous research survey conducted in this country (Yusuf et al., 2014).
iv) To add an instruction 'Please tick one of the following;' for question number 7 (Legal form of classification)
v) To change the heading in question number 6 from 'Major services of the company' to 'Major area of operations'
vi) The term 'inter department cultural resistance' in question number 12 was rephrased as 'Lack of inter-department cooperation', to reflect its actual meaning.
vii) The suggestion was made to rephrase instruction for question number 11 from;
'Please indicate by a tick (√) level of importance of the determinant factors for the performance measures in your organisation'.
to;

‘Please indicate by a tick (√) the degree of the following factors that influence the choice of performance measures in your company’. This is to make the instruction clear to the participant and limit unnecessary clarification of the term ‘determinant factor’.

viii) To include one section where participants are allowed to provide their opinions. Hence, the following statement was included in the last section of the questionnaire;

‘Do you have any other thoughts on the performance management of the oil and gas supply chain?’

ix) Other comments received included that this questionnaire was brief, straightforward, and easy to understand.

These comments were incorporated into the final questionnaire as in **Appendix II**. Following these amendments, the questionnaires were posted to a hundred companies (target respondents) for a pilot survey. 12% of the companies responded with the completed survey forms. This indicates that the questionnaire could be understood and completed if it were performed with a larger group of respondents. Based on this outcome, a full-scale survey was conducted in the UK and Malaysia.

4.7.5 Analysis technique

This section discusses statistical techniques of this research. These include the types of data, preliminary analysis, descriptive statistics, and inferential statistics.

4.7.5.1 Types of data

Nominal scale or also known as categorical data using numbers was used to label categories. This type of scale normally contains least information. The examples of data suitable for this scale are gender, ethnicity, and colours. One important thing in managing this data is to ensure the categories are mutually exclusive (Tolmie et al., 2011). In other words, choosing one category ruled out other alternative categories in the same question. By using this scale, a user can assign observations into various categories and compute the frequency of each category. Nominal scale is not used to express quantity. For instance, if a user wants to measure people according to gender, he might assign '1' for male and '2' for female. But, this does not mean that female has more gender than male (Sprinthall, 2007).

Ordinal scale or known as ranked data is normally used by social scientists in a likert-scale questionnaire. In certain research design, a researcher might need to know how much X and how much Y of observations (Sprinthall, 2007). The ordinal scale provides this need by assigning ranks to categories. For instance, in the field of management, a researcher designs the ordinal scale to measure the leadership ability of a group or individuals. In ordinal scale, the respondents have to choose their degree of agreement of a statement (Tolmie et al., 2011). It is important to note that ordinal scale only defines ranked-order of the numbers and not how much difference between them.

Another type of scale is interval scale. In this scale, a number is assigned by ensuring the intervals between points are meaningful (Boone and Boone, 2012). In other words, the scale can provide information not only about A is more than B but also how much is A more than B (Sprinthall, 2007). In this regard, the distance between points on a scale is equal. Therefore, inferences made for scale data are considered more meaningful than nominal and ordinal data.

Ratio scale is quite similar to interval scale. The only difference is it has an absolute zero (Boone and Boone, 2012). The examples of ratio scale are weight, age, and years of experience. Understanding the types of data is very important in designing questionnaire form. The choice of data to be used depends on the questions the research intends to answer (Sprinthall, 2007).

This study used nominal data for some demographical questions and interval for financial information. Likert scale types of data were used in seeking organisations' opinion about organisational strategies, performance measures, organisational performance, determinant factor in choosing performance measures, and challenges in managing supply chain performance. Despite some authors contend that non-parametric analysis is a suitable technique to analyse likert-scale data (Pallant, 2016; Sprinthall, 2007), there are some researchers who strongly supported the usage of parametric analysis for this type of data (Norman, 2010; Murray, 2013). On that basis, this research used parametric analysis, which most authors stated as having better statistical power than non-parametric analysis (Sprinthall, 2007; Field, 2009; Andy Tolmie and McAteer, 2011; Pallant, 2016).

4.7.5.2 Preliminary analysis

All the responses received from this survey were inserted into IBM SPSS 22, a statistical analysis software. This enables the data to be interpreted through frequency, means, and standard deviations in an efficient manner. In addition, it also allows inferential analysis to be performed to investigate the relationship and difference between variables. Thus, the research questions can be answered. Prior to the statistical analysis stage, a preliminary analysis is very important (Pallant, 2016). This exercise is conducted to:

- Inspect if there are any missing data/ outliers (Pallant, 2016; Tolmie et al., 2011)
- To test for normal distribution of data (Pallant, 2016; Tolmie et al., 2011)
- To check validity and reliability of the data (Pallant, 2016; Tolmie et al., 2011; Sprinthall, 2007)
- To identify potential bias (Pallant, 2016; Sprinthall, 2007)

4.7.5.3 Assessing the assumption of normality

Normality assessment is conducted to determine whether the data set is well-represented by normal distribution population or Gaussian distribution (Ghasemi and Zahediasl, 2012). This assessment is a pre-requisite for parametric analysis, such as t-test, regression, analysis of variance (ANOVA) (Tabachnick and Fidell, 2007; Pallant, 2016). Failing to hold to this assumption might affect the accuracy of the conclusion derive from reality (Ghasemi and Zahediasl, 2012). However, with a large data (more than 40), violation of normality assumption might not create any major problem to the analysis (Tabachnick and Fidell, 2007; Ghasemi and Zahediasl, 2012). Hence, a parametric test can be executed despite not having a normal distribution observation.

There are two categories of normality assessment which are graphical method and statistics method. The graphical method includes histogram, stem-and-leaf plot, box plot, normal distribution plot, and detrended normal plot (Tabachnick and Fidell, 2007; Field, 2009; Ghasemi and Zahediasl, 2012). The statistics methods include Kolmogorov–Smirnov (K-S) test, Shapiro-Wilk test, skewness, and kurtosis (Field, 2009; Ghasemi and Zahediasl, 2012).

4.7.5.4 Reliability and validity of data

Most researchers associate the quality of their survey instrument (questionnaire) through its reliability, content validity, and construct validity (Boudreau, Gefen, and Straub, 2001). Reliability assessment is important to determine the consistency of the survey instrument (questionnaire) (Pallant, 2016). On the other hand, validity of the survey instrument is important to ensure its ability to capture what it is designed to measure. A reliable instrument would be able to yield a consistent result through multiple measurements across time and across the multiple items in it (Sekaran and Bougie, 2013). This refers to the degree to which multiple items that represent a construct are intact.

The standard coefficient of internal consistency or Cronbach alpha is a widely used method to assess reliability (Boudreau, Gefen, and Straub, 2001). It is based on the number of items or questions within the construct or variable and the average correlation between items within the same construct (Hinton, 2004). For instance, to identify the true measure of ‘factors influencing the choice of performance measures’, it is important that the score will be able to reflect the true values for that particular construct with some random errors (Hinton, 2004). This can be observed from the correlation between items. The high correlation indicates the representation of the same construct. Additionally, a high inter-item correlation also means that there is only a small value of error. On the contrary, a low inter-item correlation shows a lack of consistency for that construct in measuring the same thing and there are a lot of errors.

Cronbach alpha values range from 0 to 1. The closer the value is to 1, the higher the reliability of that construct. In general, a Cronbach alpha value above 0.8 is considered good, in between 0.6 and 0.8 is considered adequate, while a value below 0.6 is poor, and less than 0.5 is unacceptable (Sekaran and Bougie, 2013).

4.7.5.5 Addressing bias

There are two types of assessment of bias conducted in this research, which are common method bias and non-response bias.

4.7.5.5.1 Common method bias

Common method bias or known as common method variance is a method to test measurement error of the instrument. It refers to the shared variances among quantified variables that appear under the assessment using common method (Siemsen, Roth and Oliveira, 2010). This test is very important as an erroneous instrument might affect the validity of findings drawn from the statistical analysis. This is especially important if the error is too large to conclude the relationship between variables (Eichhorn, 2014).

The procedural common method bias may be caused by the respondents (e.g. : consistency motive and social desirability), item characteristics (e.g. : complex and ambiguous questions), item context effects (e.g. : respondent's interpretation of one item to another item in the instrument), and measurement context (e.g. : time, location, and medium to obtain information) (Podsakoff et al., 2003).

There are several control measures that can be implemented to minimise procedural common method bias, which include:

- Obtain predictors and dependent variables from various sources
- Protect respondent information
- Structure the questions order
- Improve scale items

All of these aspects were implemented prior to distributions of the questionnaire except for the first item. This was due to the difficulty in obtaining secondary data from the company. Nevertheless, the choice of respondents in this research (e.g.: top management) would not create a major bias to the information obtained from the survey regardless of the usage of a single source.

Accordingly, in order to ensure the validity of the research instruments, the questionnaire was given to industrial practitioners and academicians for their opinions on the constructs and wordings. The details of that procedure were previously presented in the questionnaire validation section.

Despite the considerations on controlling the procedural bias, the statistical procedure also plays a major role in examining the influence of common method bias. The four types of statistical common method bias are as follows:

- Harman's single factor test
- Partial correlation procedure
- Control the effects of a directly measured latent method factor
- Multiple methods factors (multi traits and multi-methods)
    a) Confirmatory factor analysis
    b) Correlated unique model
    c) Direct product model

This research applied Harman's single factor test, which is a widely used procedure in the literature (Podsakoff et al., 2003). The outcome of the analysis is presented in **Chapter 6**.

4.7.5.5.2 Non-response bias

Non-response bias is associated with the bias in the responses received from a survey. Despite a considerable sampling procedure, due to lack of response, certain profiles of survey respondents might be under-represented (Berg, 2005). The under-represented or over-represented respondent characteristics would affect the generalisation made on the entire population. The response rates of this survey from the UK and Malaysia were 11% and 33%, respectively. This comprises 15% of the total questionnaires that were distributed. Hence, non-response bias test was conducted to ensure that the data were able to represent the actual context.

There are several methods to examine the non-response bias of the survey. One of the methods is by summarising the original questionnaire and redistribute it to the non-respondents for them to complete (Lambert and Harrington, 1990). The results of the responses need to be examined using one-way analysis of variance (ANOVA) between the first respondents of the full questionnaire and the second respondents of the brief questionnaire. This method was not adopted in this research as it is time-consuming, expensive, and impractical. More importantly, there was no affirmation that the non-respondent participants would respond to this study.

Another approach involves testing the possibility of non-response bias in the collected data by segregating the responses into two waves, early and late responses (Lambert and Harrington, 1990; Johnson et al., 2000). The statistical significance between the 1st wave (early responses) and the 2nd wave (late responses) was examined using t-test. The 1st wave, in this case, was represented by the respondents that were willing to participate in this survey while the 2nd wave was represented by the non–responding organisations. This research adopted this method due to its practicality. The outcomes of the wave analysis are presented and discussed in **Chapter 6**.

4.7.5.6 Descriptive statistics

The previous sections presented the data screening involved in this research. The normality assessment, reliability assessment, as well as construct and external validity assessment were conducted and discussed in the previous sections. The outcomes of the assessments were very important in deciding the suitable statistical analyses to be adopted for this research. Although the descriptive statistics only outlines the observable data and possesses very limited features in answering research questions, it is essential in presenting the basic features of our data in a manageable form (e.g. : graphs and cross-table) (Sprinthall, 2007; Pallant, 2016).

4.7.5.6.1 The mode, mean, and standard deviation

The mode represents the most common value of the data. The mode can be easily observed from frequency distribution, as it is shown as the tallest bar (Field, 2009). One of the issues with mode is it can be more than one value. Thus, it requires researcher judgement to interpret the data in that case, or to choose other method to present the central of tendency, such as the median and the mean.

The mean is the measure of central tendency (Morris, 2008). It is the average score of the data. To get the mean, the data is summated and divided by the number of cases (Morris, 2008; Tolmie et al., 2011). Despite being used frequently as a simple description to present the average value, it has one disadvantage. The extreme score (outlier) might influence the mean value and eventually misrepresent the data (Field, 2009). Thus, there is a need to check the data before deciding to use the mean in explaining the average score.

The standard deviation is used to express how much the deviation of values from the mean value of the group (Field, 2009; Tolmie et al., 2011). This standard deviation will determine the usefulness of mean value to explain a dataset. If the standard deviation value is close to the mean value, then the mean value is a good representation of the dataset.

4.7.5.7 Inferential statistics

The descriptive statistics of this research has been discussed in the earlier sections. As the main aim of the statistical analysis was to draw conclusions about the industry, the results from the descriptive statistics might not be sufficient to answer the research questions. Hence, this section depicts the inferential statistics of this research. Inferential statistics would give a deeper meaning to the research by presenting the relationship between variables and computing the correlation between them. Noting that investigating the whole population was not viable and also time-consuming, the outcomes of the inferential statistics would be able to make generalisations about the research population (Freeman and Walters, 2013). This was conducted by using probability theory to test the links between research constructs and allow inference to be drawn for the oil and gas industry (Neuman, 2006).

4.7.5.7.1 Correlation analysis

Correlation refers to the strength of association between two variables. A strong correlation demonstrates that two variables are highly associated while weak correlation shows there is minimal or no association between the two variables. Accordingly, correlation analysis is the process of analysing the strength of that association within statistical data by determining a correlation coefficient value. The coefficient of correlation is denoted by the letter 'r' and ranges from -1 to +1 to represent the magnitude of the association between one variable and another (Hoy, 2010; Pallant, 2016). The closer the coefficient value to 1 or -1, the stronger the relationship between variables and its direction of either positive or negative (Huizingh, 2007).

A positive value shows that there is a direct relationship between variables which means that the score in one variable increases with the increase in values of another variable. On the other hand, a negative value indicates an inverse relationship between variables (Field, 2009). There are various types of correlation including Pearson r, Pearson product-moment, Spearman Rank, and Autocorrelation (serial correlation). One of the widely used correlations is Pearson r. This correlation technique is performed with the assumption that the two variables are on interval scales and are measured in increasing values. Apart from that, in order to utilise this method, the sample has to come from a bivariate normal distribution (Huizingh, 2007). However, most of the major constructs in this research used likert scale (ordinal data). Thus, it has violated one of the assumptions highlighted by Huizingh (2007). Nevertheless, studies by Norman (2010) and Murray (2013) support the usage of parametric techniques, such as Pearson r in analysing Likert scale data. Drawing from those studies, Pearson r was used as the correlation technique for this research.

Edwards (1976) argues that correlation does not allow manipulation of variables to derive causal relationship. For that reason, arbitrary judgements are required to identify the predictors and dependent variables which are normally established from the theoretical frameworks.

4.7.5.7.2 Regression analysis of the research construct

Regression analysis is a statistical process to test a relationship between several variables (Field, 2009). It is also one of the techniques that can be used to examine the relationship between single continuous dependent variables and a number of independent variables which are also known as predictors. It is based on the correlation but allows more complex explorations of the interrelationship of the variables (Tabachnick and Fidell, 2007). This makes it suitable to investigate the relationship between constructs in the operation management research. Nevertheless, strong understanding of the conceptual theory is important to ensure the outcomes of this analysis are valuable (Huizingh, 2007).

This method is known for its ability to answer a variety of research questions. One of these is identifying the strength of a set of variables in predicting a dependent variable. In this research, how well a set of subscales of performance measures in predicting organisation performance was investigated.

Apart from that, multiple regression can be utilised to statistically control an additional variable (or variables) when exploring its predictive ability of the model. This makes it possible for the researcher to identify which variable emitted the largest variance in predicting the dependent variable (Tabachnick and Fidell, 2007; Field, 2009).

4.7.5.5.2.1 Major types of multiple regressions

There are various types of multiple regression analyses which can be utilised depending on the nature of the research. The three commonly used multiple regression analyses are (Tabachnick and Fidell, 2007);

- Standard or simultaneous
- Hierarchical or sequential
- Stepwise

The standard multiple regression requires all predictor variables (independent variables) to be entered into the model simultaneously (Tabachnick and Fidell, 2007; Field, 2009). This method ensures each independent variable is evaluated simultaneously in terms of its predictive power. The outcomes of this method will be able to explain the variances that the predictor has (as a group) on the dependent variables (Huizingh, 2007; Pallant, 2016). In addition, it also helps researchers to identify the unique contribution of each variable has on the dependent variables.

Hierarchical regression which is also known as sequential regression method, allows the independent variables to be entered into the model based on the order decided by the researcher (Tabachnick and Fidell, 2007; Pallant, 2016). This sequence is arranged according to the theoretical background. In this method, a variable or cluster of variables is entered in blocks. At the same time, each independent variable is examined for its contribution to the prediction of the dependent variable after the previous variables have been controlled (Field, 2009; Pallant, 2016).

Stepwise multiple regression allows researchers to create a list of independent variables which then allows the programme to choose the sequence of the variables to be entered into the equation based on a set of statistical criteria (Pallant, 2016). The three versions of this approach are forward selection, backwards deletion, and stepwise regression.

This research adopted standard multiple regression for the impact of a set of performance measures had on organisational performance.

4.7.5.7.3 Factor analysis

Factor analysis is conducted to identify latent variables for a set of observed variables. These variables are fewer in number but hold the same important information (Jöreskog and Moustaki, 2006). The latent variables are defined as variables that are not directly measured but inferred through a mathematical model. If it remained constant, the observed variables would become independent. Technically, the factor analysis is performed by exploring the pattern of covariance between the observed items. This means that items that are highly correlated are most likely influenced by the same factor while those with weak correlations are driven by different factors (Decoster and Hall, 1998).

Factor analysis has a number of different purposes. Among the purposes are to refine and reduce a set of items into smaller numbers of consistent subscales and to reduce a large number of items into more manageable variables (Pallant, 2016).

Subsequently, the outcome of analysis can be used for regression analysis or multivariate analysis of variance. Factor analysis is recommended to be performed on a newly constructed survey instrument to verify if the subscales are representing a similar construct to the one that it is intended to measure. Furthermore, items with low correlation values ($r < 0.3$) can also be eliminated (Pallant, 2016). Several assumptions need to be observed when factor analysis is performed. The most important assumptions are sample size and the degree of relationships (correlation values) between items (Pallant, 2016).

Exploratory factor analysis (EFA) and Confirmatory factor analysis (CFA) are the main approaches to factor analysis. EFA is concerned with exploring the interrelationships among a set of variables which are normally applied in the early stage of research. On the other hand, CFA is commonly used in the later stage of the research and focuses on testing specific hypotheses or theories which are derived from a set of variables (Pallant, 2016).

There are seven methods of extractions of factor analysis which include principal components, unweighted least squares, generalised least squares, maximum likelihood, principal axis factoring, alpha factoring, and image factoring (IBM Corps., 2013).

Principal component analysis is the most common extraction method being used due to its simple mathematical techniques and is commonly used in scale developments and evaluation (Pallant, 2016).

4.8 Summary of the research process

The research process of this study involved four main steps. At the initial stage of the research, literature on supply chain performance measurement framework was reviewed. The review concentrated on three main themes: supply chain management, performance measurement, and the oil and gas industry. This is to explore performance measurement framework in the existing literature and to understand the need of PMF in the oil and gas industry. Thereafter, a set of performance measures for the industry was proposed.

The outcomes of the previous step were then organised to construct interview questions. The industrial interviews were performed with five supply chain experts in the industry. This interview was to explore the most important performance measures of the industry, challenges in managing performance, and other issues surrounding it. Interviewees were also given the opportunity to provide any further thoughts on the discussion. The interview data were then transcribed and analysed using the thematic analysis technique (Braun and Clarke, 2006) to identify similarities and differences of interviewees' perceptions. This information was used as the basis to propose the expanded set of performance measures. In this process, the initial set of performance measures was amended to incorporate additional measures based on the interviews findings. This expanded set of performance measures is presented in **Chapter 5**.

In the following step, the expanded set of performance measures and other findings of interviews were used to design the self-administered questionnaire. This process was employed to achieve data triangulation. It was intended to validate the set of performance measures based on the level of importance to the industry. In addition, it aimed to test the causality between the choice performance measures, organisations' strategies, and organisations' performance. The questionnaire survey was distributed in the UK and Malaysia and resulted in 15% response rates from both countries.

The data analysis process was performed using IBM SPSS. This process was conducted to seek descriptive information of the data and to test the causality relationship between variables as in the proposed conceptual model. The conceptual model is illustrated and discussed in **Chapter 3**. Figure 4-2 presents the overview of the research process.

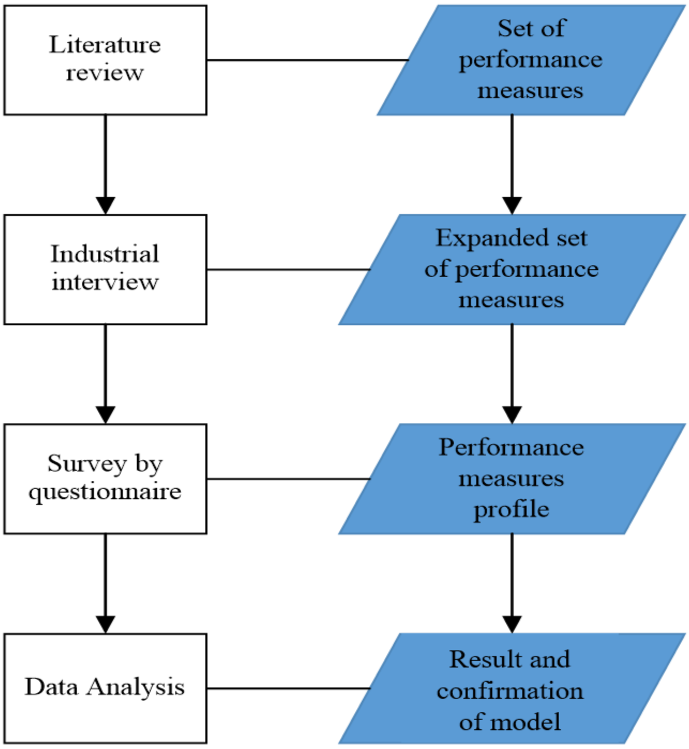

Figure 4-2: Research process

4.9 Conclusion

This chapter explains the methodological approaches for this research. It also discusses the philosophical assumptions corresponding to the methodologies adopted. The methodologies adopted were greatly influenced by the pragmatism stance, which supported mixed-method study and emphasised the practical way to answer the research questions. The chapter also explains the rationale of using an exploratory interview and questionnaire survey in answering the research questions. The industrial interviews were conducted to gather supply chain experts' opinion on the supply chain performance measurement issues. In particular, the findings were used to refine a set of performance measures proposed for the industry, which were developed from the extensive literature review. Also, it discusses how the outcomes of the interviews were then used for the next phase of the research through the survey by questionnaire. Three main elements of the questionnaire survey; questionnaire design, administration, and validation are discussed in this section. Finally, the summary of the research process is outlined in the last section to provide a clear picture of the research process. The following chapter presents the analysis of the industrial interviews and their findings.

CHAPTER 5

EXPLORATORY INTERVIEW

5.1 Introduction

This chapter illustrates the detail of exploratory interviews conducted among five supply chain experts in the oil and gas industry. It was aimed at exploring the oil and gas industry supply chain from industrial perspectives. Existing literature, on performance management of the supply chain by the manufacturing industry, oil and gas research papers, government policies on the oil and gas industry, and consultant corporate reports have been studied to develop a set of interview questions.

The adoption of the in-depth interview prior to quantitative research is very important to identify if the research is worth exploring. This method has increased in popularity within this field of study. Particularly, it is very useful when there is scarcity of publications on the topic (Asrilhant et al., 2007; Urciuoli et al., 2014; Voss et al., 2002). Also, this method is normally undertaken to generate a hypothesis for further research investigation (Leonard-Barton, 1990; Voss et al., 2002). For instance, the same approach has been used by Bunse et al.(2011) to identify research needs in the energy efficiency area.

5.2 Demographic information of participants

This section presents the demographic information of participants. The participants involved were renamed as A, B, C, D and E to protect the confidentiality of the information. The participants involved in this research have experience ranging from fifteen to thirty years in the industry. The detail of participants' profiles is presented in this section. The brief summary of participants and their involvement in the oil and gas supply chain is presented in Table 5-1.

Table 5-1: Demographic characteristics of participants

Participant	Year of experience	Role in company	Country	Educational background	Previous companies	Current company
A	20	President	UK	Engineering	Services advisory – oil and gas operator	Services advisory
B	25	Project procurement manager	USA	Business administration	Oil and gas operator and contractor	Services advisory
C	15	Senior supply chain manager	Indonesia	Engineering	Oil and gas operator and contractor	Oil and gas operator
D	30	Head of supply chain	Malaysia	Quantity surveying	Oil and gas operator and contractor	Oil and gas contractor
E	15	Leader, supply chain	Malaysia	Engineering	Oil and gas operator and contractor	Oil and gas contractor

5.2.1 Participant A

Participant A is the partner and leader in an advisory services company for the oil and gas industry in the UK. He is a qualified engineer and also a member of the Chartered Institute of Purchasing and Supply. He has around 20 years' experience in consulting services specialising in the oil and gas, and other sectors in energy industries. In his career, he has worked with many international oil and gas companies including British Petroleum, Shell, Tullow Oil, TNK-BP.

5.2.2 Participant B

Participant B has around 25 years' experience in the oil and gas industry. He has held managerial roles in the procurement and supply chain area. These include procurement manager, project procurement manager for strategic sourcing, leading a cross functional team in procurement for engineering construction, operating services in various projects around the world. Currently, he is working for an upstream exploration and production company in the United States. Prior to that, he worked in major international oil and gas companies including British Petroleum (BP) and the Atlantic Richfield Company (ARCO).

5.2.3 Participant C

Participant C is the head of a supply chain department for one of the international oil and gas operators in Indonesia. He began his career in the oil and gas industry in 1999 and has been assigned various roles including procurement analyst, material coordinator, engineering coordinator, head of stock management both inside and outside Indonesia. Prior to joining the oil and gas industry, in 1996, he spent three years in a manufacturing company as project engineer, industrial engineer and finally as senior procurement staff member. In 2014 he was awarded a master's degree in industrial management with cum laude from a local university in Indonesia, and he also holds a Bachelor of Science in Industrial Engineering in Indonesia with cum laude.

5.2.4 Participant D

Participant D has around 30 years' experience in supply chain and contract management in various industries. He graduated as a quantity surveyor from a University in Wales, United Kingdom and is a professional qualified quantity surveyor. He started his career in 1986 in the construction industry in Coventry, United Kingdom. After 3 years, he returned to Malaysia, working as a contracts executive with one of the international oil and gas operators in Malaysia for about five years. Then, he joined a project management company based in Kuala Lumpur City Centre (KLCC). In 2003, he led the supply chain department of one of the biggest IT and communication companies in Malaysia. Finally, he worked in the multinational oil and gas installation company as head of the supply chain department from 2011 until now. This company has been established for around 30 years and is one of Malaysia's leading oil and gas organisations.

5.2.5 Participant E

Participant E is currently supply chain leader in one of the international oil and gas contractor companies in Malaysia. He has a bachelors' degree in Aerospace System Engineering (Honours) and started his career as a sales engineer in the oil and gas industry. After several years' experience as a sales engineer, he moved to one of the international oil and gas contractors as a lead buyer and contributed his skills for around three years. After that, he moved to another national oil company which largely focused on fabrication and installation and was appointed project procurement manager. He has wide range of experience working with various clients for international and local projects. Throughout his 15-year experiences in the supply chain area, he has seen the industry from the viewpoints of both buyers and sales person.

5.3 Importance of performance measurement in the oil and gas supply chain

Performance measurement is very important to ensure continuous improvement in the organisation. This section aims to explore the participant's perspectives on how and why performance measurement is important for the oil and gas industry. Participants were asked about the importance of performance measurement in the oil and gas supply chain. In response to this question, all the participants suggested that the performance measurement in the supply chain in the industry is very important and is considered to be the basis of supply chain management. Furthermore, it was indicated as the critical element in determining overall organisation performance and as a basis for their improvement plan. The following extracts from the discussion confirmed this statement.

"With the old words, what you measure is what you manage, I believe it is as true today." [Participant A]

"It is absolutely critical to the overall company performance." [Participant A]

"If the supply chain fails to deliver, then the oil company delays in getting the oil, and every day delay will cost the company a lot." [Participant A]

"Yes, because supply chain performance is the basis of overall company performance." [Participant C]

"I think performance measurement for supply chain is important. It is needed to be structured to meet the needs of your operational and project organisation within your company." [Participant B]

"We need to have a proper performance measurement plan or else we wouldn't know our standard. So, it is very important in every aspect." [Participant D]

"Performance measurement must be put in place in the supply chain because you are actually involving in the main area of the project operation." [Participant E]

Similar to other industries, the reliance on outsourcing activities has mushroomed in the oil and gas industry. Research suggested that 30 - 40% of oil and gas activities will be outsourced to accomplish the project (Yusuf et al., 2014; Pillai et al. 2010). In fact, the qualitative responses suggested a bigger percentage of outsourcing activities in this industry; more than 50%. The oil and gas organisations normally outsource part of their functions to subsectors to minimise their operation cost, to overcome the limitation of expertise as well as to pass some of the supply chain risks to another party (Ernst and Young 2014). These outsourcing activities place a greater importance on having a good supply chain performance management in the industry (Kumar and Markeset, 2007). Qualitative responses from three participants confirm this issue;

"The typical upstream operator may buy in and manage somewhere between 50% - 60% of the total cost based importing thru the extended supply chain." [Participant A]

"…in many companies, they spend more than 50% to suppliers." [Participant C]

"What I'm trying to say is, most of the companies are relying on outsourcing to deliver our services." [Participant E]

The increase in reliance on outsourcing activities is also recognised in other industries. These include the manufacturing industry (Wisner, 2003; Chen et al., 2004; Gunasekan et al., 2004; Youn et al., 2014), the automotive industry (Martínez Sánchez and Pérez Pérez, 2005; Vanichchinchai and Igel, 2011), and the hospitality industry (Chen et al., 2013; Helmig et al., 2014). Finally, performance measurement is also important in managing and tracking the effectiveness of supply chain execution in each company. These, will help the manager to implement rectification action, propose improvement plan, and preventing problem from happening again.

"For example, we need to measure how much saving we have achieved, the effectiveness of the process in place, and the delivery time, the specification delivered against the requirement." [Participant D].

In terms to improve the effectiveness of supply chain management, one of the participants highlighted the need to integrate supply chain functions with other inter - departmental functions. This integration is very important in designing a good performance measurement framework to assess the overall organisation performance

"So, it's important that whatever measurement that we are using for supply chain, relates back to the overall business and meets the needs of operation, engineering and project personnel. Because to put performance measurement in place within a supply chain function doesn't accomplish what you need to do." [Participant B]

None of the qualitative responses on this issue contradicts any of the others. Even though their supportive arguments vary, it can be seen that they are related and act more as supporting information to complement the other participants' perspectives. Furthermore, the importance of measuring supply chain performance is also in line with the current literature on this topic. There are five factors that suggest the importance of measuring the oil and gas supply chain. These include basis for overall company performance, reliance on outsourcing activities, to meet the needs of operational requirement, ensuring the effectiveness of supply chain activities, and to propose improvement plans. These factors are summarised according to participants' insight as in Table 5-2.

Table 5-2: The importance of performance measurement to the industry

The importance of measuring supply chain performance	Participant A	Participant B	Participant C	Participant D	Participant E
Basis for overall company performance	√		√		
Reliance on outsourcing activities	√		√		√
To meet the needs of operational requirement		√			
Ensuring effectiveness of supply chain activities	√			√	
To propose improvement plan				√	

5.4 The importance of measuring individual and team performance

Teamwork is a critical element in operation management. Good teamwork within an organisation will enhance overall organisation performance (Duch et. al., 2010). The question about the importance of measuring individual and team performance was asked to seek its relevance and application within the oil and gas industry. With the exception of Participant B, all other participants asserted that both individual and team performance are important in assesing supply chain performance. They suggest that individual performance is the fundamental to team performance; in order for an organisation to achieve their specific goal, they have to identify the role of each individual in the team. The cumulative individual performance will then determine the overall team performance. The following qualitative extracts concur with this statement.

"I think there are group level performance measures that are relevant and there are also individual measures which are relevant." [Participant A]

"I think it works both ways. We set the company objectives, and it cascades down towards team performance and individual performance." [Participant C]

"There are two areas that you have to measure, first individual performance and then the whole team performance in term of its impact on the bottom line" [Participant D]

"First you need to have team performance goals, and then you have to set KPI to each of the team members." [Participant E]

Moreover, two participants also gave a few examples of where they consider individual performance should be assessed as illustrated by the extracts from the qualitative responses below.

"The accuracy of a warehouse operator to select the right equipment for the right job and distribute it to the right location is both important for safety and performance." [Participant A]

He also added that, although it is difficult to measure individual performance, this assessment is very important. In a similar tone, Participant D highlighted a few examples of individual measures which focus on the efficiency of the personnel in carrying out their role.

"For individual performance, the things that I'm looking at are like response time, how detailed a person is in conducting his job, compliance to the process, and also creativity." [Participant D]

Some participants also suggested a few examples of team performance measures as demonstrated in the following extract of their responses.

"I talked about forecasting that is usually a collaborative process, working across ranges of different functions, across the business operations, and across finance and the supply chain. That is probably a more collective performance target because it requires such a collaborative process." [Participant A]

"But for overall performance, regardless of what happens, we are concerned about the saving that you can gain for the company, and to me, the procurement savings have got to be department's effort" [Participant D].

On the contrary, Participant B argued that in many companies, supply chain performance measurements are more focused on team performance than individual performance. Despite that, he agreed that there are still certain areas that need to be measured individually, especially in the case of third party individuals who work within the supply chain. However, he reiterated that many performance measures focus on the company goal and overall team performance. His statement is in line with Arzu Akyuz and Erman Erkan (2010) who view measuring individual performance as a traditional measurement system.

"I haven't seen any supply chain performance measurement that people are strictly accountable for themselves only without regard to the bigger supply chain group." [Participant B]

"But, I think the majority of supply chain measurement sort of rolls up to more of the team labour." [Participant B

There is much literature which has discussed the need to assess individual and group performance, and the relationship of both perspectives in measuring organisational performance. In fact, they claimed that performance measurement of an organisation is derived from various individual performance measures (Zaman and Ahsan, 2014; Neely et. al, 1995).

Qualitative extracts from participants A and D suggested that individual performances are measured based on the competencies of the individual in handling the role. Consequently, the qualities and results that can be achieved by individuals are expected to improve the overall organisation performance (team performance) collectively.

5.5 The need for short-term and long-term performance planning

All the participants suggested that there is a need to have both short-term and long-term performance planning. In general, short-term measures cover the aspects of quality, cycle time, and productivity whereas long term performance concentrates on increasing customer satisfaction, market share and also the benefit to all the parties involved in the supply chain network (Wisner, 2003). There are several studies which have been conducted that investigate the importance of long-term performance planning. For instance, Ramanathan (2014) studied the impact of supply chain collaboration on the success of the long-term partnership. Bhagwat and Sharma (2007), highlighted that failure to determine specific long-term objectives might result in difficulties of applying the balanced scorecard concept.

In general, long-term and short-term performance planning are largely defined by the individual company. Nevertheless, current literature and the qualitative responses below help us understand that long-term performance planning is something that can only be achieved over time and requires much effort and expertise. The local content requirement is a good example of the need for long-term performance planning. This is due to the stringent requirements set by countries, which will only be achieved by companies after several years of effort as demonstrated in the qualitative responses.

"Countries set local content requirements a bit unrealistically, often deliberately so to make the oil companies have to stretch." [Participant A]

"And the capabilities and capacities in the industry in those countries in order to be able to provide the services required to comply with the country regulations are insufficient." [Participant A]

"It takes a long time to change that capability. So, the longer the range that the supply chain can have on their business plan, and then start building capabilities through education programs, entrepreneurial business programs, the better and more likely the company will be compliant with the regulation when they are in actual operational mode." [Participant A]

"I think there are short terms versus long-term performance measurement goals. And it all depends on the company and where they are doing the work and what their needs are." [Participant B]

"Yes, we do need long term and short-term planning for supply chain performance. For short-term performance, normally we will monitor it on a monthly basis or on a quarterly basis depending on the work specifications." [Participant C]

"I think we should, but can we do it? That is two different things. It all depends on the company's objective." [Participant D]

"There is always short term and long-term supply chain planning. The only difference is different companies might define it differently." [Participant E]

5.5.1 Long-term performance planning

The following qualitative responses have discussed several areas of long term performance planning in the industry. One of the interesting examples is highlighted by Participant A on the food supply chain to support the operational needs in remote areas.

"And there are some remote parts that simply don't exist in any sort of economic sense. So, the future looking companies start work with local shareholders and farmers to help and develop them become commercial farmers to feed the populations that will be created." [Participant A]

"And I know some companies that think about some simple stuff in remote parts of Africa where they have the license to operate. They expect the workforce to increase from 0 people working in that location to 1.2 or maybe 2000 and 3000 people in 5 years' time. They need to think about the food supply chain to keep those people fed." [Participant A]

In addition, participant D suggested creating a sustainable list of vendors and also that competency development is something that his company included in their long-term performance planning. This, in line with some research discussing on long term relationship with the supplier, which need to be developed over time (Rungtusanatham et al., 2003; Chen et al., 2004). Furthermore, Participant D also proposed that the long-term performance planning needs to be monitored periodically to ensure each milestone can be achieved in a timely manner.

"For example, if you are talking about one of the objectives, let say creating a sustainable pool of vendors, I think that one should be in the long term KPI. I mean, I couldn't create a sustainable pool of vendor within a short time." [Participant D]

"If you are talking about competency development, process improvement, that one should be included in the long-term performance planning." [Participant D]

"But, we have to also bear in mind when we talk about long-term performance measurement, let say for a 5-year projection period, we couldn't measure it at the end of 5 years. Obviously, we need to have a milestone for our target to track our progress in meeting that five-year planning." [Participant D]

5.5.2 Short-term performance

Qualitative responses gathered from participants show that short term performance planning is something that can be achieved within short period of times and relates to the day to day business activities. These include timeliness, delivery reliability and other measures involved in the procurement cycle.

"For short-term range, you need to make sure you get the right equipment at the right place, at the right locations." [Participant A]

"You maybe place your order two years in advance so that the product will move into the location in a series of stages. And you need to make sure you can get it into the right place not too early which has some cost implications and certainly not too late." [Participant A]

"I think smaller companies are probably more interested in shorter-term goals. Maybe it's around one year to two -year goals." [Participant B]

"If you are talking about delivery time and so on, it is part and parcel of procurement, and the procurement cycle for each item is very short." [Participant D]

The qualitative responses on this subject do not contradict the existing literature on the need to design long-term and short-term performance planning (Chen and Paulraj, 2004; Neely et al., 2005; Gopal and Thakkar, 2012; Shi and Yu, 2013; Shafiee et al., 2014). One of the long-term planning reports in this research includes developing a food supply chain for consumption by the operation in a remote area. Another example of long-term performance planning is to create a sustainable list of vendors. Other than that, some of the stringent local content requirements can also be categorised in long-term performance planning. The short-term planning proposed in this interview includes day to day business cycle such as, timeliness, delivery reliability, and products' quality which need to be met in a short-term duration. In general, short-term and long-term performance planning are relevant to this industry and are dependent on each company's objectives and their requirements.

5.6 The need to categorise performance measures by strategic, tactical and operational levels

In view of some literature that suggest the need to categorise PMF based on hierarchical level (Gunasekaran et al., 2001; Varma et al., 2008) , a question was asked to the participants on their perspectives of the practice in the oil and gas industry. All the participants agreed that there is a need to categorise performance measurement into different hierarchical levels; strategic, tactical, and operational. Participant A suggested that the performance measurement frameworks need to be designed differently according to their audience as qualitative responses.

"Yes, I think, yes I would agree. I can see you can have long term strategic measures and long-term operational measures as well." [Participant A]

"Yes, it is more or less is the same, we do have a hierarchical level of performance measures." [Participant C]

"Let us say at my level; there are three areas, strategic, tactical and operational." [Participant D]

"For example, when you are talking about long term planning at strategic, tactical, or operational levels, there is always a discussion by top management when they are setting the company objectives and strategising the managerial aspects." [Participant E]

This finding is in line with the previous literature that suggests the need to design performance measurements according to hierarchical level, which are strategic, tactical and operational level (Gunasekaran et al., 2001; Varma et al., 2008) to increase the effectiveness of their performance management.

5.6.1 The structure

Even though Participant A has suggested a few examples of how a performance measurement framework can be designed according to hierarchical levels, he claimed that he would prefer it to be used as guidelines. This is to ensure that the framework has a sensible balance and would not enforce a certain quota on the company's performance framework. In line with Participant A, Participant B claimed that he had never seen any formal structure of hierarchical segments for performance frameworks.

"So yes, they need to be designed differently depending on the audience" [Participant A]

"I think I would tend not to formalise it. I would use it as a guideline rather than a framework to construct." [Participant A]

"So, I have not seen any formal structures that exactly mentioned this in the upstream oil and gas business. Again, because of the huge profit potential, the sales

price of crude oil per barrel is a very important factor. So, other industries are probably more margin based. So, maybe that is why I haven't seen the structure like this" [Participant B]

Conversely, Participant D suggested that managers at the strategic level of the industry should segregate their tasks into time segments; as in the qualitative extract.

"If you are at strategic level, most of your time you must be able to think of your strategy. Maybe 60% of your time you allocate for strategic, 30% for tactical and another 10% for operational. That is basically your time spent." [Participant D]

5.6.2 Strategic level

Broadly, in line with Participant D, Participant A suggested that the highest level of the company is more concerned with the forecast, accuracy and compliance with safety than other operational activities.

"The chief executive may be interested in how much is being spent and how could they forecast the accuracy and their compliance with safety records. Maybe there would be two or three." [Participant A]

For the strategic level, Participant B pointed out that many companies use cost per barrel of oil produced as their performance benchmark. This indicates, at the strategic level, a company devises their performance measurements according to cost and profit.

"I think from the strategic standpoint, many oil and gas companies use the measurement of cost per barrel of oil produced as the benchmark in comparison to other companies for similar oil and gas fields." [Participant B]

5.6.3 Tactical level

Participant D and E suggested that the manager at the tactical level needs to devise a plan for the operational level to meet the expectations of the strategic level manager.

"And then the manager is more on tactical, whatever strategic plan they got from higher management, they must devise a tactic to deliver the strategy and the rest on quality assurance at the operational level." [Participant D]

"Then it scales down to the tactical level on devising a tactic on either to make or buy decision for the particular projects." [Participant E]

5.6.4 Operational level

The operational level, on the other hand focuses more on the day to day business activities which cascade down from the tactical level. See the following extracts from Participants A, D and E's responses regarding this.

"But also, if possible it's important to do that as quickly and efficiently as possible as well. So, if your forecast is incredibly accurate but it takes you, I exaggerated 2 years and 1000 peoples to generate, then, it's not very efficient." [Participant A]

"And then for the operational level is basically on turn-around time on how fast they can come out with a solution, to do things right, to do it timely." [Participant D]

"There are operational parts where you plan the things that you have decided either to procure or to make." [Participant E]

In essence, all the participants agreed on the need to have performance measures categorised by hierarchical level. However, some of them rather chose not to construct a formal structure as they presumed it might create confusion for the employee. In fact, they claimed that they have not seen any formal structure of this kind of performance framework in oil and gas companies.

It was noted that even though participants had two different perspectives pertaining to this, all of them agreed that it is important to understand this concept as a guideline for managing performance.

5.7 The characteristics of the upstream sector

In general, the oil and gas industry is divided into three main sectors; upstream, midstream and downstream. The upstream sector involves the exploration of the potential oil and gas catchment and drilling activities. The downstream sector involves the refining of crude oil, the distribution of natural gas and its products. The midstream sector is the interconnection between upstream and downstream. However, in this research, the midstream sector will be classified within the downstream sector considering it is a small size. The details of the characteristics of these sectors are presented in Chapter 2.

The interview sought to gather participants' opinions on the differences between these two sectors, particularly in managing their supply chain performances. This section presents the characteristics of the upstream sector; the characteristics of the downstream sector will be discussed in the following section.

5.7.1 Supply chain process and industrial activities

Three participants proposed that the upstream and downstream supply chains are similar in terms of supply chain processes. The following extracts support this statement;

"In many ways, the processes of the supply chain for both the services and materials are similar." [Participant A]

"I think the differences between upstream and downstream are in terms of activities carried out by the company. The supply chain structure is more or less similar." [Participant C]

"But, what I can say is regardless of what industry you were in, either in construction, IT or oil and gas, the supply chain process doesn't change much." [Participant D]

"Maybe there is a bit of tweaking to suit the industry itself, but the principles and the parameters that are used are still the same. I give an example if we were to buy something, in any industry the question being asked is either should we buy or should we build? If we decided to buy, which contracting strategy are we going to use? It could be either an open bid, close tender, direct negotiation in those situations. I think this also applies to the downstream part of the oil and gas." [Participant D]

Many researchers suggest that there are various perceptions of the performance measurement which are largely influenced by the type of industry or business activities (Otto and Kotzab, 2003; Gunasekaran and Kobu, 2007; Kumar and Markeset, 2007; Kumar and Nambirajan, 2013). This makes performance measurement research worth exploring. The qualitative responses collected from participants did not contradict this idea as it explained the supply chain process and the ways its varies according to industrial perspectives.

5.7.2 Higher risk involved in the upstream sector

The participants remarked on the fact that upstream supply chain risks are higher than those downstream. The risks involved are the uncertainty of oil resources, high costs, and other external factors as discussed in the following extract;

"I think in the upstream sector they basically have a higher degree of risk than the downstream because you are dealing with looking to find the oil when you are doing a drilling project. And you have a huge risk when you start drilling a well. You reserved that the produce from that well doesn't meet your expectation after incurring so much money having to drill that well." [Participant B]

"We can say that most of the works on the upstream sector have higher levels of urgency and also a bit volatile depending on political factors, economical situations, and other external factors." [Participant E]

"For the upstream sector, since it started with exploration operations and initial investment, big amounts of dollar and cents involved." [Participant E]

Even though the downstream sector of the industry is also influenced by political factors as well as the instability of the world's oil price per barrel (Varma, et . al., 2008; Yusuf et al., 2014), the impact that these situations have on the upstream sector is much higher. This is due to the fact that costs incurred in upstream production are high and largely fixed while the companies in downstream sectors still have a cost advantage. For instance, they can make a profit by procuring crude oil at a lower price and can sell the refined product at a premium price (Hayes, 2015; PricewaterhouseCoopers LLP, 2015)

5.7.3 Geographical location

In addition to the higher degree of risk involved in the upstream sector, Participant A suggested that upstream supply chains have unique characteristics in terms of geographical location, remote locations pose difficulties both operationally and logistically.

"For example, we are seeing an increase in exploration in the Arctic circle, then the challenges in getting the equipment into a new area like that are getting harder for sure." [Participant A]

5.7.4 Complex engineering

From a technical perspective, the upstream sector involves more complex engineering than refinery activities downstream. This sector requires the collaboration of multiple contracting services and expertise in project execution. These include marine engineering; drilling and excavation; subsea services; commissioning and decommissioning; construction and fabrication; oceanography services and other related areas. In most instances, the various expertise and services required for project execution are very unlikely to be obtained from one single company. Qualitative extracts from Participant A explain the situation.

"Even in operations, the dependence on buying in complex engineering services is greater in the upstream sector than it is in the refining part of the downstream." [Participant A]

"So, therefore, this continued in-filling requirement in an existing field to maintain production often needs the collaboration of multiple contracting service companies to be successful." [Participant A]

Table 5-3 summarises the characteristics of the upstream supply chain and compares it with the downstream sector from the interviews. The only similarity it has with the downstream sector is the supply chain process, with regards to the outsourcing strategies. In comparison, its distinctive characteristics are i) industrial activities, ii) geographical location, iii) high risks, and iv) complex engineering.

Table 5-3: Characteristics of upstream supply chain (Source: Interview materials)

Descriptions	**Details**
Similarities with downstream sectors	-Supply chain process
Distinctive characteristics of upstream sectors	-Industrial activities -Geographical locations far from basics amenities -High risks involved: Uncertainties of oil and gas resources Financial risks -Complex engineering: Involvement of multiple expertise

5.8 The characteristics of the downstream sector

For the downstream sector, the participants stated that the location of their business operation is more fixed and can be easily accessed for logistical and operational purposes.

"My sense says the downstream sector are more situated on fixed location and being onshore and usually relatively near to some other sort of facilities and are slightly easier for physical logistics location to get people and goods." [Participant A].

Moreover, most of the activities in the downstream sector are more concerned with cost compared to the upstream sector. This is due to the slim profit margins in the downstream oil and gas sector.

"My perception about downstream or as we call it the refining industry is always more focused on cost as it usually has limited profit margins based on oil prices per barrel." [Participant B]

"But for the downstream part, the cost structure to the customer is different. The cost saving pressure on them might be a bit higher compared to the upstream part. Thus, the strategy might be different." [Participant D]

"While for the downstream part, it involves smaller costs compared to the upstream part and is also more segmented." [Participant E]

"And I think also in the downstream, the number of barrels that are being produced by the refinery becomes very important because the refinery activities consist of a certain amount of capacity." [Participant B]

"Due to the small margins in downstream, continuous processing of crude oil near the refinery's capacity is critical. As such, these factors usually require different types of metrics versus the upstream business." [Participant B]

Qualitative responses from participants showed that the distinctive factors of the supply chain are largely influenced by the business activities of the company. This finding supported the previous research by Varma et al. (2008), which focused on the downstream sector of the oil and gas industry. The authors proposed a few distinctive characteristics namely; the process industry, the flammability of petroleum products, contamination of petroleum products, bulk volumes, high transportation costs, long supply chain, and the instability of the oil price. The summary of the characteristics of the downstream sector is presented in Table 5-4.

Table 5-4: The characteristics of downstream sector from the interview

Descriptions	**Details**
Similarities with upstream sector	-Supply chain process
Distinctive characteristics of downstream sector	-Industrial activities are more fixed -Fixed location -Focus on managing cost due to slim margin

5.9 The similarities and differences in performance measures for upstream and downstream supply chains

Participants have been asked about the similarities and differences in performance measures being used for upstream and downstream industries. This question is related to the previous section about the characteristics of the upstream and downstream oil and gas supply chains. The objective of this question is to explore further on this subject and to understand what are the most important performance measures in each sector.

5.9.1 Similarities between the upstream and downstream supply chain

Participant A suggested that it is important for any part of the oil and gas supply chain to have a transparent tendering process. Apparently, it is also depending on the role that the company has in the supply chain, either operator or join-investor. He also proposed the need to have a balanced set of measures across long term and short-term planning for both parts of the industry.

"You want to make sure that they are tendering in producing competition, and getting the required approvals before initiating expenditure on any initiative." [Participant A]

"The similar one is to have a balanced set of measures across the long term and short-term planning." [Participant A]

Participants B and C have mentioned similarities between the upstream and downstream sectors of the industry; the importance of safety and quality measures. Unsurprisingly, there is also much literature highlighting the crucial importance of safety measures for the oil and gas industry. The high-risk nature of the industry means that safety measures are the central consideration.

"I think again for the upstream, and downstream the reputation of the company and the desire for safety is very important. I really don't see a distinction there." [Participant B]

"The similarities are the safety and quality performance measures throughout the upstream to downstream." [Participant C]

Participant D suggested that there is not much difference between upstream and downstream performance measures based on his experience leading the supply chain in various industries. However, he also reiterates the importance for the manager to understand the operational activities of their company in order to have a better grasp of managing their supply chain.

"I just want to share with you, why I think there is not much of difference because I came from a different industry, but for me to adapt to the oil and gas upstream, it wouldn't take years. That means, the fundamental and the process everything is all the same, except that I need to learn what pipeline installation all about" [Participant D]

5.9.2 Differences between performance measures for upstream and downstream supply chains

Participant A suggested the essentiality of considering local issues in managing supply chain performance. For instance, he mentioned the need to manage theft issues in the drilling activities in the Nigerian delta. This demonstrates an example of the contingencies plan for the upstream business.

"And if you are in the midstream distribution in the Nigerian delta where theft is a problem, people tapping into the pipeline and selling out black market refineries then, I imagined crude loss would be a very important measure to the midstream." [Participant A]

Participants B and D proposed that the downstream industry needs to emphasise managing their cost as they are dealing with very slim profit margins. Furthermore, Participant B also commented that there is a need to concentrate on schedule planning in the upstream part as it involves multiple contracting services to deliver the task.

"I think the downstream are usually more focused on cost and upstream more usually focus on schedule. So, I think that is my overall view on the differences between the two." [Participant B]

"I think more or less it is similar, but in the downstream sector, they have to really manage their slim margin." [Participant D]

Also, Participant C suggested that a long lead time is part of the distinctive factor of the upstream supply chain which indirectly emphasises the need to focus on schedule.

"The differences are price and delivery. In the upstream sector, you may experience a long lead time and higher cost involvement." [Participant C]

The preceding discussions provide insights on similarities and differences in managing supply chain performance in downstream and upstream sectors. Understanding their attributes will enhance the supply chain performance within this industry. Table 5-5 summarises the similarities and differences of performance measures between the upstream and downstream sector. Based on this table, there is no major distinctions between the supply chain performance measures for upstream and downstream sector of the oil and gas industry. The distinctive factors are more on the application of the performance measures according to business operations. Therefore, supply chain performance framework can be treated the same way for upstream and downstream sector.

Table 5-5: The similarities and differences in performance measures in upstream and downstream sector from the interview

Descriptions	Details
Similarities between upstream and downstream sector	-Supply chain process -Transparent tendering process -Balanced set of measures across long-term and short-term planning -Safety measures -Quality measures -Reputation of the company
Differences between upstream and downstream sectors	-Business activities -Local issues often occur in upstream sector due to geographical location -The need for emphasis on schedule in the upstream sector -Long lead time in the upstream sector -Higher cost involvement in the upstream sector -The need for emphasis on cost in downstream sector

5.10 Determinant factors for choices of performance measures in the supply chain

From the qualitative responses, there are nine factors considered by participants that drive the selection of performance measures. The first factor is local content, followed by the need to have the balance of priorities in choosing supply chain measures, the third factor is the role in the supply chain as either operator or joint-venture. In addition, the company's' reputation, desire for safety, profitability potential, oil price per barrel, and the company's objective are amongst the determinant factors for performance measures preferences.

5.10.1 Local content

Local content requirements are aimed at leveraging business wealth into national wealth. This factor is seen as one of the drivers that influence the choice of performance measures. All the rules and regulations set by the country in operations such as purchasing from local vendors should be incorporated into supply chain performance management. Increasingly, the local governments whose provide a license to the operator ask them to engage a certain amount of services or equipment from the local companies instead of international companies.

"The percentage of your total bought in of your goods and services is being set for local country provision. And sometimes it might be in an absolute amount of spend in pounds. But, usually, it is in a percentage." [Participant A]

Furthermore, the following qualitative extracts suggest the impact of local content requirements on their supply chain activities.

"So, if you are working in a remote area, your company might have a desire to hire a certain amount of local people or local companies to work on those jobs. I think that becomes very important." [Participant B]

The following qualitative extract from Participant C is one of the typical examples of how a company must consider local content requirement in managing organisations' performance;

"The local content required us to deal with the local supplier where most of them are the middle person and do not have sufficient knowledge of the products or services they provide." [Participant C]

In order to comply with local content requirements while at the same time ensuring services delivery, an organisation has to go one step further in educating local suppliers. In the same time, there is a need to thoroughly measure suppliers' performance in the caveat of their level of competencies.

"And another thing on procurement is, if we go to the market, we need to look at whether the market is being regulated by the government. Here in Malaysia, the government objective is to maximise local participation." [Participant D]

"If you are dealing with national oil companies as your client, they might have different perspectives and expectations towards us. They might need a more transparent and more stringent process involved in our supply chain activities which at the same time comes with cost and time." [Participant E]

In the preceding responses, Participants D and E suggested the need to consider local contents requirement in managing their supply chain activities. Participant D pointed out the importance of considering local content requirements prior to outsourcing activities to ensure government regulations are not violated. Moreover, Participant E emphasised the need to trade time and cost to comply with stringent process of tendering process as required by the local government. For this reason, another measure, like process compliance might need to be introduced and implemented to manage this requirement.

5.10.2 Role of the company in supply chain

Participants highlighted the importance of considering the role that the company has in the supply chain which is either as operator or joint-venture. The role of the company in the supply chain will influence the information required and the area to monitor and evaluate in managing supply chain performance.

"So, for example in procurement, if you are a joint-venture operator, you would want to make sure, normally you are not responsible for the delivery of the procurement. But, you want to make sure that the operator who is responsible, is following a good and fair process and is in compliance with the standards and procedures that have been set in place." [Participant A]

"If we look into client perspectives which involve national oil and gas companies, there are other indicators that outweigh cost and timeliness which are integrity and transparency because they represent public entities or governments corporation." [Participant E]

The responses suggest similar findings with Gunasekaran et al. (2004), who proposed the need to segregate performance measures according to the level of authority and responsibility. In their research, performance measurement framework was designed according to three different levels; strategic, tactical, and operational. In essence, participant responses are consistent with their study which found different roles in the supply chain require different performance information.

5.10.3 Company reputations

According to one of the participants, the reputation of the company, particularly regarding environmental concerns and corporate social responsibilities influences the choice of performance measures. The way they perceive their company's reputation is translated into their choice of performance measures.

"The primary effect that I've seen driving measurement is the reputation of your company. I think companies in the oil and gas business are really concerned about their reputations. They want to make sure that they are doing things responsibly, protecting people, and protecting the environment." [Participant B]

In a similar tone, a recent study by Zhang et al. (2013) indicates that corporate social responsibility activities would able to enhance firms' reputations. For instance, an organisation that focuses on environmental concerns such as waste reduction may gain competitive advantage through superior reputations, which directly enhances customer satisfaction (Coates and Mcdermott, 2002; Youn et al., 2013). Moreover, Taticchi et al. (2013), highlight that failure to adhere to environmental regulations, ethical sourcing of raw materials, and human rights issues might not only result in serious reputational damage but also discounting brand equity. The depleting of Shell's profits in early 2016 by 87% illustrates the impact of reputational damage. The loss is not only due to the fall in the current oil prices but is also impacted by the negative publicity in regards to drilling in the Arctic which cost them USD 7billion (Barret, 2015; BBC News, 2015; Macalister, 2015, 2016). The effect of reputational damage mentioned earlier signifies the importance of this factor as a predictor in devising performance measures for an organisation.

5.10.4 Desire for safety

In the oil and gas industry, the priority of safety measures over others is believed to be the key that drives the performance.

"I think the next factor is a sort of desire for safety, going to operate safely. And basically not to do things that are going to harm anyone. So, I think that companies

in the oil and gas business place safety and facilities integrity as more important than lowering costs." [Participant B]

"The oil and gas industry is exposed to a high risk. Thus, safety and quality are considered to have priority over price and cost." [Participant C].

Due to the high risk nature of the industry, safety regulations generally are being set by the local governments (Oil Industry International Exploration and Production Forum, 1997; Hunter, 2014; Organisation Petroleum Exporting Countries, 2015). Indeed, violation of safety rules is commonly considered as a main factor contributing to accidents in this industry (Mearns and Yule, 2009). Despite the considerable amount of research and debates pertaining to safety performance issues, this subject is rarely discussed from the supply chain perspectives. Furthermore, Attwood et al. (2006) claimed that organisational decisions with regards to safety precautions in operational activities are very important in enhancing safety performance. This shows the importance of safety measures from supply chain perspectives. Supporting this, Gopal and Thakkar (2012), who reviewed supply chain performance measures and metrics from the year 2000 – 2011, have recommended further research to analyse safety-related measures in the supply chain.

5.10.5 Profitability potential

Most participants agreed that profitability potential is considered one of the drivers in determining their choice of performance measures. In certain circumstances, paying a premium cost to expedite the project outweighs the cost savings that can be earned through engaging low-cost services with a slower delivery. This situation is referred to in the following extracts:

"And another one is profitability potential. Because if we can get stuff onboard faster, the profitability that we can make from that is far more from the potential cost savings that you might come out with" [Participant B]

"Whatever key performance indicator that we choose must be able to contribute to the profit and loss. For example, cost saving would directly influence the bottom

line, and then timely delivery that wouldn't cause any standby penalty would also directly improve the bottom line. That is why I said, all the key performance indicator selection should reflect on how to improve the bottom line." [Participant D]

"Since most of the oil and gas companies are run as profit-driven organisation, most of the indicators chosen are influenced by the cost and delivery reliability aspects." [Participant E]

Profitability potential has been discussed in much research regarding traditional business performance measures (Neely et al., 1995; Gunasekaran and Kobu, 2007; Gopal and Thakkar, 2012). Even though its significance was recognised long before research began on non-financial measures, it remains a relevant subject to date. This, in particular, is important to profit driven organisations such as oil and gas companies.

5.10.6 Risk mitigation

Risk mitigation is a daily concern within the oil and gas industry. There are various risks faced by the industry, including volatile oil prices, pollution, major injuries, supply and demand risks and others depending on the business activities (Bigliani, 2013). By understanding the business risks, an organisation will be able to introduce specific mitigation measures to eliminate or reduce the risks involved. As presented in the qualitative extracts, Participant B proposed risk mitigation considerations in determining the choice of performance measures. The risks involved in this case are the potential geological risks together with the financial exposure in the exploration activities.

"And the next one I have is risk mitigation. So, you know the oil and gas business requires a really large sum of money for projects and at the same time has really large potential profitability. But, there is really a large factor of risk of loss and then they have to reserve that in their project. So, you see in the oil and gas business upstream where companies take on partners and joint ventures to minimise potential risk then if they go in solely by themselves." [Participant B]

And you have a huge risk in that you have started drilling a well. You reserved that the produce from that well doesn't really meet your expectations after incurring so much money in having to drill that well." [Participant B]

The preceding qualitative responses provide insights about the financial risk driven by geological factors, which occur in this industry. This makes the implementation of risk mitigation actions necessary. Accordingly, appropriate performance measures need to be introduced to ensure their effectiveness in mitigating risk.

5.10.7 World oil price per barrel

The world's oil price per barrel is considered one of the determinant factors in defining performance measures for the industry. The current low-price environment requires oil and gas companies to reassess their strategy in order to sustain financially viability. Alternatively, they could also take the opportunity to multiply their profits in a high oil price environment. The following qualitative extracts explain this situation:

"Again, we get back to the 100$per barrel prices of oil, if we are in a supply chain and all we want to measure is cost, the business might be saying that the most important factor now is the speed of completion. Because if we can get stuff on-board faster, the higher profitability from more quickly obtaining oil & gas sales is greater than focusing on reducing project costs." [Participant B]

"When the price of oil dropped, say what we have today 50$ per barrel range, you see the shifting of more emphasis on the cost side." [Participant B]

"Nowadays, since the world's oil price is very low, we are trying very hard. There are a lot of areas that we have to squeeze. One thing, for example, a lot of time we never care less about the brand that we purchase, if we normally use a certain brand, we just go for that. Nowadays, the oil and gas price have dropped a lot; we started looking for cheaper other options." [Participant D]

"In the current dropped of oil price per barrel, we got to really manage our cost and to get more job for the company to sustain. In this case, we have to change our

sourcing strategy, choose different vendors or equipment in order to get a better price." [Participant E]

In designing performance measurement framework, the significance that an organisation gives on each measure should reflect their strategy. The extracts indicate that organisations concentrated more on the cost saving measures during a low-price environment. However, the same measure was not their main concern in the high-price environment. Instead, organisations emphasis more on profit growth. The same applies in supply network of any industry. "When business was booming, executives concentrated on maximising speed, and when the economy head south, firms desperately tried to minimise supply costs" (Lee, 2004, p. 102). This might infer, for the oil and gas industry, the world oil prices per barrel are one of the driving factors in choosing performance measures.

5.10.8 Company objectives

Company objectives are considered to be one of the influencing factors in designing supply chain performance measurement. The following extract is referring to the contingency plan in the low oil price environment. It raised the emphasis on cost reductions through staff reductions and procurement cost savings in order to meet the company's financial objectives

"For example, first of all, we want to have 300million which is the enabler. So, from our revenue stream, we found that we can only gain 280million, we are short of 20milliom, where can we get this 20million? One of the options is through staff reduction, and another 10 million maybe through procurement savings, so that we exercise bidding. That is how we normally do it. Key performance indicator (KPI) must always start from the objective, whatever KPI you designed, must be able to support you to achieve your objective. It must be aligned with the company objective." [Participant D]

Also, in the view of meeting company objectives, some participants have proposed that there is a need to have the right balance of priority across the supply chain. These include an adequate consideration between financial and non-financial factors, across cost and schedule, long term and short-term planning, safety, quality, effectiveness and other factors, which are important in evaluating performance.

"There is a need to balance the priority between the schedules versus cost." [Participant B]

"For example, we have the KPI stated that we need to have the most comprehensive tender document being issued, but the question is does it serve the purpose, or in post-award part, the most airtight contract being issued, still we have to ensure that it serve the purpose. I mean, I can have the airtight contract, but it might be very expensive. Let us say for procurement activities we set the key performance indicator to always have competitive bidding, or no direct negotiation,, we may end up delaying the delivery time which might also affect the bottom line." [Participant D]

Qualitative extracts from Participant D reiterate the importance of having the right balance of priority in managing performance measures. Despite acknowledging the importance of complying with the supply chain process set by an organisation, Participant D mentioned the impact that it may has on the delivery reliability. This issue requires the right decision to be made by the organisation in a way that align with company objectives.

In support of the extracts, there are various literature that emphasises on the importance of aligning company objectives in designing performance measurement frameworks (Otto and Kotzab, 2003; Gunasekaran et al, 2004; Neely et al., 2005; Gunasekaran and Kobu, 2007; Gopal and Thakkar, 2012). Most importantly, Kagioglou et al. (1997) contend that an organisation will not be able to achieve effectiveness if the performance measurement framework used are not in line with their strategic goals.

Table 5-6 lists the determinant factors extracted from the discussion. There are eight determinant factors perceived by participants as the drivers in designing performance measures for an organisation. These are; profitability potential, companys' reputation, desire for safety, risk mitigation, oil prices per barrel, the role in supply chain, local content, and company's objectives.

Table 5-6: Determinant factors for the choice of performance measures from the interviews

Determinant factors	Participant A	Participant B	Participant C	Participant D	Participant E
Profitability potential		√		√	√
Company's reputation		√			
Desire for safety	√	√	√		√
Risk mitigation	√	√		√	
Oil prices per barrels		√		√	√
The role in supply chain	√				√
Local content	√	√	√	√	√
Company's objectives	√	√		√	

5.11 Challenges in managing the performance of the supply chain

There are various challenges faced by the oil and gas industry as discussed in the previous literature. These include high logistics costs, long lead times, uncertainties in supply chain distribution among others (Othman et. al., 2008; Chima and Hills, 2007; Fernandes et. al., 2010; Varma et al., 2008).

In the interview, questions were asked about the challenges in managing supply chain performance in the oil and gas industry. It was found that among the challenges highlighted by participants were ensuring the accuracy of data input, various structures of data for performance measurement, lack of inter-departmental cooperation, local content challenges, and the need to manage the project at minimal cost.

5.11.1 Ensuring the accuracy of data

One of the challenges suggested by Participant A is to ensure the accuracy of data for the purpose of assessing performance. Apart from choosing the right measures and framework, there is a need to track performance progress, where data accuracy is essential.

"I think we can design an ideal performance scorecard. But, being able to catch and capture information accurately and reliably is very difficult often." [Participant A].

Data accuracy has been one of the measures in supply chain performance which have been discussed in the literature on supply chain and logistics management (Chae et. al., 2013; Kumar and Nambirajan, 2009). Moreover, many authors perceive it as the driver to increase process efficiency (Hall et al., 2013; Shafiee et. al., 2014). The same is true for the oil and gas industry as inaccurate data would not bring any added value in improving supply chain performance.

5.11.2 Various structures of data

Regarding the various structures of data, Participants A and B pointed out that there are some difficulties in standardising it for comparison purposes. The involvement of multiple expertise in delivering a task complicates the matters. For example, it is difficult to assess suppliers providing installation services as it involves manpower, vessel rates, diesel consumables for vessels and machinery, working capacity of machinery and many other factors. The involvement of a company's operation and engineering departments is necessary to assess the cost structure offered by a supplier and ensure every angle has been covered. This makes the process of assessing the performance very challenging.

"Even as something as simple as how much spend you have with one supplier or another is not always accurate because the companies supplying us are structured into many parts and it's not always obvious if they have combined and information is not entered accurately into the information capture system." [Participant A]

Furthermore, Participant B considered managing the assessment tools to monitor supply chain performance as one of the obstacles that they have.

"One of the obstacles we have is in managing the integrated tool to monitor the performance of the supply chain." [Participant B]

5.11.3 Lack of inter-departmental cooperation

Participants A and B suggested that there is also a lack of inter-departmental cooperation among employees in utilising the constructed performance measurement framework. The following extracts explain this situation;

"People who are so experience tend to say, I will use my experience and judgements rather than driving hard to insist the accurate information is captured." [Participant A]

"I think there are companies who have bought a lot of gadgets to measuring performance but haven't put it into the culture." [Participant A]

"Then, getting people outside of supply chain to focus on performance measurement can be very difficult. Because most of the time they are being asked to get the job completed and when you say we should be measuring stuff, they might probably come back and say I'm not interested in it and it has no value to me." [Participant B]

Although supply chain emphasis is on external collaboration with the supplier, customer and business partner, it must be supported by collaboration between departments to make it successful (Vanichchinchai and Igel, 2011). Literature suggests that inter-departmental cooperation allows the firm to enhance information sharing between departments, reduce redundancy in organisational tasks and increase overall efficiency (Chang et al., 2016). Indeed, previous research on the supply chain integrations found that inter-departmental cooperation has a positive impact on the organisations' performance (Flynn et al., 2010; Afshan, 2013). This includes operational performance, logistical performance, and enhancement of its efficiency, which eventually improves their financial returns (Flynn et al., 2010; Chang et al., 2016).

From the previous discussion, it can be presumed that the lack of inter-departmental cooperation needs to be resolved to improve overall organisational performance. Pertaining to this, (Zin et al., 2013) proposed the need for top management involvement to address this barrier effectively; this is also suggested by Participant B.

"I think all the time that is difficult, except when someone higher up in the company support having certain measurement and must say we need to be measuring this. But, if you have to work from the supply chain point, it becomes much more difficult." [Participant B]

5.11.4 Local content challenges

Participants A, C, and D commented on the difficulties they encountered in complying with the stringent requirements set out by the country in which they were operating.

Among the barriers suggested by Participant A is a very high standard set by the country which requires a lot of effort to achieve. He also pointed out that some of the requirements stipulated by the country need to be factored into long-term plans as they are very difficult to achieve in a short period of time.

"So, typically countries set those requirements a bit unrealistically often deliberately so to make the oil companies stretch." [Participant A]

"And the capabilities and capacities in the industry in those countries in order to be able to provide the services required to comply with the country's regulations are insufficient." [Participant A]

Furthermore, Participant C claimed that there is a lack of knowledge among the service providers due to their role as an intermediary for the services they offer. This might disrupt the business operations as there is a communication barrier between the client's expectation and services delivered.

"The local content required us to deal with the local supplier where most of them are the middle person and do not have sufficient knowledge on the product/ services they provided." [Participant C]

In addition, Participant D stated that there is a limited number of vendors for certain services because of local content requirements on the need to purchase only from a local supplier. This, eventually weakens the competitive advantage.

"Here in Malaysia, the government objective is to maximise local participation. By doing that, you demarcate your market. This regulation make your market became narrower." [Participant D]

It can be observed that local content has been presented in both determinant factors (Section 5.11) and challenges in managing supply chain performance. It is interesting to come across similar opinions raised by participants operating in developing and developed countries with regard to their concerns about local content. This leads to the next question as to whether the local content requirements are applied equally for the work performed on developing and developed countries. The follow up question clarified this matter. Participant B explains that they have to comply with local content requirements in the USA, which are concerned more with safety, environmental issues and social responsibilities and do not particularly concentrate on engaging a local services provider. In the 1990s, studies began into local content requirement. Thus, there is much literature on this issue, which focused on the booming industry of that time; manufacturing and also the automotive industries (Ovadia, 2014; Kazzazi and Nouri, 2012; Qiu and Tao, 2001; Munson and Rosenblatt, 1997). A recent article from Ngoasong (2014) discusses how the international oil and gas companies have to respond to local content requirements. This includes renegotiating local content requirements with local government, which underlines the fact that it is a vital component in supply chain performance management.

5.11.5 The need to manage the project at minimum cost

There are two situations raised by participants with regard to this issue. First, there is the need to manage efficiency at minimal cost, and the need to provide best service at minimum cost.

5.11.5.1 The need to manage urgency at minimum cost

Participant B suggested that they have to deal with the pressure of delivering the task within a shorter time-scale at minimum cost.

"I think the obstacles and challenges that we talked about is the need to have a fast completion schedule that overrides cost control performance measurement." [Participant B]

Participant D suggested that there are times they have to manage their urgent requirements at minimal cost which is somewhat difficult to perform. Most of the time, they have to avoid competitive bidding, which would entail a longer process.

"At the end user perspective, they used to issue the request at the very last minute. When it comes to very last-minute request, it is not viable to do open bidding. To have a proper procurement process, I think we need to have a minimum 7 days from delivery time. If it involves bigger value and more complicated services, we need even longer time. That is always the challenge for us." [Participant D]

5.11.5.2 The need to have the best services at the lowest cost

Another cost-driven pressure claimed by Participant D is to have the best services or product at the minimal cost.

One of the biggest challenges we have in procurement and supply chain is they want the best services or products and the cheapest cost. These two rarely go hand in hand. Obviously, most of the time we have to consider the vendor to meet the minimal requirement at the cheapest price. [Participant D]

The qualitative extracts show that there are six main challenges in managing performance involved in this industry as in Table 5-7. The detail of each challenge has been discussed supported by the relevant literature. All the challenges extracted from the discussion were examined with larger group of respondents through a questionnaire survey, which will be discussed in Chapter 6.

Table 5-7: Challenges in managing supply chain performance from the interviews

Challenges in managing supply chain performance	Participant A	Participant B	Participant C	Participant D	Participant E
To ensure accuracy of data	√				√
Various structure of data	√	√			
Internal resistance	√	√			
Local content challenges	√		√	√	√
The need to manage the project at minimum cost		√		√	√

5.12 Performance measures for the oil and gas supply chain

Throughout the discussion sessions, the participants were asked about the performance measures that are important in managing the oil and gas supply chain.

Among the performance areas are health, safety and environment, quality, cost, timeliness, process compliance, forecast, equipment reliability

"There are ranges of balance across safety, efficiencies, effectiveness, quality, and cost." [Participant A]

"I have four main areas that I have seen, basically companies focus on for supply chain measurement when dealing with business. They are HSSE, equipment reliability, schedule, and cost." [Participant B]

"I think the most important one is again the desire for safety. I think if companies can operate safely, and the contractor that oil and gas companies is hiring is working safely, and people aren't hurt, nothing else really matters. And I think that is the most important factor." [Participant B]

"We focus on four main areas which are Safety, Quality, Delivery, and Price" [Participant C]

"I think our company priority is safety and then quality." [Participant C]

"...procurement saving and the second one is to measure the process effectiveness. The way we measure it is the ability to meet delivery within the stipulated timeline." [Participant D]

"Safety is always a priority in the oil and gas business. If there is any breach in the safety requirement, or any safety issues arise we have to stop work until things resolve." [Participant D]

"The first indicator that they have for supply chain is timeliness. Then, the second one is of course the bottom line, the monetary factors or cost saving" [Participant E]

Safety measures are most often quoted by participants in this research. In fact, one of the participants claimed that it is an important measure for both upstream and downstream sectors. This signifies the crucial role of safety measures for this industry.

"We have seen BP experience in Macondo, how reliant BP is on the safety of its supply chain and the impact of getting that wrong and how it involves the environment of BP and its supply chain. So, safety has to be part of it. It is a very important set of measures." [Participant A].

"The first is Health, Safety, Security and Environment (HSSE) or overall safety. I think that is the key performance measurement for the upstream or the downstream. I think it is an issue that I have always seen a company focus on as a primary performance measurement." [Participant B]

Cost savings are also important to the industry to help them meet their profit target. Nevertheless, it should not be treated as a discrete measure as it cannot be achieved by itself. There are many operational measures which need to be incorporated to achieve this financial goal. For instance, any delay in the schedule will deplete the organisation's cost savings. This is due to the high transportation costs and also the involvement of high wages of manpower for completion of the project. In addition, unreliable equipment will also directly increase operational costs which might shrink the organisation's profit margins. The following qualitative extracts explained the situation.

If you have equipment reliability issues, you have to end up shutting down operations which have a huge impact on the business. [Participant B]

Accordingly, timeliness is also a critical factor to this industry. This measure is important to avoid any additional costs resulting from delays in project execution. The following extracts explain the situation.

A delayed schedule usually results in higher cost and a loss of potential revenue, so I think the schedule is very important." [Participant B]

"The first indicator that they have for a supply chain is timeliness. Because any delay in oil and gas operations will cost a lot of money to the company." [Participant E]

"The second one is to measure the process effectiveness. The way we measure it is by the ability to meet delivery within the stipulated timeline." [Participant D]

Interestingly, even though the first measures mentioned by both participants D and E is timeliness in meeting the delivery date, it can be seen from the extracts that the ultimate concern with timeliness is how it will affect the cost savings. However, in complex operations such as the oil and gas industry, there are many factors which can contribute to the profit and loss of a company. Therefore, having the right measures for each area will act as both preventive and reactive contingencies to their ultimate concerns.

Consequently, quality and reliability are also mentioned by the participants. Participant B commented on the necessity of equipment reliability to avoid unnecessary delay and incurring of costs. Not only that, unreliable equipment 'pose a potential risk of injury, or even death, for the workforce, which is more important than financial risk.

If you have equipment reliability issues, you have to end up shutting down operations which have a huge impact on the business. Also, there can be major incidents if equipment malfunctions, that could cause injury or death." [Participant B]

For Participant D, process compliance is very important. This measure will ensure that the integrity values are upheld throughout the purchasing process. The following extracts explain the situation in his company and the way it indicates an attempt to violate this principle:

And another important measure that we need to have in the process is "the deviation from the norm". For example, if your award process always goes for direct negotiation or non- bid mechanism, it shows that something is wrong with the work execution. We need to monitor and measure this kind of thing. [Participant D]

If we look into client perspectives which involve national oil and gas companies, there are other indicators that outweigh cost and timeliness which are integrity and transparency because they represent public entities or governments corporation." [Participant E]

In line with this, Participant E also provides insight of the need of integrity and transparency measures as in the previous extract.

Additionally, Participant A also suggested the need to have predictive and historical data to plan projects in advance.

"And then, ahead of that, you need to measure the forecast accuracy of the right quantity, right quality, and things like lead time to get the right supply chain, be the people or the material. The quality of forecast and what is the quality of the outcomes after the events. So, there are forecast indicators and historical indicators. And then there are a lot of details in each of those areas." [Participant A]

"I think it is the forecast, because it's hard, and it's in the future. And it's across many functions." [Participant A]

"But, it's important, because if you can get that right, then other things are easier to deliver." [Participant A]

Tai et al. (2010) claimed that a market forecast provides effective inventory control through having either a low, or zero, level inventory. The forecast information not only eases the process of meeting the supply and demand but also improves cost reduction (Tai et al., 2010). Moreover, the loss of USD 2.2billion of inventory write-off by the Cisco system resulting from forecasting error proves the vitality of forecast information (Ho, 2007). In the oil and gas industry, the forecast information is largely influenced by each business's activities. For instance, in marine services activities one of the participants spelt out an example of their contingencies plan arising from forecast information;

"If we look at vessel management, there are items that need hot spot replacement for example, if the crane's cable broke, you have to replace if immediately to avoid paying huge amount of standby. There are some preventive items you could consider having onboard the vessel in order not to delay the overall project executions." - Participant D

Apart from recommending important areas of performance, most of the participants suggested that it is important to have the right balance of priority across performance measures. In other words, it is essential to minimise costs, but at the same time, the services or products must be able to meet delivery requirements and achieve the right quality. This means that a supply chain manager should be able to make the right decision in trading any area of performances based on their organisational priority. The qualitative extracts explain the issues as follows:

"…and there are the ranges of the balance of right quality, right cost, right quantity and the right location. It's a very important set of measures." [Participant A]

"We focus on four main areas which are Safety, Quality, Delivery, and Price. We have 5 'R" principle: Right Quality, Right Time, Right Price, Right Location, and Right Quantity" [Participant C]

Table 5-8 depicts the main performance areas according to participants.

Table 5-8: Performance measures for the oil and gas supply chain

Participants	**Main area of performance**
Participant A	Safety, efficiencies, effectiveness, quality, cost, forecast and historical data
Participant B	Health, safety and environment, equipment reliability, delivery schedule, and cost
Participant C	Safety compliance, quality, delivery schedule, and price, return on investment.
Participant D	Safety compliance, cost savings, process effectiveness, process compliance, process effectiveness - timeliness
Participant E	Timeliness and cost savings Integrity and transparency

The discussion with all participants provided a list of performance measures that are important to the oil and gas industry. These include safety, efficiencies, effectiveness, quality, cost, forecast and historical data, equipment reliability, schedule, integrity and transparency. From all the proposed performance measures, all the participants pointed out that safety has to be the first priority on the list. The safety measures mentioned by the participants include the environmental aspect as it is commonly considered to be part of safety requirements. This finding is in the same vein as the oil and gas report provided by International Energy Agency, (2012) and

Organization of Petroleum Exporting Countries (2013) which stated the importance of safety and environmental factors in the oil and gas industry. Apart from safety measures, other areas of performances stated by participants are widely discussed in the previous literature on supply chain and performance management (Beamon, 1999; Neely et al., 2005; Gunasekaran and Kobu, 2007). Nevertheless, all the performance measures recommended by participants were considered in the development of the questionnaire survey for further investigation with larger group of respondents.

5.13 Relevance of commonly used performance measures to the oil and gas industry

In addition to section 5.12 on performance measures, respondents were asked about some of the commonly used performance measures. These performance measures were selected from the literature review of the performance measurement of the supply chain:

Table 5-9: Most common performance measures according to literature

P. Measures	Authors
Quality	(Benita M. Beamon, 1999; Neely, Gregory and Platts, 2005; Shepherd and Günter, 2006; Bhagwat and Sharma, 2007; Gunasekaran and Kobu, 2007; Varma, Wadhwa and Deshmukh, 2008; Sambasivan, Mohamed and Nandan, 2009; Fan *et al.*, 2013; Arif-Uz-Zaman and Ahsan, 2014)
Flexibility	(Benita M. Beamon, 1999; Neely, Gregory and Platts, 2005; Shepherd and Günter, 2006; Bhagwat and Sharma, 2007; Gunasekaran and Kobu, 2007; Varma, Wadhwa and Deshmukh, 2008; Fan *et al.*, 2013; Arif-Uz-Zaman and Ahsan, 2014)
Innovation	(Shepherd and Günter, 2006; Asrilhant, Dyson and Meadows, 2007; Bhagwat and Sharma, 2007; Varma, Wadhwa and Deshmukh, 2008; Fan *et al.*, 2013)
Cost/price	(Benita M. Beamon, 1999; Neely, Gregory and Platts, 2005; Shepherd and Günter, 2006; Bhagwat and Sharma, 2007; Gunasekaran and Kobu, 2007; Varma, Wadhwa and Deshmukh, 2008; Sambasivan, Mohamed and Nandan, 2009; Fan *et al.*, 2013; Arif-Uz-Zaman and Ahsan, 2014)
Delivery reliability	(Gunasekaran, Patel and Tirtiroglu, 2001; Bhagwat and Sharma, 2007; Gunasekaran and Kobu, 2007; Varma, Wadhwa and Deshmukh, 2008; Sambasivan, Mohamed and Nandan, 2009)
Delivery speed	(Benita M. Beamon, 1999; Neely, Gregory and Platts, 2005; Shepherd and Günter, 2006; Bhagwat and Sharma, 2007; Gunasekaran and Kobu, 2007; Varma, Wadhwa and Deshmukh, 2008; Sambasivan, Mohamed and Nandan, 2009; Fan *et al.*, 2013; Arif-Uz-Zaman and Ahsan, 2014)

Apart from that, safety measures were also explored throughout the interview. This considers the importance of safety measures in the oil and gas industry by both research and industrial practitioners (Oil industry International Exploration and Production Forum, 1997; Halman and Voordijk, 2012; International Energy Agency, 2012; Hunter, 2014; Organisation of Petroleum Exporting Countries, 2015). Moreover, the previous literature review by Gopal and Thakkar (2012) proposed to explore safety measures from supply chain management perspectives.

In addition, this study also includes environmental and corporate social responsibility measures. These measures were chosen based on the current business environment, where most organisations are becoming more environmentally friendly and socially responsible in their operations (Asrilhant et al., 2007; Gold et al., 2010; Taticchi et al., 2013).

Moreover, safety, environmental, and corporate social responsibility measures were the primary concern in most multinational oil and gas operators. This can be clearly observed from their official web page, which presents their efforts to enhance these areas (BP p.l.c, 2016; Chevron Corporation, 2016; Exxon Mobil Corporation, 2016; Saudi Arabian Co., 2016; Total S.A, 2016).

The discussion of the listed measures was aimed at exploring its importance and practical application in the oil and gas industry.

5.13.1 Quality measures

Many existing literature discussed the impact of quality management on organisational performance (Hsu et al., 2009; Ketchen and Hult, 2007; Li et al., 2011; Soltani et al., 2011; Vanichchinchai and Igel, 2011). Quality was initially defined as conformance to specifications (Neely et al., 2005). Thus, the amount of rejects and defects were used as a means of measuring quality performance (Neely et al., 2005). However, the perspective of quality shifted around 1960 to consider preventive plan (customer satisfaction survey), assessing quality (quality monitoring and evaluation), and reactive (number of defects/ rejects) (Neely et al., 1995). The following qualitative extracts discuss oil and gas perspectives on quality measures.

"Quality is a measure of the actual performance to the specifications or requested performance" [Participant A]

"For quality, it means that the product or services delivered by our vendor must meet or exceed the minimal requirement that we have in place." [Participant E]

Participant B suggested requesting manufacturer certificate from suppliers to ensure that the materials they supplied meet the project requirement. This statement is in line with Soltani et al., (2011) and others who claimed that managing the quality of the supplier is one of the ways of managing quality performance. This is particularly important with the increase in reliance on suppliers in the current business environment.

"For quality, if you are installing a pipeline and you are concerned about the quality of that pipeline, you might have a performance measurement that deals with the quality of the pipe as being manufactured in the steel mill. So, generally speaking, you would want to get mills certification to verify that the pipe has been manufactured to a proper specification." [Participant B]

In addition, Participants B and D also pointed out that number of reworks, repair and rejects are used to assess quality of services.

"Of course, we also have specific ranges for services and products in this industry. The right quality should be delivered with the right product to the client. For example, automated welding services, we need to ensure less rejects and reworks for joints welding." [Participant D]

"So, the ways we measure quality are mostly by the number of reworks and the number of repairs." [Participant D].

5.13.1.1 Challenges in managing quality measures

Participant A pointed out that assessing services quality is rather difficult in comparison with products. However, Participant B commented that quality performances for services can be managed by planning requirements ahead and ensuring involvement of the engineering and project team. In essence, a strong internal integration would be able to overcome this barrier. Supporting this, one field study has been conducted on staff involvement in designing performance measures in the beverage manufacturing industry (Groen et al., 2012). The staff participation increases their motivation in the usage of that framework, and ultimately improved departmental performance.

"It is quite fixed and simple to measure for equipment, but a bit complex and subjective for contracting services." [Participant A]

"So, I think the key element in measuring services quality is being able to work really closely with your operational and engineering and project's people to come out with quality measurement that are meaningful and easy to measure." [Participant B]

The responses suggest that quality measures are important in the oil and gas industry. One way of managing these measures are through preventive action by requesting quality certification from suppliers to ensure the material or products supplied are according to the specified standard. Other participants claim that the number of rejects and reworks are amongst the metrics used in this industry, which is normally monitored throughout the project execution. In practice, the involvement of various departments is essential in determining the quality standards a company aims to achieve.

5.13.2 Flexibility

Participants A and B claimed that flexibility measures are less common in oil and gas companies. Conversely, Participants C, D, and E suggested that flexibility measures are relevant to the oil and gas industry yet the measures are quite difficult to evaluate and very subjective.

"Flexibility comes with cost and normally a company that acquire goods and services wants flexibilities but is unprepared to pay the cost." [Participant A]

"If I were to tell someone the performance measurement about flexibility, they probably might be confused. So, that's why using that as specific metrics, I haven't really seen it very much" [Participant B]

However, Participant B highlighted the importance of the element of flexibility in managing performance measures in order for a company to be sustainable in the current market. The strategy chosen for supply chain performance management should not be rigid and should be able to respond to changes in the market environment.

"You can define flexibility from the standpoint of having to develop a performance measurement that reflects the current price of crude oil" [Participant B]

"Being in a supply chain you need to be flexible on what you going to use for your performance measurement based on the overall market and sales prices for crude oil and what your operation and engineering project personnel feel important to the business." [Participant B]

5.13.2.1 The relevance of flexibility measure for the oil and gas industry

Participant D emphasised that flexibility is required for project executions. But, the supply chain manager has to ensure it is not excessively exercised as it will distort the process compliance and procedure. Moreover, this might be perceived as a lack of integrity from the perspective of the shareholder and the client.

"In any process, we need to have flexibility. But if there is too much flexibility that means you don't have a process." [Participant D]

Participant E also pointed out the same concern as Participant D on the importance of flexibility in managing a company's supply chain as can be seen in the following extract. In this regard, he indicated the need for flexibility from the client's perspective to the supplier in order to meet the result that they required.

"It means that the vendors must be able to comply with our requirements and be flexible with their company process in order to deliver the services that we required." [Participant E]

Many research have been conducted on flexibility measures, which focus on manufacturing industry (Yusuf et al., 2003; Sánchez and Pérez, 2005; Boyle and Scherrer-Rathje, 2009; Koçoğlu et al., 2011; DeGroote and Marx, 2013; Youn et al., 2014). However, most of the research primarily focused on the flexibility of the tangible products (Gunasekaran and Kobu, 2007), which are volume flexibility, order fulfilment, product variety, and flexibility in delivery (Chen et al., 2013; DeGroote and Marx, 2013; Youn et al., 2014).

Ketchen and Hult, (2007) define flexibility as “supply chain responsiveness to the consistent, and changing needs of its user”. They contend that the application of flexibility is related to both product and services, and supply chain process. This is in line with Sánchez and Pérez, (2005) research, which claimed flexibility comprises two elements: products/ services, and the supply chain process. In fact, that research indicates that there is a positive relationship between superior flexibility capabilities and the overall organisational performance. Not only that, the author found that the impact of flexibility of manufacturing system technology on organisations’ performance outperforms the flexibility measures of the end products. Nevertheless, the importance to emphasis either on the supply chain process or the end products is largely influenced by the market environment. In one study on flexibility in the food supply chain, the authors proposed flexibility measures that consider both productions and the supply chain process (Shafiee et al., 2014). This shows the importance of both aspects of flexibility in enhancing organisational performance.

The qualitative responses regarding flexibility in the oil and gas industry suggest that participated organisations do not specify flexibility measures in their performance framework. This is due to the fact that the participated organisations are focussed more on applying the flexibility principle in their supply chain strategies; which is rather difficult to quantify. For instance, two participants highlighted the need to design performance measurement frameworks that reflect the current oil prices environment. Nonetheless, flexibility of products might be more prevalent to the manufacturing companies, which produce oil and gas equipment.

5.13.3 Innovation measures

Innovation measures are very important in increasing organisational operation efficiency, and eventually lead to better overall organisational performance (Bhagwat and Sharma, 2007). This measure was introduced by Kaplan and Norton (1992) through their balanced score card model, which has been extensively explored by many researchers (Bhagwat and Sharma, 2007; Varma et al., 2008; Gopal and Thakkar, 2012; Kim and Rhee, 2012; Fan et al., 2013; Zin et al., 2013; Shafiee et al., 2014). Despite that, Gunasekaran and Kobu, (2007) stated that innovation measures only represent 27% of performance measures presented in the literature. This could mean that either organisations do not pay attention to this measure or this measure receives less attention from the researcher. Therefore, this particular section is aimed at exploring oil and gas practitioners' perspective towards this measure.

5.13.3.1 The importance of innovation measures for the oil and gas industry

When the interviewees were asked about innovation measures, three participants claimed it was less common and usually applied in high technology companies. Some other participants suggested that it is very subjective to measure and yet they value it in their company.

"*There is no standard measure for innovation and it is very subjective.*" [Participant A]

"And for innovation, yes but to a lesser extent doing something different is basically the measurement that I have seen used." [Participant B]

"Yes, it is considered as the least important among the measures listed." [Participant C]

"We value that in our company but it is a very subjective measure." [Participant D]

"Yes we need our supply chain to have new ideas so that we can achieve things better." [Participant E]

5.13.3.2 How innovation measures are viewed in the oil and gas industry

There is much literature highlighting the importance of innovation as a performance measure in supply chain management (Bhagwat and Sharma, 2007; Yeh et al., 2007; Varma et al., 2008; Thakkar et al., 2009; Halman and Voordijk, 2012). However, most of the previous literature focused on innovation from the perspective of tangible products, manufacturing inventory, and distribution.

Some researchers have shifted their focus to also include other forms of innovation which emphasise operating systems as a means of creating value for the company (Lin et al., 2010). This type of innovation, while focusing on intangible products, does not neglect the importance of their tangible products. In the oil and gas industry, innovation of intangible products is predominantly more practical. The reason is, the end product of this industry has very minimal differentiation to attain competitive advantage (Chima and Hills, 2007).

The following qualitative extracts explain how the innovation measures are viewed by the oil and gas industry, which concentrates on the operating system'

"It can be defined by how well the supplier works with the client to improve all the other dimensions of safety quality, cost, reliability, delivery speed." [Participant A]

"How the supplier uses innovation by driving down to improve companies' business performance by getting more oil out, or getting oil faster or moving it faster." [Participant A]

The previous statements by Participants A and B are in line with innovation measures proposed by Bhagwat and Sharma (2007). These measures focus on the initiatives taken by suppliers to facilitate their clients' requirements, and include both financial and non-financial factors. Other perspectives include the innovation of environmental friendly working conditions as mentioned by Participant C, and innovation in supply chain strategy as highlighted by Participant D.

"We use innovation measures in developing environmental friendly working conditions" [Participant C]

"In procurement it is very important. For example, packaging or contracting strategy or terms and conditions, that kind of innovation." [Participant D]

Because sometimes it is a by-product of what you are doing things. For example, if you got some cost saving for procurement activities, it could be derived from your innovation on how you are doing it." [Participant D]

"If you have new innovations that could actually save cost either by making the operation better or much more productive, I think most of the company want to have it." [Participant E]

5.13.3.3 Challenges in managing innovation measures

Among the challenges in managing innovation are the difficulties in measuring it as it is very subjective and lies in the judgement of the supply chain manager. Another constraint in managing innovation according to Participant B is the need to have a proper plan before the project execution. Once the project is executed, it is not easy to introduce innovations in how they manage their work. The distraction of introducing innovations during project execution might hinder the project delivery.

"It is very difficult to measure innovation and it's a bit subjective too. But, this kind of thing is normally done at strategic level and not much at operational level as they are busy handling their daily executions." [Participant D]

"Things like flexibility or innovation is not always easily quantified because it is too subjective." [Participant E]

"Innovation can be difficult depending upon what you are working on. If you are working on a large project, and you have time to really think about innovation and how it can improve your project, it's easier to implement something. But, if you are working on oil and gas ongoing operation that is basically operated in a certain way, trying to push innovation in the form of the supply chain point can be difficult." [Participant B]

5.13.4 Cost savings

Cost or price are widely used performance measures in many industries. It is the same in the oil and gas industry. All participants agreed that cost or price are very important measures in the industry and can be easily managed in their organisations. The following extracts explain this.

"To me, cost measures are easy and straightforward to manage and evaluate" [Participant D]

"This is where we need our supply chain to emphasise where we can earn cost saving or achieving a win – win situation with the suppliers." [Participant E]

"It can be easily quantified for evaluation purposes. I mean you can set the expected number that you are aiming for and you can compare with the actual performance." [Participant E]

5.13.4.1 Managing costs in the oil and gas industry

Participant A suggested that the best way to manage cost is by focusing on the total cost of ownership.

"Good practice is to measure the total cost of ownership. For example, for trucks, 90% of the total life cost of a truck is fuel. Hence, buying a slightly cheaper, but less fuel-efficient truck may be a higher total cost to the company." [Participant A]

Participant B, however, proposed that the oil price per barrel is a good benchmark in managing cost and prioritising the supply chain strategy to optimise profitability potential.

"Cost or price is usually not too difficult to use that, against the price per barrel." [Participant B]

In line with other participants, Participant C also agreed that cost measures are being used by oil and gas companies and are quite easy to manage and evaluate. He claimed that return on investment is the financial measure used in his organisation. However, Participant C argued that it is the sixth priority after safety, quality, delivery speed, delivery reliability, and flexibility. In the oil and gas industry, safety and quality measures should not be traded to other measures such as cost or even speed. From this, Participant C's viewpoint can be understood.

Noting the importance of the cost savings, Participant D reiterates the need to view it from a broader perspective or in the form of total cost of ownership as stated by Participant A earlier. For instance, in certain circumstances, you have to pay higher prices to ensure that your services meet the delivery time. This is to avoid unnecessary cost incurred due to the delay in delivery which might outweigh the cost savings that they could earn. In essence, it is very important for the oil and gas practitioner to understand what matters most to the company.

"Yes, as the sixth priority from the list of measures. One of our financial indicator is return on investment" [Participant C]

"Sometimes, we have to pay a slightly higher price as long as it can be delivered on time, because whatever cost saving you could make by letting the main vessel standby, will be gone down into the drain. One day's vessel standby will cost us much more than we could save on procurement activities." [Participant D]

In addition to what has been discussed earlier, Participant D also provides his insights on procurement cost saving. He claimed that the procurement cost savings that a company can make are not valued against the current market price nor against the budget that they have for particular services or products. He claims however, the company assesses cost savings from the cost reduction they can make from the lowest offer they got from the market after all other aspects including safety, quality, reliability and other competencies have been taken into consideration.

"In the supply chain, there are always two schools of thought, the first one is, this guy cost 10,000 USD and another guy cost me 5k, so, my contribution is I'm getting a lower rate in the form of 5,000 USD savings. But for me, that is not so much your contribution because it's something dictated by the market environment. For me the value of procurement is, this is the lowest in the market, and I can squeeze them further." [Participant D]

"And another case is, should we compare against our financial budget? For example, the price offered is 5,000 USD, but our budget is 3,000 USD. In this case, we can't simply say that is the amount cost saving that we got unless we could earn another reduction on top of the prices offered." [Participant D]

5.13.5 Delivery reliability

A higher degree of delivery reliability in complex supply chain networks such as in the case of the oil and gas industry can improve the overall supply chain performance and eliminate unnecessary expenditure on time, effort and cost (Lam and Ip, 2012). In this industry, the reliance on third party services is crucial due to the need for various fields of expertise to complete the project. Therefore, delivery reliability measures have to be one of the important factors when considering the need to assess supplier performance (Ho, 2007) and also organisation reliability from customer perspectives.

The responses show that all participants agreed that delivery reliability measures are relevant to the oil and gas industry.

"I guess I probably redefine it as reliability and it is an important measure to the industry." [Participant B]

"Delivery reliability is the 4th important measures after flexibility." [Participant C]

"These are the performance measures that we always use to assess our suppliers and subcontractors." [Participant E]

"If we found a company that was not reliable in providing services or equipment, we might opt not to consider them in the next tendering activities." [Participant E]

5.13.5.1 Challenges in managing delivery reliability measures

In managing delivery reliability measures, most of the participants suggested that it is straight forward and can be quantified easily as long as an organisation sets their objective and requirement clearly. However, Participant A pointed out that the delivery reliability of materials and equipment is comparatively easy compared to other complex services.

"For materials this is very measurable (especially with increased systems in logistics and warehouse). But, for complex services this is harder and requires experienced company representatives to assess timely delivery." [Participant A]

"Delivery reliability or reliability of equipment, I don't think that is an issue in implementing that." [Participant B]

"Cost or price, delivery reliability, speed, schedule and safety you can all develop specific metrics within that and can be relatively easy to track." [Participant B]

"If we talk about delivery reliability, delivery speed or cost and price, it can be easily quantified for evaluation purposes." [Participant E]

5.13.6 Delivery speed

All the participants agreed that delivery speed is relevant to the oil and gas industry. Participant A suggested that delivery speed for services is hard to measure when compared with assessing them for material delivery.

"For materials, it is easily measurable (especially with increased systems in logistics and warehouse)." [Participant A]

"For complex services, this is harder and requires experienced company representatives to assess timely delivery." [Participant A]

Participant B suggested redefining delivery speed terms as schedules as it involves complex services and requires the involvement of multiple parties in most cases.

"For delivery speed, I'm going to call that more schedule. And I think the schedule is the critical performance measurement for the oil and gas industry." [Participant B]

Participant D pointed out one of the examples of services that he needs to deal with in his company which involves main work barge vessels for offshore installation activities. They use no – delay of the main work-barge vessel as an indicator for services and equipment in meeting the specific delivery speed requirement.

"All in all, our ultimate measure is zero main work barge on standby due to non-delivery of the item. As long as there is no stop works due to undelivered items, we are still ok." [Participant D]

5.13.6.1 Challenges in managing delivery speed

Delivery speed is perceived by participants as a straightforward measure and can be managed easily. However, according to Participant D, in certain circumstances, there is a need to trade the cost saving factor in order to ensure the services and equipment can be delivered within the stipulated time. In this case, he mentioned that sometimes the cost of vessel standby due to delay is much higher than the procurement savings that the company could earn. It is interesting to understand the scenario being highlighted by Participant D as he prioritises the delivery due to the damage cost which is normally stated in the contract and is much higher after a cost analysis has been made. Therefore, it is not necessary in all cases to focus as much on the cost saving as a discrete element but instead to focus on the ultimate cost which will affect the company's profit.

"Schedule is not an issue, and it is basically easy to implement that." [Participant B]

"In this case, sometimes, we have to pay a slightly higher price as long as it can be delivered on time, because whatever cost saving you could make by letting the main vessel standby, will go down the drain as a one-day vessel standby will cost us much more than what we could save on procurement activities." [Participant D]

5.13.7 Safety measures

All the participants agreed that safety measures are the most important indicator for the performance measurement in this industry. Most of the participants claimed that they used the safety monitoring record to assess their performance. In addition, they have made considerable efforts to ensure that safety awareness has been instilled in their operation. This is conducted through many campaigns and courses introduced to the employee to establish a safety culture at work.

"*Safety usually means safety to people, equipment and the environment."* [Participant A]

"And then for safety, yes definitely. Safety has always been in the performance measurement that I've seen for years." [Participant B]

"Safety measures are the most important indicators to oil and gas industry and are much more important than cost." [Participant C]

"If there is any breach of the safety requirement, or if any safety issues arise we have to stop work until the things are resolved." [Participant D]

Other than that, for the reactive part of safety management, Participant D suggested that the stop work policy will be activated if there is any breach of safety requirements until the issue is resolved. This statement shows the great impact of safety violation has not only on the people and the environment but also on the overall operational activities. Although a reactive plan such as stop works policy is important, Dea and Flin (2001), claimed that employee motivations and safety initiatives are more effective in enhancing safety performance of an organisation. The following qualitative extracts present discuss how some organisations motivate their workforce.

"We have put in place a lot of safety plans and our measurement is the number of days without a loss time injury." [Participant D]

The number of days without a loss time injury is one of the motivation forces for the employee as they will publish it in their organisation and around the workplace. In fact, they will celebrate after their employees reach a certain number of days without a loss time injury. In addition, they also implemented 'You see you act' campaign and gave a reward to their staff for the action they took in regards to safety precautions at the workplace.

"Safety measures are always the first priority for the oil and gas companies before any other things. That is why we have to ensure our supply chain always keeps safety in mind." [Participant E]

Participant E also highlighted some management efforts to ensure that the supply chain always puts safety as their priority. This is undertaken through safety assessment prior to project execution, safety and development training, and assessing safety compliance of a supplier prior to the project being awarded. Similarly, Attwood et al., (2006), claimed that a preventive approach in safety management is critical in enhancing the safety performance of an organisation.

5.13.7.1 Safety management in the oil and gas industry

All the participants agreed that safety is something relatively easy to assess and monitor. Safety compliance records in most companies are made available for staff and public to view to instil a safety culture in their mind.

"Safety measures are assessed through some safety compliance records." [Participant A]

"We have an HSE monitoring system, so it's quite easy to record and monitor." [Participant D]

Furthermore, oil and gas companies would normally extend safety awareness towards their sub-contractors by stipulating their safety requirements. The qualitative response by Participant D confirms this.

"Whatever safety requirements are stated in the contract level will be cascaded down to all the vendors. The vendor's safety will be our safety. We cannot have two different safety standards." [Participant D]

The previous discussion illustrates how safety measures are viewed in the oil and gas industry. The way organisations manage this measure is also supported by literature on safety management. Moreover, one of the researchers reviewing the performance measures and metrics in supply chain recommended the need to include safety measures in assessing supply chain performance (Gopal and Thakkar, 2012).

5.13.8 Environmental and social responsibility measures

The awareness of environmental and social responsibility has greatly increased in recent times among corporate organisations (Zhang et al., 2013). Social pressure from the public, non-government organisations and local government have increased organisation awareness on this aspect. Moreover, there is also an empirical study that supports the positive correlation between corporate social responsibilities practices and company performance (Zhang et al., 2013; Cheng et al., 2014).

The qualitative responses gathered from all the participants supported the current literature on this issue.

5.13.8.1 The importance of environmental and social responsibility measures

The local content is one of the requirements that an oil and gas company must adhere to in order to operate in a certain country. In fact, the emphasis on local content which involves environmental and social responsibilities is far greater in this industry than others. Qualitative responses proved that it is an important element for the industry. Furthermore, these measures also considered as an element to enhance the corporate image of one's company.

"I think oil and gas companies take that very seriously." [Participant A]

"It is very important for companies as far as its reputation and desire for safety and to be socially responsible." [Participant B]

"I think those factors are more important than cost and schedule. I mean, you can be socially responsible, you can protect the environment, and you can be safe, I don't think anything else matters for most companies." [Participant B]

5.13.8.2 Managing environmental and social responsibility measures

From the qualitative responses from Participant A, oil and gas companies are responsible for ensuring the corporate social responsibilities aspects are taken care of in their company and also other companies involved in their supply chain networks. The second statement from Participant A shows that there are great concerns on the violation of child labour acts being practiced on the part of their suppliers. These efforts will increase the pressure on the entire chain to comply with the corporate social responsibilities programme being set by the company that awarded the project.

"Corporate social responsibility is usually captured now under that local content. The dimension of companys' supply chain now takes on responsibility for that locally, and in their extended supply chain as well." [Participant A]

"They are making sure they are not employing or buying goods and services from the company that uses child labour." [Participant A]

Other aspects of corporate social responsibility pointed out by participant B, C and D are in improving the socioeconomic status of local people by providing job opportunities and engaging local suppliers to support its operations.

"So, if you are working in a remote area, your company might have a desire to hire a certain amount of local people or local companies to work on those jobs." [Participant B]

"Developing local content - *we educate the local community by increasing participation in supply chain process."* [Participant C]

"Whenever possible, we will award and develop local vendors, and it is part of the requirements set by the Malaysian government." [Participant D]

In addition, the qualitative responses show that they not only focus on the social responsibility factors related to the local content requirement but also involve other volunteering activities. The qualitative response from Participant D exhibited some of the initiatives made by the company namely, hungry kitchen for the homeless, financial support for a local orphanage shelter, and also other environmental campaigns involving their employees and local communities.

"We organised a hungry kitchen for the homeless in the city area, we also allocate some amount of money for the orphanage, and there is also a green campaign to grow plants." [Participant D]

Similarly, Participant E claimed that there are social responsibility events being carried out actively by the corporate communications department where it opens for staff who are interested in being volunteers.

"There is a dedicated department called corporate communications which is responsible for corporate social responsibility matters." [Participant E]

"They have a sort of social responsibility activities organised by this department around once a month or twice a month, on charities events as well as environmental campaigns." [Participant E]

Apart from the above efforts, Participant D claimed that they have also conducted a mentoring programme to help a new local offshore installation company to be successful. There are terms and conditions and certain areas that they have to supervise as part of their programme. This effort is introduced and monitored by the Malaysian government to ensure both parties will benefit from this collaboration.

"We also have one project, we called it mentoring, where we guide one local company to become a successful offshore installation company." [Participant D]

Finally, there is also an on the job training programme being held to cultivate the talent of young graduates throughout six months of on the job training. This programme is conducted in collaboration with the Ministry of Labour with the aim of minimising unemployment issues and at the same time benefiting the fresh graduates with on the job training experience. In most cases, they will be recruited if there is a vacancy after they finish their training programme.

"Firstly, through the job training with them being monitored by our operation people and there are also some discussions on commercial and contractual matters as well." [Participant D]

The qualitative responses illustrate the issues and application of commonly used performance measures in supply chain performance management from oil and gas perspectives. Most participants propose specific examples on the applications of these measures in the industry as in Table 5-10.

Table 5-10: Performance measures in the oil and gas industry

Performance measures	**Issues**	**Application in the oil and gas industry**
Quality measures	-Very important - Requires involvement of multiple departments to assess services quality	-Actual performance to the specifications -Quality compliance certification -Number of reworks -Number of rejects
Flexibility	-Very subjective and less common in this industry	-Flexibility in supply chain strategies based on the current market
Innovation	-Very subjective and less common in this industry -Need to plan prior to project execution -Focus on operating systems -Relevant to the strategic level	-By getting more oil out, or getting oil faster or moving it faster -Packaging or contracting strategy or terms and condition -Developing environmental friendly working conditions -Supplier initiative in facilitating organisation on financial and non- financial aspects
Cost/price	-Straight forward -Easy to quantified -Can be easily compared with financial target	-Total cost of ownership/ return on investment -Use world oil price per barrel as a benchmark -Compare against the lowest offer from the market
Delivery reliability	-Very important -Straight forward and can be quantified easily	-Use to assess supplier performance
Delivery speed	-Relevant and straightforward to measure	-Use no– delay of the main work-barge vessel as an indicator for delivery speed
Safety measures	-First priority in the oil and gas industry	-Use safety monitoring record to manage this measure -Number of safety compliance records -Safety to the people, equipment, and environment -Safety training -Safety requirements that are stated in the contract will be cascaded down to all the vendors
Environmental and corporate social responsibility	-Important to the oil and gas industry -Part of local content requirements -Can improve corporate image of company	-Not buying goods or services from companies that use child labours -Providing job opportunities for local communities through on the job training -Engaging local suppliers -Feed the poor and less fortunate -Financial support for orphanage shelter -Environmental campaigns

From eight measures listed in Table 5-10, only flexibility and innovation are perceived by some participants as less common performance measures in this industry. Nevertheless, it does not mean being innovative and flexible is not important to the industry. In fact, the high exposure of risks, the involvement of multiple expertise and high transportation cost might require more innovation and flexibility in managing oil and gas business. Even though it is not clearly defined in their performance frameworks, most participants acknowledged these two measures are very subjective, and are used in crafting solutions for their companies.

5.14 The proposed list of performance measures

This section presents a set of performance measures for the oil and gas industry as in Table 5-11.

Table 5-11: The development of set of performance measures

Performance measures proposed from literature	**The revised list of the proposed performance measures based on interviews**	**Additional performance measures based on the interviews**
-Cost/price	-Cost savings	-Process compliance -Ethical business -Forecast accuracy -Return on investment
-Quality	-Product/ services quality	
-Flexibility	-Flexibility in meeting customers' needs -Supplier flexibility	
-Delivery reliability	-Product/ services reliability -Supplier reliability	
-Delivery schedule	-Timeliness -Schedule accuracy	
-Innovation	-Innovation in operation -Technology innovation -Number of innovation ideas generated	
-Safety and environmental measures	-Safety compliance -Safety training -Environment pollutant control -Reduction of waste	
-Corporate social responsibility measures	- Investment in charitable programmes -Supplier compliance on social responsibilities policy	

This set of measures is developed from the literature review, the discussion on the most important performance measures in section 5.12 and section 5.13 on the commonly used performance measures. The first column listed the performance measures proposed based on the literature. The second column outlined the revision of the proposed performance measures. Some of the performance measures initially proposed from the literature were revised based on the inputs gathered from the interviews. The third column depicts the additional performance measures based on the suggestions from the interviewees. Accordingly, Table 5-12 presents the refined set of performance measures. There are twenty-one performance measures proposed for the industry. These performance measures will be validated through questionnaire survey with a larger group of participants (oil and gas companies) in the UK and Malaysia.

Table 5-12: Set of performance measures for the oil and gas industry

Final list of performance measures
PM1 Cost savings PM2 Return on investment PM3 Accuracy of schedule PM4 Timeliness PM5 Product/ services reliability PM6 Supplier reliability PM7 Flexibility in meeting customers' needs PM8 Supplier flexibility PM9 Products/ services quality PM10 Forecast accuracy PM11 Process compliance PM12 Innovation ideas generated PM13 Innovation in operations PM14 Technology innovations PM15 Environmental pollutant control PM16 Reduction of waste PM17 Safety compliance PM18 Safety training PM19 Supplier compliance on social responsibilities policy PM20 Ethical business PM21 Investment in charitable programmes

5.15 The final conceptual model

The final list of performance measures gathered from the literature and exploratory interviews informed the final conceptual model of this research. This conceptual model in Figure 5-1 is the extension of the preliminary model proposed in Figure 3.1 in Chapter 3. This model contained the final list of performance measures as one of the research constructs. In other words, the initial construct of performance measures containing nine measures will be replaced with twenty-one measures as in Table 5-11. Also, the organisational performance attributes, which were initially consisted of 12 organisation performance attributes in Figure 3-1 have been amended to reflect additional performance measures from the interviews. This model will be validated using questionnaire survey. The outcomes of the survey and the analysis process is detailed in Chapter 6.

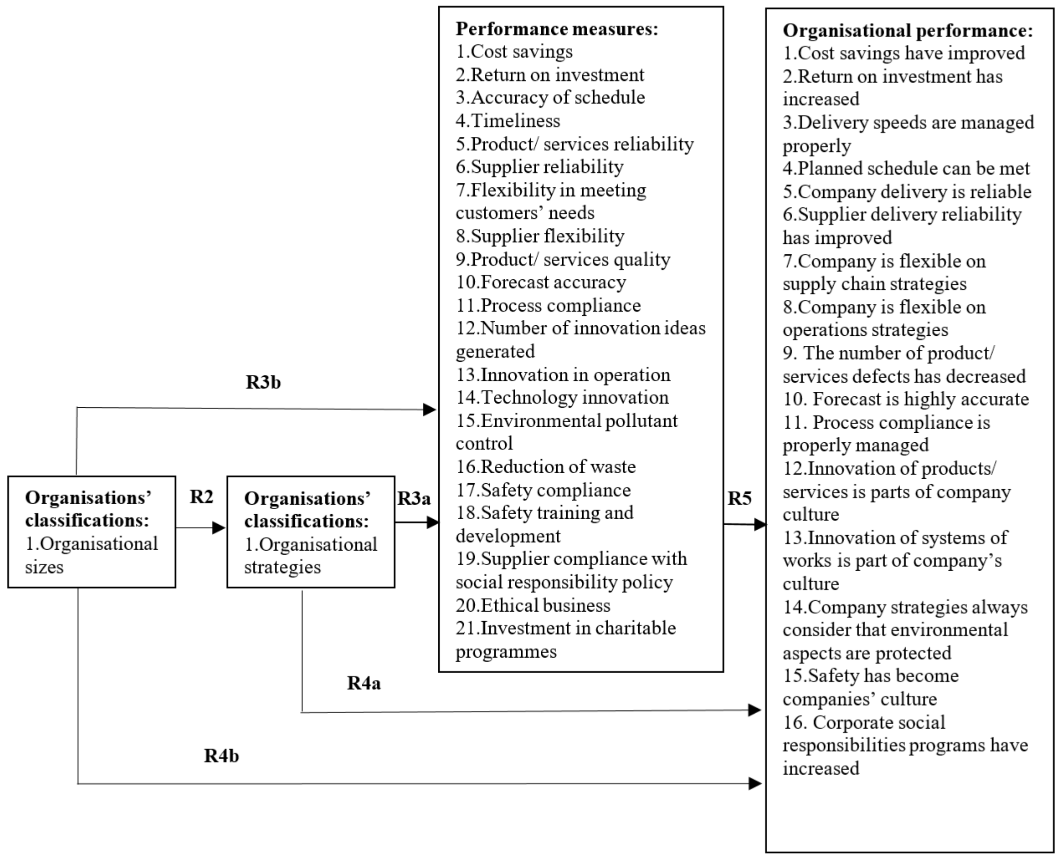

Figure 5-1: The final conceptual model

5.16 Summary

This chapter presents the details of five in-depth interviews with supply chain experts exploring supply chain performance management in the oil and gas industry. It has reported the supply chain performance management from oil and gas perspectives, the differences and similarities between upstream and downstream sectors of the industry and their relevant performance measures. In addition, it also illustrates the determinant factors in the choice of performance measures and the challenges in managing supply chain performance. Other than that, the most important performance measures in the industry were sought. Accordingly, the commonly used performance measures, which were cited from supply chain performance management literature, were explored in regards to its application in the oil and gas industry.

The importance of supply chain performance management in the oil and gas industry is consistent with other industries. This practice was perceived as the basis of overall organisation performance, particularly due to their reliance on outsourcing activities. Apart from that, the need to measure individual and team performance based on Neely et al. (1995) is sought. The majority of participants supports this idea considering that individual performance will determine the success of an organisation performance. This study also investigated the need to have short and long-term performance planning in supply chain management (Neely et al., 1995, 2005; Fleischmann and Meyr, 2003; Bhagwat and Sharma, 2007). For instance, short- term performance planning involves achieving target on a day to day operations' activities like delivery speed, quality and others. The long-term performance planning, on the other hand, concentrates on other time-consuming and complex efforts like developing sustainable pools of vendors. Another remarkable example of long-term performance planning includes the need to create food supply chain for oil and gas operations that located in the remote area and far from basic amenities. Other than that, there is a need to categorise performance measures according to hierarchical level to enhance the effectiveness of performance framework. This is to ensure the performance measures are designed for the right audiences, in order to capture relevant information (Gunasekaran et al., 2001; Varma et al., 2008).

Also, this study indicates that there are some similarities and distinctivesness characteristics of upstream and downstream sectors in the oil and gas industry. In this industry, safety and environment factors are very important. This element is similar for both sectors. Amongst the distinctive characteristics is the geographical location. In the upstream sectors, the area of operations is normarlly defined by the oil and gas resources location. On the contrary, the localities of the downstream sector is largely fixed. Apart from that, there are also differences in terms of financial risks between sectors. The exposure of financial risks are higher in the upstream sector in comparison to the downstream sector. These characteristics influence the way an organisation manages the performance and also the choice of performance measures.

These interviews discussed the determinant factors in choosing performance measures and also challenges in managing supply chain performance. The determinant factors not only influence their choice of performances but also determine their supply chain strategies (Wronka-Pośpiech and Frączkiewicz-Wronka 2016; Gimenez 2000; Hambrick 1983). One of the determinant factors, the oil prices per barrel, was found to affect the way organisation strategise the financial target. They focused on maximising profits in the high prices oil environment and concentrated on cost savings efforts in the current low oil prices environment. On the other hand, the challenges faced by the oil and gas industry in managing supply chain performance were sought. It is interesting to note that local content requirement was considered as both determinant factor and challenge. On one side, it influences organisation choice of performance to deal with this aspect, on another, some of the local content requirements required a lot of time, efforts, and cost to meet the requirement.

Apart from that, this study exhibits the most important performance measures in the oil and gas industry. Health, safety, and environment, quality, cost, timeliness, process compliance, forecast, and equipment reliability were amongst the performance measures highlighted by participants. It can be understood that the industry prioritised safety, health and environment measures above other measures due to high exposure of risks. In addition to this, commonly used performance measures in the industry are investigated on its importance and application in the oil and gas industry. These measures, while similar to other industries, they are not identical in nature as some of the measures are defined differently from the oil and gas perspectives. For instance, some of the measures, which are flexibility and innovation were considered less common in the industry. The participants contend that these measures are very abstract to quantify. Nevertheless, they did recognise their importance in this industry. For instance, one of the participants used innovations in their contracting strategy to gain more profits. The application of these two measures is focuses more on the intangible parts like operating systems or supply chain process. This is due to the end products of the industry, refined oil and gas have very minimal differentiation.

In essence, the outcomes of this interview support the previous findings that industry or nature of business influences organisations' supply chain strategies (Hambrick, 1983; Gimenez, 2000; Otto and Kotzab, 2003; Gunasekaran and Kobu, 2007; Kumar and Markeset, 2007; Kumar and Nambirajan, 2013; Wronka-Pośpiech and Frączkiewicz-Wronka, 2016). This can be observed from participants' perceptions on commonly used measures and their remarks on relevant performance measures in the upstream and downstream sectors. The proposed list of performance measures is presented together with its derivation process. The final conceptual model, which is the extension of preliminary model in **Chapter 3** is also presented in the final section of this chapter. Overall, the supply chain experts' opinions on performance measures and the application of the commonly used performance measures signifies that this study is worth to be explored further. The outcomes of this interview informed the design of questionnaire survey, which will be reported in **Chapter 6.**

CHAPTER 6

SURVEY BY QUESTIONNAIRE

6.1 Introduction

The quantitative phase of this research is detailed in this chapter. The phase consists of structure of the questionnaire, sample selection and response rates, preliminary analysis, descriptive statistics, inferential statistics, and relationship of the main constructs. The questionnaire was distributed to gather opinions from oil and gas practitioners on the supply chain performance measurement with view to explore and to answer the research questions.

This research was conducted based on two main theories. The first theory is based on Miles and Snow's organisational fit theory. This theory suggests that an organisation may be classified according to its adaptation strategy, namely, Prospector, Analyser, Defender, and Reactor (Miles and Snow, 1978; Wronka-Pośpiech and Frączkiewicz-Wronka, 2016).

The second theory is resource-based view theory which explains that the focus of an organisation on tangible and intangible resources would enhance the overall performance of an organisation (Hart et al., 1995; Coates and Mcdermott, 2002). In this regard, performance measurement framework (a set of performance measures) is viewed as a resource in attaining competitive objectives.

A questionnaire was constructed to study the prevalence of performance measures in the oil and gas industry, investigate the relationship between organisational classifications and the choice of performance measures. This research also investigates the relationship between organisational classifications and organisational performance. In addition, this research study the impact of the usage of performance measures on organisational performances.

The questionnaire is adopted at this stage as it is considered an appropriate technique to collect the opinions from practitioners in management research (Forza, 2002).

Since a questionnaire is deductive in nature, it is suitable to assess the relationship between variables. This quantitative phase is derived from the extensive literature review and exploratory interview, which have been reported in the previous chapter. A mixed methods research design, consisting of qualitative (exploratory interview) and quantitative phase (survey by questionnaire) is well-practised among researchers in order to produce more rigorous research outcomes (Brannen, 2005; Östlund et al., 2011).

To date, a substantial amount of research has been conducted to investigate supply chain performance management (Beamon, 1999; Gunasekaran et al., 2001; Gunasekaran et al., 2004; Yusuf et al., 2006; Bhagwat and Sharma, 2007; Narasimhan et al., 2008; Li et al., 2011; Estampe et al., 2013; Zin et al., 2013; Yusuf, Musa, et al., 2014). However, a majority of the previous research has concentrated on the manufacturing and automotive industries. The research on supply chain performance management in other industrial contexts such as the oil and gas industry is still lacking.

Although there are some existing studies on performance measurement in petroleum supply chain (West and Lafferty, 2007; Varma et al., 2008), most of the research are primarily focused on the midstream and downstream sector of the oil and gas industry. The upstream sector is more complex and has the same level of importance. Nevertheless, this sector is often neglected. In addition, Kumar and Markeset (2007) stated that the operators of complex oil and gas production facilities are becoming increasingly dependent on service providers to support their efforts to perform according to demands. In this regard, performance measurement is a very critical aspect in evaluating their supply chain performance. Despite its importance, empirical research on performance measurement from the context of the oil and gas industry is still lacking.

There is a very minimal research has been conducted to empirically investigate the impact of organisational classification and the choice of performance measures on organisations' performance in the oil and gas industry context. Therefore, this survey is conducted after a thorough literature review on the subjects was performed as described in **Chapter 2** and an exploratory interview was performed as discussed in

Chapter 5. The self-rated questionnaire was designed with the aim to answer the research questions (Taylor-powell, 1998; Braun et al., 2012). All questionnaires received were analysed using a statistical software, IBM SPSS.

6.2 Structure of the Questionnaire

The questionnaire was designed based on a questionnaire design method suggested by Braun et al. (2012) as presented in **Chapter 4.** This requires a broad set of questions to be constructed by considering the order of demographic, social desirability, questions wordings, durations of the survey, response alternative, and also numerical scales. Total design method was also incorporated to increase the response rate (Kanuk and Berenson, 1975; Don A., 1979; Dillman, 1991). This method was adopted in designing the survey instrument and also conducting follow-up calls with the participants.

The questionnaire as shown in **Appendix I** consists of seven sections and a total of thirteen (13) questions. Details of each section are as follows;

First section: Company and respondent information

Second section: Financial information

Third section: Organisational adaptation

Fourth section: Determinant factor for performance measures

Fifth section: Choice of performance measures

Sixth section: Challenges in supply chain performance management

Seventh section: Organisational performance

First section: Seeks to collect demographic characteristics of the company and respondents. This includes company name, respondent designation and contacts, number of employees, the major area of operations and their legal form of classification. These items are covered from questions one to seven.

Second section: This section gives account of the average sales turnover of the company. This item is covered by question eight. It is a range band structured question based on the business turnover rate classification in the United Kingdom and Malaysia to cater for small, medium, and large companies.

Third section: This section deals with strategic adaptations of the organisation. It comprises thirteen items of organisational strategies attributes. These attributes represent four main organisational strategies, which are Prospector, Analysers, Defenders, and Reactors as expounded by Miles & Snow (1978). Previous literature suggests that there is a relationship between organisational strategies and organisational performance (Mintzberg 1989; Miles and Snow 1978; Parnell and Wright, 1998).

Fourth section: This section accounts the determinant factors in choosing performance measures in the participants' organisation. It covered by question ten (10) consisting of 9 factors. The determinant factors listed in this question were derived from the literature on supply chain performance (Neely et al., 2005; Gunasekaran and Kobu, 2007; Wildgoose et al., 2012; Shi and Yu, 2013) and exploratory interview conducted in the qualitative phase of this research. Research on supply chain performance indicates that there are several factors to be considered in designing performance measurement framework. Among the factors to be considered are business activities, organisation goals and mission, (Neely et al., 2005; Gunasekaran and Kobu, 2007), market situation, and sourcing strategies (Wildgoose et al., 2012; Shi and Yu 2013) and cultural and political factors of the country in operation (Gunasekaran and Kobu, 2007).

Fifth section: This section seeks to examine the choice of performance measures of respondents' organisation. In this section, participants are required to rate the level of importance of the performance measures used in their organisation. This item is covered by question eleven (11) with twenty-one (21) performance measures. There is plenty of research suggesting that the way an organisation measures their supply chain performance will positively influence their overall organisation performance (Chang et al., 2016; Shi and Yu, 2013; Vanichchinchai and Igel, 2011; Chen et al., 2004; Gunasekaran et al., 2004). Therefore, this question will be analysed by studying its correlation with question number thirteen (13) on the organisation performance. The list of performance measures was constructed based on the previous literature on supply chain performance measurement and also from the exploratory interview conducted in the first phase of this research and presented in **Chapter 5.**

Sixth section: This section is represented by question number twelve (12) consisting of six challenges in managing supply chain performance. The list of challenges was proposed based on the exploratory interview conducted in the first phase of this research which was present in Chapter 5. In addition, current literature on supply chain challenges or disruptions (Storey et al., 2006; Taticchi et al., 2013; Ivanov et al., 2016) was also reviewed to incorporate any relevant perceptions in the instrument.

Seventh section: This section deals with the performance of the company in four main aspects, which are financial, operation, safety. and environment, and corporate social responsibilities. This item is covered by question thirteen (13) and comprises of sixteen (16) statements to represent the level of organisational performance. This section of the questionnaire was intended to obtain current performance of the participating organisations. The organisation performance information is required to test its relationship with the choice of performance measures.

Final section: This section consists of two parts. The first part comes in the form of question fourteen (14) where participants are required to comment if they have any other thoughts on performance management of the oil and gas supply chain. This is very important in order to gain additional insights from industrial practitioners on any part which were not covered in the questionnaire. Furthermore, despite providing a self-addressed envelope, the last part stated where the questionnaire should be returned in order to increase the response rate.

6.3 Response rates

Table 6.1 reports the number of samples, response rates, and usable responses for UK and Malaysia. A total of five hundred and fifty (550) questionnaires were addressed to the selected companies in the United Kingdom while a hundred and twenty (120) questionnaires were sent to selected companies in Malaysia. The sampling technique has been discussed in Chapter 4.

Table 6-1: Response rates according to countries

Description	UK	Malaysia	Total
Sample	550	120	670
Responses	71	45	115
Responses %	13%	38%	17%
Usable responses	62	38	100
Usable responses %	11%	33%	15%

From the 550 questionnaires posted in the UK, 70 questionnaires were returned which amount to 12% of the response rate. Out of the 70 received questionnaires, only 62 were deemed complete and considered valid for further analysis. The remaining 9 questionnaires were discarded. For the survey in Malaysia, 45 questionnaires were returned which represents 38% of the total questionnaires sent. After examining the responses, only 38 responses were considered complete and usable to be included in the analysis. This produced overall response rate accounting 11% for the UK oil and gas companies and 33% response rates for Malaysia companies, resulting into 15% response rate for the whole survey. The response rates considered reasonable, given it is an empirical survey of organisations (Yusuf et al., 2014) and the respondents consisting of CEOs and executives of organisations (Wisner, 2003).

Table 6.2 presents the responses from the UK and Malaysia according to major areas of operations. The data shows that the responses are well-distributed between business sectors. Hence, no response bias based on demographic profile may be assumed.

Table 6-2: Response rates according to major area of operation

Major area of operation		UK	Malaysia
Exploration and production	Count % within country % of total	10 12.0% 6.8%	10 15.6% 6.8%
Marine and subsea services	Count % within country % of total	12 14.5% 8.2%	13 20.3% 8.8%
Energy consultancies including geographical consultancies	Count % within country % of total	9 10.8% 6.1%	3 4.7% 2.0%
Transportation, storage, logistics, catering and allied services	Count % within country % of total	8 9.6% 5.4%	9 14.1% 6.1%
Well and drilling services	Count % within country % of total	10 12.0% 6.8%	3 4.7% 2.0%
Engineering services, facilities management, structure designs and fabricators	Count % within country % of total	21 25.3% 14.3%	18 28.1% 12.2%
Refining, refined oil distribution and marketing	Count % within country % of total	6 7.2% 4.1%	7 10.9% 4.8%
Other- Decommissioning	Count % within country % of total	3 3.6% 2.0%	- - -
Other- Repair and maintenance	Count % within country % of total	2 2.4% 1.4%	- - -
Other- Trading and supply	Count % within country % of total	2 2.4% 1.4%	1 1.6% 0.7%
Total	Count % of total	83 56.5%	64 43.5%

The highest response among the major area of operations was engineering services, facilities management, structure design, and fabrication which account for 26.5% out of the total responses from both countries. This percentage consists of 14.3% of the responses from the UK, while 12.2% from Malaysia. The highest responses from this business area can be explained by the nature of their operation which requires the involvement of many companies to accomplish the work requirements.

6.4 Preliminary analysis

This section presents preliminary analyses undertaken for this research. These include data screening, assessing the assumption of normality, reliability and validity, common method bias, and non-response bias. The details of these methods have been discussed in Chapter 4.

6.4.1 Data screening

There are a few things to consider when data screening is performed. First, the data needs to be examined for any monotone scores. Monotones score can be seen if there is no variance in the scores. This step was conducted prior to data entry process. Since this survey involves a professional level of participants (i.e.: CEO or Managing Director), none of the data was found to have monotone scores. Secondly, the data was checked for missing values. Throughout this process, there were some instances where the demographical information such as company name and respondent name were incomplete. Nevertheless, this does not affect the analysis process. Overall, there were minimal missing values for a few of the sections which are believed to be due to negligence from the respondent side. Due to minimal missing values (less than 3%) for each respective section, this means that imputation was employed to replace the values. Sainani (2015) suggested that it is suitable to adopt any replacement methods for missing values of less than 5%.

6.4.2 Assessing the assumption of normality

The methods used for normality assessment in this research were histogram, normal quantile-quantile plot (q-q plot), Detrended q-q plot and two statistical methods, namely, Kolmogorov–Smirnov (K-S) and Shapiro-Wilk tests. Figures 6.1 to 6.4 present histogram, normal and detrended plot, and box plot for a normally distributed data of the choice of performance measures and overall organisation performance. Moreover, Table 6.3 reports the K-S and Shapiro-Wilk test for the choice of performance measures and overall organisation performance.

Figure 6.1 depicts the histogram of the data set for the two constructs: the choice of performance measures, and organisational performance. It can be observed that the histogram for both constructs was normally distributed. In addition, the normality of data may also be examined from the normal quantile–quantile plot (q-q plot). A straight-line plot as shown in Figure 6.2 indicates that the data is normally distributed. Moreover, the Detrended quantile – quantile plot (q-q plot) which represents the deviation of values from expected values in Figure 6.3 shows that the data set for the choice of performance measures and organisation performance are normally distributed with minimal deviation from the straight line (Ghasemi and Zahediasl, 2012).

Another visual method, box plot was also utilised in this research. The box plot is a standard five number summary consisting of minimum and maximum ranges value, the upper and lower quartiles, and the median (Potter, 2006). The box plot in Figure 6.4 for the choice of performance measures and organisations' performances reports that the data set is normally distributed. It can be seen that there is one observed value outside the lower quartile for the choice of performance measure and one observed value outside the upper quartile for the overall organisations' performance. Nevertheless, the overall data set for both constructs are normally distributed.

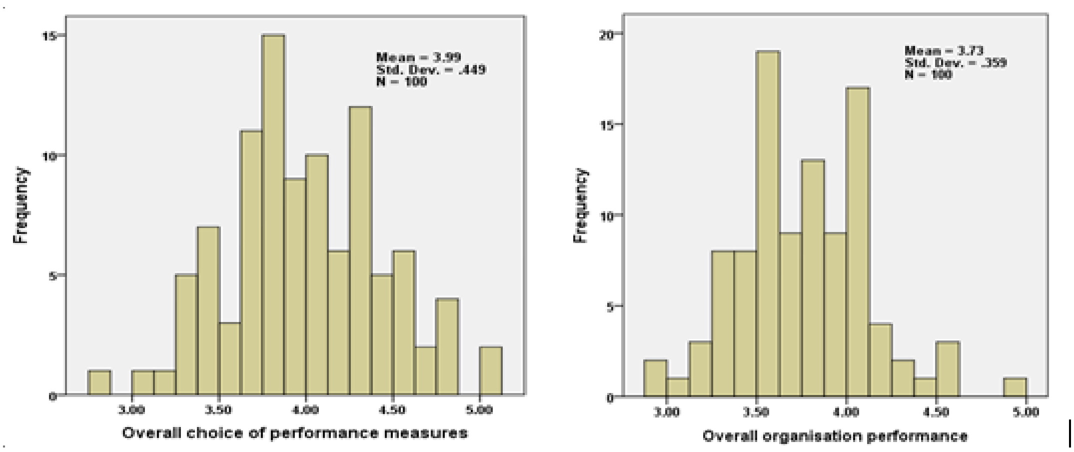

Figure 6-1: Histogram plot of the choice of performance measures and overall performance

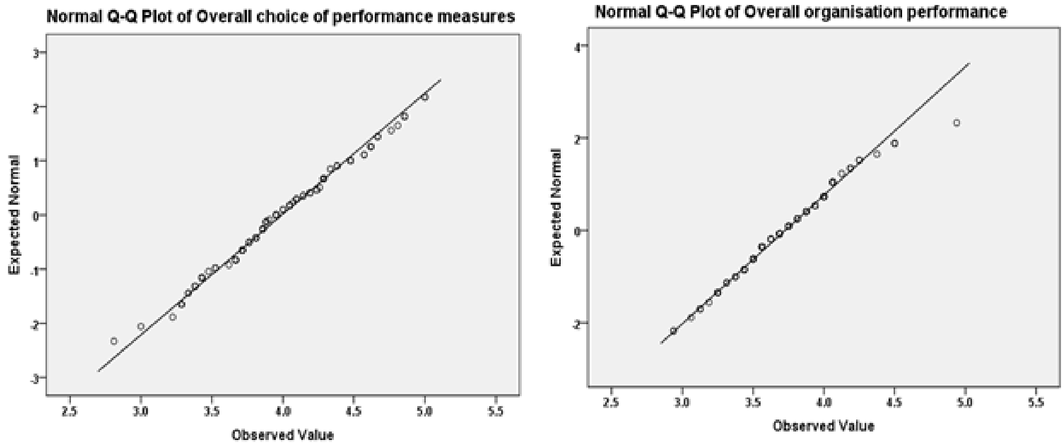

Figure 6-2: Normal Q-Q plot of the choice of performance measures and overall organisation performance

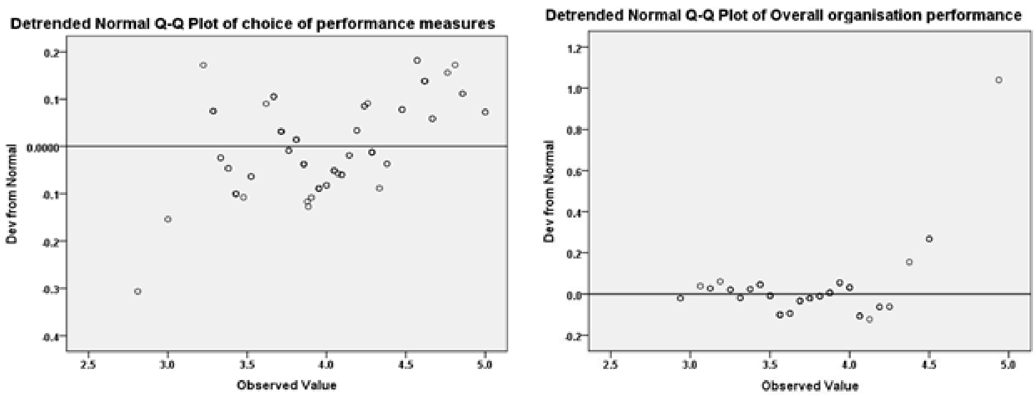

Figure 6-3: Detrended Normal Q-Q plot of the choice of performance measures and overall organisation performance

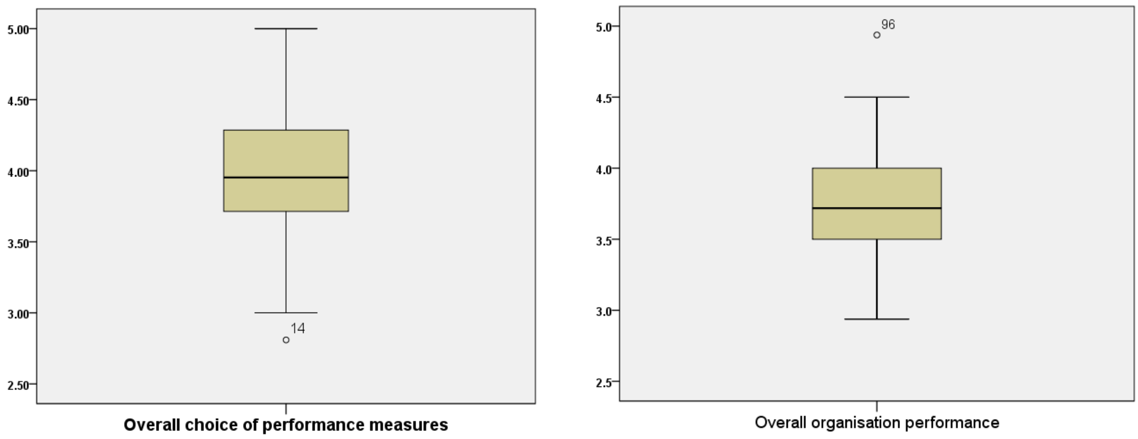

Figure 6-4: Box plot of the choice of performance measures and overall organisation performance

Table 6.3 presents the statistical result of the normality assessment based on Kolmogorov-Smirnov and Shapiro-Wilk tests for overall choice of performance measures and overall organisation performance. For K-S statistics, both constructs indicate that normality is assumed with a value of 0.2 and 0.67, respectively. Coakes et al. (2008) stated that normality is assumed for any significance value greater than 0.05.

Table 6-3: Kolmogrov-Smirnov (KS) and Shapiro-Wilk test of normality

Descriptions	KS statistics			Shaphiro- Wilk		
	Statistics	df	Sig.	Statistic	df	Sig.
The choice of performance measures	0.65	100	0.200	0.989	100	0.62
Organisational performance	0.86	100	0.067	0.984	100	0.248

Therefore, the null hypothesis that there is no significant difference between the distribution of the data set and normal distribution cannot be rejected. At the same time, the normality was also assessed using Shapiro-Wilk test, which is known as the most powerful method for assessing normality based on Monte Carlo simulation (Razali and Wah, 2011). In the same vein as K-S test, the significance values for constructs were 0.62 for performance measures, while 0.248 overall organisation performance. Thus, normality is assumed considering both values are greater than 0.05.

Other statistical tests undertaken in this research is the observation of Kurtosis and Skewness values. The z values of kurtosis and skewness need to be in the range of +/- 1.96 to assume that the data set is normally distributed (Pallant, 2016). The z values were not directly available from the test. The data need to be computed manually by dividing the skewness and kurtosis statistics values with its standard error. Table 6.4 presents the z values for performance measures preferences and overall organisation performance. It was found that the z values for both constructs using skewness and kurtosis test were within the acceptable range. Hence, the data sets were considered to be normally distributed.

Table 6-4: Skewness and Kurtosis for performance measures and overall organisation performance

Research constructs	Skewness			Kurtosis		
	Stats.	Error	Z values	Stats.	Error	Z values
The choice of performance measures	0.057	0.241	0.23	-0.199	0.478	-0.416
Overall organisation performance	0.353	0.241	1.46	0.536	0.478	1.12

Overall, the normality assessments presented from Figures 6.1 to 6.4 and from Table 6.3 to 6.4 demonstrate that the data set met all the conditions for normal distribution. Therefore, it can be concluded that the data were taken from a normally distributed sample, and parametric test can be applied for this research (Tabachnick and Fidell, 2007). The two results presented in this thesis does not suggest that the normality assessment was only conducted on these two constructs but act as parsimony as all the variables were assessed for normality and most of the variables met the requirement of normality. The detail of normality test (Skewness and Kurtosis) value for each variable is presented in Table 6.10

6.4.3 Reliability and validity

Table 6.5 reports the Cronbach alpha values for the entire questionnaire and the major constructs in the questionnaire. The Cronbach alpha value of the entire questionnaire is 0.904, which indicates a high reliability. In addition, it can be seen that constructs such as ‘performance measures’ and ‘organisations’ performance’ show high-reliability values with 0.893 and 0.794 respectively. Also, another two constructs ‘factor influencing the choice of performance measures’ and ‘challenges in managing supply chain performance’ indicate the Cronbach alpha values of above 0.6 and close to 0.7, which are adequate. However, the Cronbach alpha values for ‘organisational strategies’ is less than 0.6 with a reading of 0.513. To improve the Cronbach alpha value, one of the items in organisational strategies is removed. The item eliminated from the questionnaire is ‘not encourage risk taking’ which has a similar meaning to ‘encourage risk taking’ which was also included in the questionnaire. This process was conducted while ensuring the theoretical aspects of this construct were not diminished by deleting this item (Field, 2009).

Table 6-5: Cronbach alpha values for major constructs in the questionnaire

Major construct	**Cronbach's alpha**	**Number of items**
The entire questionnaire	0.904	64
Organisational strategies	0.513	13
Organisational strategies 1	0.577	12
Factors influencing the choice of measures	0.656	8
Challenges in managing supply chain performance	0.658	6
Performance measures	0.893	21
Organisational performance	0.764	16

After deleting one of the items in the construct, the value of 'organisational strategies', which has been denoted by 'organisational strategies 1' has increased to 0.577, which is closer to 0.6. This value is acceptable considering the small number of items in this construct which is thirteen (13) and was based on a broadly defined construct (i.e.: four different organisations' strategies) (Forza, 2002).

6.4.4 Common method bias

This research applied Harman's single factor test which is a widely used procedure in the literature (Podsakoff et al., 2003).

Table 6.6 reports the variance on the first component resulted from the Harman's single factor test.

Table 6-6: Common method bias assessment using Harman's single method score

Harman's single factor test	**Percentage variance %**
Component 1	17.933%

Any value of percentage variance of first component that is less than 50% indicates that there is no significant bias effect on the survey instrument (Podsakoff et al., 2003). Hence, the percentage variance of 17.933% in this analysis proves that this research was not significantly affected by the common method bias.

6.4.5 Non-response bias

The independent sample t-test was adopted in this research for 1st and 2nd wave respondents from the UK and Malaysia. The t-test is commonly used to compare the mean scores between two groups where a significant difference in the mean between two groups can be identified (Pallant, 2016). The detail on t-test considerations has been discussed in Chapter 4. The attributes computed for wave analysis were demographics information (turnover rates, the number of employees), overall organisational performance, and organisational strategies (prospector, analyser, defender, and reactors).

Table 6.7 and 6.8 present the wave analysis to test external validity for non-response bias for questionnaires from the UK and Malaysia, respectively. In these tables, 1st and 2nd wave show the mean scores information for each group.

The Levene test shows the equality of variance, 2 tailed sig. provides significant difference values, and df details outline the degree of freedom. It can be seen from the Levene test in Table 6.7 that all the significant values exceeded 0.05 with the exceptions of turnover rates and reactors (Pallant, 2016). Therefore, based on the exception of these two attributes (reactors and turnover), the assumption of homogeneity of variances may be assumed for all other constructs.

Based on the Levene test values, the first-row readings of the 2-tailed sig. were applied for employees, overall organisation performance, prospector, analyser, and defenders. Meanwhile, the second row reading of the 2-tailed sig. were applied for turnover and reactors due to the violation of homogeneity of variances for these two constructs. The readings of 2 tailed sig. for all the constructs exceeded 0.05 suggesting that there is no significant difference between the 1st wave (participants that willing to response) and the 2nd wave (non-response organisations). Therefore, based on the results of the Levene test and 2 tailed sig., it can be concluded that the survey in the UK was not affected by non-response bias and conforms to a high level of validity.

Table 6-7: Wave analysis to test external validity for non-response bias (UK).

Research constructs	1st Wave	2nd Wave	Levene test	2 tailed sig.	df
Turnover	1.58	2.17	0.039	0.93 0.94	59 55.2
Employees	1.73	2.25	0.095	0.214 0.218	56 51.8
Overall organisation performance	3.74	3.65	0.935	0.297 0.297	59 59
Prospector	3.22	3.07	0.273	0.335 0.333	59 57.3
Analyser	3.29	3.49	0.383	0.215 0.214	59 57.6
Defenders	3.46	3.56	0.16	0.526 0.524	59 55
Reactors	3.71	3.67	0.037	0.875 0.874	59 48.7

Table 6.8 reports wave analysis for questionnaire in Malaysia where all the attributes show value of more than 0.05 in the Levene test.

Table 6-8: Wave analysis to test external validity for non-response bias (Malaysia)

Research constructs	1st Wave	2nd Wave	Levene test	2 tailed sig.	df
Turnover	8.45	7.26	0.077	0.117 0.123	37 29.37
Employees	2.15	2.26	0.193	0.78 0.78	37 35.1
Overall organisational performance	3.7	3.84	0.931	0.25 0.25	37 36.3
Prospector	3.28	3.52	0.436	0.141 0.143	37 35.5
Analyser	3.41	3.63	0.974	0.09 0.089	37 37
Defenders	3.33	3.67	0.055	0.526 0.524	37 34.2
Reactors	3.75	3.58	0.067	0.427 0.423	37 32.5

This observation suggests that homogeneity of variance was assumed in all cases. Thus, the first rows of 2tail sig. readings and df were applied. Accordingly, all the values of 2 tailed sig. were observed to be more than 0.05. This implies that the null hypothesis cannot be rejected. The null hypothesis stated that there is no significant difference between the first group (willing to participate) and the second group (non-response organisation). Similar to the UK case, the external validity for the survey in Malaysia was satisfied and is considered to be not affected by the non-response bias

6.5 Descriptive statistics

This section presents the demographic profiles of the respondents and distribution statistics of the research variables as in Table 6.9. The table depicts the demographic characteristics of the respondents. These characteristics include the size of company, designations of respondents, company annual turnover, major business sector, and the number of respondents based on country.

6.5.1 The size of organisation

The size of an organisation is normally indicated by the number of employees and the annual turnover rate. However, the classification of organisation into small-medium-sized organisation, medium-sized organisation, and large-sized organisation is influenced by the nature of the business and the country of operations. In the UK, an organisation that has less than 50 employees is categorised as a small-sized organisation, 51 – 250 employees in the small-medium size category, and mid-sized organisation accounts for the workforce in the range of 251-500 people. Meanwhile, a large organisation refers to an organisation with more than 500 employees (Department for business and innovation skill, 2012).

In Malaysia context, a small-sized organisation refers to an organisation that employs less than 50. A medium-sized organisation is defined to possess more than 51 but less than 250 employees. A large organisation is the one that has more than 250 people (Bank Negara Malaysia, 2005). It can be observed in Table 6.9 that a majority of the respondents in this survey is categorised under small-sized organisation accounting for 50 % out of the total surveyed companies. A total of 12% of the surveyed organisations has employees in the range of 201 – 500 staff. Meanwhile, 16% of the surveyed organisations have more than 500 workforces.

Table 6-9: Demographic characteristics of respondents

Total number of respondents	Frequency	Percentage
Size by number of employees		
Less than 50	50	50%
51 -200	19	19%
201 – 500	12	12%
501 – 1500	8	8.0%
1501 – 3000	3	3.0%
Above 3000	5	5.0%
Total	97	97%
Designation of respondents		
MD/ CEO/ CFO/ Director	29	30.5%
Manager: Supply chain & contracts	15	15.8%
General Manager/ Country Manager/ Business Development	11	11.6%
Manager	11	11.6%
Manager: Technical / Operations	12	12.7%
Executive: Procurement/ Contracts specialist	10	10.5%
Engineer: Project/ Process/ Cost	5	5.3%
Executive	2	2.1%
Others: Port development advisor/ Marine consultant		
Company annual turnover UK (£ million)		
Less than £25million	42	42%
£26million - £50million	5	5%
£51million - £100million	4	4%
£101million - £500million	8	8%
> £500million	4	4%
Company annual turnover Malaysia (MYR million)		
Less than MYR 20million	11	11%
MYR 21million - MYR50million	4	4%
MYR 51million - MYR 100million	2	2%
MYR101million - 500million	5	5%
>MYR500million	15	15%
Major business sectors		
Exploration and production	20	13.6%
Marine and subsea services	25	17%
Energy consultancies including geographical consultancies	12	8.2%
Transportation, storage, logistics, catering and allied services	17	11.6%
Well and drilling services	13	8.8%
Engineering services, facilities management, structure designs and fabricators	39	26.5%
Refining, refined oil distribution and marketing	13	8.8%
Other services:		
Decommissioning	3	2%
Repair and Maintenance	2	1.4%
Trading and supply	3	2%
Country		
UK	62	61.4%
Malaysia	38	38.6%

The distribution of the respondents is spread across small-sized towards large-sized organisations. However, 81% of the total respondents in the survey are categorised as small and medium-sized companies (less than 500 employees). This finding is in line with the findings from previous research by Yusuf et al., (2014) where 75% of their respondents from oil and gas organisations in the UK are comprised of small and medium-sized companies.

Apart from that, another way of determining company size is by observing the average turnover. A small-sized company in the UK is defined as a company with an annual turnover rate of less than £25million, a medium-sized company with the turnover in the range from £26 to £500 million. A company with a turnover rate of more than £500million are referred to as a large company (Department for business and innovation skill, 2012). Table 6.9 depicts that the small companies in the UK (less than £25million) represents 42% of the total population while large companies (more than £500 million) only consist of 4% out of all companies involved in this survey.

In contrast, a majority of the companies from Malaysia (15% of the surveyed organisations) was from large companies (turnover rate > than MYR 500million). The next highest group (11% of the total organisations) was from small companies with turnover rates of less than MYR 25million.

The spectrum of the observed population between UK and Malaysia is slightly different in terms of the distribution of companies in their size based on turnover rates. Overall, a majority of respondents from both countries (80%) were from the small and medium scale companies (< £500 million for UK) and (< than MYR500 million for Malaysia). This result illustrates the same trend for organisations' classification based on the number of employees.

6.5.2 Designation

The designations of the respondents in the survey were reported in Table 6.9. Around 30% of the respondents are represented by top management (MD, CEO, CFO, and Director). Despite addressing the survey to the top management, some of the surveys were reassigned to other respective personnel, most likely due to their tight responsibilities. However, this reassignment would not affect the analysis in the account that the appointed personnel were chosen by the top management to provide the information for this survey. Moreover, around 70% of the respondents were from managerial level or above, with another 30% were from various professional levels. Therefore, it can be concluded that the characteristics of respondents for this survey would suffice to provide the information sought for this research.

6.5.3 Major business sectors

Table 6.9 also describes the major business sectors of the respondents. They were given the options to choose more than one sector in which their companies are involved in. Overall, majority of the responding companies (26.5%) are involved in 'Engineering services, facilities management, structure designs and fabricators' and are followed by 'Marine and Subsea services' (17%). 'Exploration and Productions' reports about the same proportions with 'Transportation, storage, logistics, catering and allied services' sector with 13.6% and 11.2% respectively. Another three sectors which are 'Energy consultancies including geographical consultancies', 'Well and drilling services', and 'Refining, refined oil distribution and marketing' record the same distributions of about 8% for each of the participating organisations. Additionally, respondents from business sectors that was not listed in the questionnaire are relatively small (around 2%).

The findings show the same trend in terms of proportions with the number of companies according to business sectors as reported in 'Review in the UK oilfield services industry' by Ernst and Young (2016). Moreover, as in the UK, many oil and gas companies in Malaysia are also involved in the 'Engineering services, facilities management, structure designs and fabricators' due to high demands in this sector. Furthermore, apart from the local project, most of the international jobs awarded to Malaysia companies in this sector will be locally fabricated (Candiah, 2005). Thus, the demographic of respondents according to business sectors are considered true to the actual context of the oil and gas industry in the UK and Malaysia.

6.5.4 Descriptive statistics of research variables

Table 6.10 shows the resulting mode, frequency, means, standard deviations, and also skewness and kurtosis for each item in the research variables.

Table 6-10: Descriptive statistics of research variables

	RESEARCH VARIABLES	Mode	Freq.	Mean	SD.	Skew	Kurt.
Organisational strategies Overall mean 3.37	Focus on single market segments	3	30	2.6	1.23	.345	-.740
	Not encourage risk taking	3	34	2.94	1.17	.002	-.719
	Encourage risk taking	3	30	2.9	1.07	-.149	-.810
	Search for new market with new growth opportunities	4	50	4.15	0.796	-.89	.717
	Lead the market in introducing new product/ services	4	35	3.39	0.994	-.161	-.614
	Focus on maintaining stable growth	4	70	3.89	0.68	-1.228	3.672
	High degree of centralisation	3	41	3.38	0.896	-.331	.26
	Have a market niche with a limited range of products	3	32	3.11	1.22	-.045	-.85
	Relatively stable product market	4	42	3.23	0.983	-.748	.1
	Priority is on maintaining current markets	4	49	3.43	0.832	-.525	-.179
	Moderate emphasis on innovation	3	40	3.05	0.999	-.164	-.324
	Tight cost control	4	40	4.05	0.903	-.941	1.123
	Strategy based around reacting to change in the market place	4	47	3.68	0.92	-.825	1.191
Determinant factors Overall mean 3.95	Company objectives	4	57	4.18	0.702	-.803	1.233
	Requirement of local content	4	44	3.37	0.914	-.662	.273
	Role of company in supply chain	4	45	3.45	0.936	-.644	.341
	Profitability potential	4	65	4.07	0.655	-.951	3.951
	Desire for safety	5	53	4.4	0.791	-1.847	5.171
	Company reputation	4	50	4.38	0.663	-1.453	5.373
	Risk mitigations	4	53	4.05	0.744	-.534	.222
	World oil prices per barrel	4	39	3.7	1.132	-.738	-.198
Challenges Overall mean 3.45	Lack of data consistency	3	44	3.14	0.829	-0.6	.102
	Lack of inter-departmental cooperation	3	44	2.9	0.937	-.169	-.185
	Compliance with local content requirement	3	41	3.01	1.01	-.321	-.182
	Instability of world oil prices	4	32	3.75	1.12	-.707	-.11
	Need for fast completion at minimal cost	4	53	3.95	0.88	-1.078	1.647
	The need to manage urgency at minimal cost	4	52	3.96	0.8	-.761	1.171

Table 6-10 (CONTINUED): Descriptive statistics of research variables

RESEARCH VARIABLES		Mode	Freq	Mean	SD.	Skew.	Kurt.
Performance measures Overall mean 3.99	Cost savings	5	45	4.33	0.711	-.922	.827
	Return on investment	4	53	4.18	0.687	-.439	-.074
	Accuracy of schedule	4	57	4.08	0.734	-.755	.945
	Timeliness	4	59	4.21	0.656	-.685	1.273
	Product/ services reliability	4	48	4.39	0.6	-.438	-.618
	Supplier reliability	4	57	4.09	0.754	-1.018	2.42
	Flexibility in meeting customers' needs	4	45	4.29	0.729	-.511	-.963
	Supplier flexibility	4	50	3.92	0.8	-.579	.794
	Products/ services quality	5	55	4.48	0.674	-1.745	5.857
	Forecast accuracy	4	57	3.85	0.77	-.546	.274
	Process compliance	4	49	4.14	0.752	-.824	1.683
	Number of innovation ideas generated	4	39	3.45	0.89	-.327	.57
	Innovation in operations	4	40	3.59	0.865	-.223	-.084
	Technology innovations	4	37	3.62	0.94	-.345	-.065
	Environmental pollutant control	4	43	3.88	1.017	-.986	.854
	Reduction of waste	4	48	3.68	0.963	-.839	.8
	Safety compliance	5	63	4.59	0.57	-1.029	.089
	Safety training	5	46	4.29	0.795	-1.187	2.005
	Supplier compliance on social responsibilities policy	4	42	3.58	0.966	-.712	.762
	Ethical business	4	45	4.12	0.795	-.589	-.181
	Investment in charitable programmes	3	48	3.08	0.976	-.298	.128
Organisation performance Overall mean 3.73	Cost savings have improved	4	52	3.97	0.758	-.375	-.145
	Return of investments have increased	3	45	3.19	0.873	-.196	.019
	Delivery speed are managed properly	4	56	3.688	0.634	-.103	-.082
	Planned schedule can be met	4	66	3.75	0.609	-.632	.875
	Company delivery is reliable	4	67	4.05	0.626	-.540	1.459
	Supplier delivery reliability has	4	47	3.47	0.758	-.464	.401
	Company is flexible on supply chain strategies	4	49	3.73	0.84	-.498	.351
	Company is flexible on operation	4	55	3.78	0.746	-.360	.052
	Number of product/ services defects have decreased	3	41	3.5	0.859	-.098	-.127
	Innovation of products/ services are part of company's culture	4	42	3.65	0.947	-.480	-.009
	Innovation of systems of works is part of company's culture	4	47	3.72	0.944	-.659	.232
	Corporate social responsibilities programme has increased	3	52	3.32	0.827	-.224	.827
	Company strategies always consider that environmental aspects are protected	4	59	3.95	0.687	-.317	.194
	Safety has become company's culture	5	54	4.49	0.595	-.697	-.459
	Forecast are highly accurate	4	44	3.5	0.759	-.283	.476
	Process compliance of your company are properly managed	4	58	3.87	0.661	-.632	-.200

The mode describes the highest rated scale by the surveyed organisation while frequency provides the number of organisations which rated that mode. Accordingly, the value of the mean was also computed to obtain the average scores of each item. Measures of dispersions on variables measured from the standard deviations information are also shown in this table. From the skewness and kurtosis data, none of the values is too high which indicates the data are well-distributed. Overall, this descriptive statistic illustrates respondents' perceptions on their organisations' strategies, their choice of performance measures, and determinant factors in choosing performance measures. It also provides information on the challenges in managing supply chain performance and their organisations' performance. All of these constructs were assessed by a five-point Likert scale that ranges from very low to very high and strongly disagree to strongly agree for some questions.

6.6 Inferential statistics

To further explore the relationship between variables of this research, inferential statistics were conducted. These consists of correlation analysis to investigate the link between variables. Also, regression analysis is conducted to study the cause effect relationship between variables and clustered variables. Prior to inferential statistical analyses, t-test on major constructs and factor analyses were conducted.

6.6.1 t-test on major constructs

As sample populations in this research were taken from two different geographical locations, the United Kingdom and Malaysia, t-test was executed to examine if there is any significant difference in the responses. A t-test was conducted for demographic information including turnover rates, the number of employees, organisational strategies, overall organisational performance, and seven clustered performance measures which are innovation, safety and process compliance, financial measures, environmental and social responsibility, quality, supplier reliability, and delivery schedules.

Table 6-11 presents the result of the t-test conducted between two countries, UK and Malaysia. In this table, columns for UK and Malaysia provide mean score information for each group. Levene test reports equality of variance, 2 tailed sig. provides significant difference values, and *df* details the degree of freedom.

Table 6-11: t- test on demographic information and major constructs between UK and Malaysia

Major construct	**UK**	**Malaysia**	**Levene test**	**2 tailed sig.**	**df**
Turnover	1.87	3.13	0.00	.00 .00	98 65.85
Employees	1.98	2.21	0.409	0.46 0.439	95 92.5
Prospector	3.148	3.397	0.168	0.031 0.025	59 57.3
Analyser	3.39	3.52	0.03	0.257 0.214	59 57.6
Defenders	3.41	3.49	0.48	0.498 0.485	59 55
Reactors	3.69	3.67	0.024	0.908 0.899	59 48.7
Overall organisational performance	3.7	3.77	0.725	0.342 0.344	98 79.86
Innovation	3.45	3.71	0.689	0.105 0.106	98 80.74
Safety compliance	4.34	4.33	0.605	0.936 0.935	98 84.99
Financial	4.26	4.24	0.085	0.877 0.87	98 93.91
Environmental and social responsibility	3.59	3.8	0.419	0.138 0.129	98 87.65
Quality	4.46	4.28	0.486	0.102 0.109	98 76.32
Supplier reliability	3.93	4.13	0.207	0.159 0.128	98 97.46
Delivery schedule	4.01	4.1	0.942	0.452 0.449	98 82.9

From the Table 6-11, Turnover and Prospector have 2 tailed significance values of of less than 0.05. The rest of the constructs and variables in the Table have Levene test values of more than 0.05. Therefore, based on the values of Levene test for the majority of the constructs and variables, the assumption of homogeneity of variances can be presumed (Pallant, 2016). This implies the null hypothesis that there is no significant difference between the UK and Malaysia cannot be rejected. Thus, separate analysis for individual countries was not required.

6.6.4 Factor Analysis

This research applied principal component analysis as the method of extractions. It was performed for performance measures (containing 21 items) and organisational strategies (containing 12 items). Varimax with Kaiser Normalisation were used as the rotation method. Table 6-12 depicts the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) value of 0.787 which is above 0.5 and that the Bartlett's test is 0.000 (less than 0.05). Therefore, the sample data is deemed suitable for factor analysis.

Table 6-12: KMO and Bartlett's Test for performance measures preferences

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	.787
Bartlett's Test of Sphericity.(Sig.)	.000

Table 6-13 presents the outcome of the principal component analysis for the choice of performance measures.

Table 6-13: Outcome of principal component analysis

Component 1	Component 2	Component 3	Component 4	Component 5	Component 6
PM 13: (0.840) Innovation in operations PM 12: (0.834) Number of innovation ideas generated PM 14: (0.796) Technology innovations	PM 17: (0.851) Safety compliance PM 18: (0.76) Safety training and development PM 11: (0.57) Process compliance	PM1: (0.71) Cost saving PM2: (0.702) Return on investment PM3:(0.585) Accuracy of schedule PM 4: (0.583) Timeliness PM10: (0.568) Forecast accuracy	PM7: (0.777) Flexibility in meeting customers' needs PM5: (0.695) Product/ services reliability PM9: (0.697) Products/ services quality	PM 19: (0.82) Supplier compliance on social responsibilities policy PM16: (0.573) Reduction of waste PM 21: (0.525) Investment in charitable programmes PM 15: (0.53) Environmental pollutant control	PM8: (0.775) Supplier flexibility PM 6: (0.719) Supplier reliability PM20: (0.539) Ethical business and trading

Six components were yielded from this exercise. This pinpoints which performance measures are appropriate to be in the same components based on their scores. In addition, the outcome of this analysis shows that the survey instrument was well-constructed as it classified subscales of the same factor in the same component.

Nevertheless, the components were re-assigned into clusters based on the literature on performance management. The components were categorised into four main aspects of performance as tabulated in Table 6-14. These are: financial measures, operational measures, safety and environmental measures, and social responsibility measures. These components were used as the independent variables in the multiple regression analysis in the next section.

Table 6-14: Performance measures preferences

Component 1 Financial measures	**Component 2** Operation measures	**Component 3** Safety and environment	**Component 4** Social responsibility measures
PM1: Cost saving PM2: Return on investment PM10: Forecast accuracy	PM3: Accuracy of schedule PM4: Timeliness PM5: Product/ services reliability PM 6: Supplier reliability PM7: Flexibility in meeting customers' needs PM8: Supplier flexibility PM9: Products/ services quality PM 11: Process compliance PM 12: Number of innovation ideas generated PM 13: Innovation in operations PM 14: Technology innovations	PM15: Environmental pollutant control PM16: Reduction of waste PM 17: Safety compliance PM 18: Safety training	PM 19: Supplier compliance on social responsibilities policy PM20: Ethical business PM 21: Investment in charitable programmes

Table 6-15 reports the results from the KMO and Bartlett's test for organisational strategies. It can be observed that the value of KMO is 0.57 which is adequate (Field, 2013). Any value less than 0.5 is considered as not acceptable. Subsequently, the Bartlett test shows a value of 0.00 (less than 0.05) which is significant.

Table 6-15: KMO and Bartlett's Test for organisational strategies

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	.57
Bartlett's Test of Sphericity. (Sig.)	.000

Table 6-16 depicts the outcome of factor analysis of organisation strategies. There are four components that are derived from this analysis which represent variables that belong to the same factor.

Table 6-16: Outcomes of factor analysis

Component 1	Component 2	Component 3	Component 4
S4: (0.801) We search for new markets with new growth opportunities S5: (0.657) We lead the market in introducing new product/ services S6: (0.499) We focus on maintaining stable growth	S7: (0.511) We have a high degree of centralisation S12: (0.770) We have tight cost control S13: (0.730) Our strategy is based around reacting to change in the market place	S9: (0.821) A relatively stable product market S10: (0.680) Our priority is in maintaining current markets	S1: (0.778) We focus on single market segments S8: (0.783) We have a niche market with a limited range of products

Based on the outcomes of these four components, organisation strategies were classified as Prospector, Analyser, Defender, and Reactor based on the basis of the most dominant attributes in each group. This is where theoretical considerations were used to interpret the outcomes of factor analysis. Table 6-17 is derived based on the most dominant attributes for each factor. The outcomes of this analysis will be used for the correlation and regression analyses.

Table 6-17: Organisational strategies based on factor analysis

Prospector	Analyser	Defender	Reactor
S4: We search for new markets with new growth opportunities S5: We lead the market in introducing new product/ services S6: We focus on maintaining stable growth	S9: A relatively stable product market S10: Our priority is in maintaining current markets	S1: We focus on single market segments S8: We have a niche market with a limited range of products	S7: We have a high degree of centralisation S12: We have tight cost control S13: Our strategy is based around reacting to change in the marketplace

6.7 Relationship of the main constructs of the research

This section presents correlation between the major constructs of the research. The correlation analysis is performed to investigate the degree of associations between variables. There are three correlation analyses between research constructs that will be presented here. These include organisational classifications and the choice of performance measures, organisational classifications and organisational performance, and performance measures and organisational performance

6.7.1 Relationship between organisational classifications and the choice of performance measures

The organisation classifications studied in this research were based on organisational fit theory Miles and Snow (1978) and organisational sizes based on: number of employees and turnover. The Miles and Snow (1978) suggest that an organisation can be classified into four main strategies; Prospector, Analyser, Reactor, and Defender. According to Miles and Snow (1978), organisation strategies influence the way organisations are managed. This also includes their choice of performance measures. Therefore, each strategy is likely to approach performance measures differently and eventually lead to different organisational performance outcomes (Wronka-Pośpiech and Frączkiewicz-Wronka, 2016). For this reason, this section will present descriptive statistics of organisational strategies and performance measures. Previous researchers suggest that there is an association between organisations' strategies and its performance (Miles and Snow., 1978; Mintzberg, 1989; Parnell and Wright, 1998). However, our interest here is the association between organisational strategies and the choice of performance measures. A correlation analysis was employed to empirically test the theory that organisation classifications based on strategies influence their choice of performance measures. In addition, the correlation analysis was conducted to investigate the link between organisational classification based on sizes and the choice of performance measures.

6.7.1.1 Mean value of organisational strategies

Miles and Snow (1978) argue that organisations' adaptation is a way of managing the relationship between an organisational strategy and its external environment. The internal resources must be aligned with these strategies to enhance organisational performance. The organisational strategies in this study consist of 13 attributes, which represent four main strategies, namely, Prospector, Defender, Analyser, and Reactor. For this construct, participants were asked to rate from 1 to 5 on their level of agreement on the organisational strategies statements (Appendix I). Based on Table 6-10, out of the 13 attributes, the highest mean result is 'search for new markets with new growth opportunities' with a mean value of 4.15 while the lowest mean is 'focus on single market segments'. This returned a mean value of 2.6. On the other hand, the highest strategy was Prospector with a mean value of 3.8. Table 6.18 presents the four organisational strategies and their attributes, which were derived from the factor analysis in Section 6.5.4.

Table 6-18: Descriptive statistics for organisation strategies

Strategies	Organisational strategies attributes	Mean	Std. dev.	Mode	Freq.
Prospector	S4: We search for new markets with new growth opportunities S5: We lead the market in introducing new product/ services S6: We focus on maintaining stable growth	3.8	0.63	4	55
Analyser	S9: A relatively stable product market S10: Our priority is in maintaining current markets	3.33	0.74	4	59
Defender	S1: We focus on single market segments S8: We have a niche market with a limited range of products	2.85	1.01	3	43
Reactor	S7: We have a high degree of centralisation S12:We have tight cost control S13:Our strategy is based around reacting to change in the marketplace	3.7	0.66	4	55

It can be observed that only 10 strategies' attributes were presented in Table 6-18 as some attributes were eliminated through the factor analysis. The table also suggests that Prospector is found to have the highest mean (3.8) and is followed by Reactor (3.7), Analyser (3.33) while Defender indicates the lowest mean of 2.85.

The mean values suggest that this industry is dominated by Prospector and is followed closely by Reactor. The high mean of Reactor in this industry seems surprising since prior empirical evidence of other industries illustrate a slightly lower number of this strategy in comparison to other three organisational strategies (Desarbo et al., 2005; Helmig et al., 2014). Despite that, a recent study by Pośpiech and Wronka (2016) involving public entities indicates a domination by organisations that adopted Reactor strategy. They contend that the characteristics of public entities that demonstrate high reliance on government regulations influence the result. In line with this, Miles and Snow (1978) suggest that Reactor can only survive in a 'protected environment' such as monopolistic and highly regulated industry. One possible explanation for these restrictions is the local content requirement set by the local government. The local content requirements in the developed countries focusing on the environmental protections and socially responsible practices. In the developing countries, apart from environmental protections and socially responsible practices, there are some regulations set by the local government to procure services or products from local suppliers. From companies' perspective, this may reduce the selection of suppliers and eventually limits organisations way of strategising their organisation. The following extracts from interviews with supply chain experts further explained the situation;

"Here in Malaysia, the government objective is to maximise local participation. By doing that, you demarcated your market. Instead you can go global, your market became narrower." [Participant D]

"The local content required us to deal with the local supplier where most of them are the middle person and do not have sufficient knowledge on product or services they provided." [Participant C]

"In my opinion, the following also applies when companies are working in a developed country such as the USA. Companies do not want to have environmental

issues, do not want to have oil spills, and do not want to have safety incidents. So, I think that has the big impact on companies. I think those factors are more important than cost and schedule. I mean, companies should be socially responsible, should protect the environment, and should operate safely" [Participant B]

"The local content can also be important in a developed country. This requirement includes to hire suppliers and workers from the country in operation". [Participant B]

6.7.1.2 Mean values of performance measures

In this section, participants were asked to rate the level of importance of the performance measures in their companies from very low to very high (Appendix I). The finding shows that four attributes have a mode of five (very high), namely, cost saving, product/services quality, safety compliance, safety trainning. Accordingly, the performance measures were ranked based on the mean values as in Table 6-19.

Safety compliance was found to be the most important performance measure with a mean of 4.59. This is then followed by services/ product quality with a mean of 4.48 and product and services reliability (4.39). This is in line with previous research on performance measurement which suggests that customer satisfaction is the main focus of the organisation. Literature suggests that quality and reliability are the main components in achieving customer satisfaction (Chen et al., 2013; Varma et al., 2008b; Gunasekaran et al., 2004).

Even though safety compliance was not widely discussed in previous research, it is recognised as the most important measure in the oil and gas industry. This is due to the nature of this industry that often encounters high exposure of risks. Not only that, safety compliance is important in enhancing customers' perspectives of the oil and gas companies. Despite internal driver to have safety as an organisation priority, this measure is also driven by various external factors. In particular, the local content requirement by the government, stakeholders' expectation, and social responsibility pressure driven by non-government organisations. These three important parties are considered as customers for this industry. In essence, safety compliance is a measure motivated by both internal and external factors.

Table 6-19: Performance measure based on the level of importance

Ranking	Performance measures	Mean	SD	Mode	Frequency
1	Safety compliance	4.59	0.57	5	63
2	Product/ services quality	4.48	0.674	5	55
3	Product/ services reliability	4.39	0.6	4	48
4	Cost saving	4.33	0.711	5	45
5	Flexibility in meeting customers' needs	4.29	0.729	4	45
6	Safety training	4.29	0.795	5	46
7	Timeliness	4.21	0.656	4	59
8	Return on investment	4.18	0.687	4	53
9	Process compliance	4.14	0.752	4	49
10	Ethical business	4.12	0.795	4	45
11	Supplier reliability	4.09	0.754	4	57
12	Accuracy of schedule	4.08	0.734	4	57
13	Supplier flexibility	3.92	0.8	4	50
14	Environmental pollutant control	3.88	1.017	4	43
15	Forecast accuracy	3.85	0.77	4	57
16	Reduction of waste	3.68	0.963	4	48
17	Technology innovations	3.62	0.94	4	37
18	Innovation in operations	3.59	0.865	4	40
19	Supplier compliance on social responsibilities policy	3.58	0.966	4	42
20	Number of innovation ideas generated	3.45	0.89	4	39
21	Investment in charitable programmes	3.08	0.976	3	48

Also, it can be observed that cost savings was ranked fourth. This was rather conflicting with findings from previous research on performance management in the oil and gas industry. Yusuf, Musa, et al., (2014) studied the agility in the oil and gas industry found that organisations perceived competing through cost as their least consideration. The nature of huge profit in this industry has caused this factor to be considered as not crucial in attaining competitive edges. Thus, the focus on cost measure in this study might be driven by the current drop of oil prices. The exploratory interview in **Chapter 5** with the oil and gas practitioner concurred this as shown in the following extracts;

"When the price of oil dropped, say what we have today 50$ per barrel range, you see the shifting of more emphasis on the cost side." [Participant B]

"Nowadays, since the world's oil price is very low, we are trying very hard. There are a lot of areas that we have to squeeze. One thing, for example, a lot of time we never care less about the brand that we purchase, if we normally use a certain brand, we just go for that. Nowadays, the oil and gas price have dropped a lot; we started looking for cheaper other options." [Participant D]

"In the current dropped of oil price per barrel, we got to really manage our cost and to get more job for the company to sustain. In this case, we have to change our sourcing strategy, choose different vendors or equipment in order to get a better price." [Participant E]

The previous extracts from three supply chain experts signify that cost savings are not part of their performance measurement concern despite there are improvements in the area. The current oil environment has left the oil and gas industry no choice but to emphasise on cost savings measures.

On the other hand, the least important performance measure was 'Investment in charitable events'. The distribution of respondents' organisation based on the annual turnover could explain this finding where the majority of them were small and medium companies. Therefore, they might have a limited financial budget for the charity investments. Moreover, current oil prices may also affect their financial allocation for the charitable events.

The table also suggests that most of the innovation measures were ranked among the least important performance measures. Technology innovation was ranked 17th by the participants. These are followed by innovation in operations (ranked 18th) and number of generated innovation ideas (ranked 20th). Unlike other industries such as automotive, electronic, and fashion industry (Sukwadi et al., 2013), the final products/ services of the oil and gas industry have very minimal differentiation (Chima and Hills, 2007). Therefore, this might suggest why the innovation measures were less popular in this industry.

In addition, supplier compliance on the social responsibilities measure was ranked 19th. The reason for the low rank is that this measure was considered less important and might be due to the fact that participating organisations were dominated by small and medium-sized organisations. There is less involvement of suppliers appointed by this kind of organisation which made this measure not relevant to them.

The descriptive results of the performance measures of the industry which ranked from the most important to the least important have answered the first research question;

R1: What is the prevalence of performance measures in the oil and gas industry?

6.7.1.3 Correlation between organisational strategies and the choice of performance measures

Bivariate correlation analysis was conducted to understand the association between organisational strategies and the choice of performance measures. This correlation involves four organisational strategies and twenty-one (21) performance measures. Prior to correlation analysis, the scores of each organisational strategy attributes of four strategies were aggregated and the mean values were computed using SPSS. Thereafter, correlation analysis was conducted and the outcomes of analysis were discussed in this section. Parnell and Wright (1998) propose that organisational strategies influence the way organisation perform their businesses and eventually enhance their overall organisational performance. This includes their choice of performance measures. The result of the correlation analysis in Table 6-20 illustrates the level of association between these two constructs. It presents which organisational strategy correlates to which performance measure. The degree of the correlation is also indicated.

Table 6-20 revealed that there is a correlation between organisational strategies and the choice of performance measures. Prospector and Reactor were correlated with more performance measures in comparison to Analyser and Defender.

Table 6-20: Correlation between organisational strategies and performance measures

Strategies / P. Measures	Prospector	Analyser	Defender	Reactor
PM1 Cost savings	NSC	NSC	NSC	0.267**(0.007)
PM2 Return on investment	NSC	NSC	NSC	0.245*(0.014)
PM3 Accuracy of schedule	0.264**(0.008)	NSC	NSC	
PM4 Timeliness	0.212*(0.035)	NSC	NSC	0.199*(0.047)
PM5 Product/ services reliability	0.406**(0.00)	NSC	NSC	0.348**(0.000)
PM6 Supplier reliability	NSC	0.318**(0.001)	NSC	0.203*(0.043)
PM7 Flexibility in meeting customers' needs	0.231*(0.021)	NSC	NSC	0.320**(0.001)
PM8 Supplier flexibility	0.21*(0.036)	NSC	NSC	0.293**(0.003)
PM9 Products/ services quality	0.240*(0.016)	0.266**(0.008)	NSC	0.269**(0.007)
PM10 Forecast accuracy	0.344*(0.00)	NSC	0.321**(0.001)	0.382**(0.000)
PM11 Process compliance	0.221*(0.027)	NSC	NSC	0.316**(0.001)
PM12 Innovation ideas generated	0.445**(0.00)	NSC	NSC	NSC
PM13 Innovation in operations	0.542**(0.00)	NSC	NSC	0.251*(0.012)
PM14 Technology innovations	0.518**(0.00)	NSC	0.206*(0.040)	0.269**(0.007)
PM15 Environmental pollutant control	0.301**(0.002)	NSC	NSC	NSC
PM16 Reduction of waste	0.304**(0.002)	NSC	NSC	NSC
PM17 Safety compliance	NSC	NSC	NSC	NSC
PM18 Safety training	0.333**(0.001)	NSC	NSC	0.197*(0.049)
PM19 Supplier compliance on social responsibilities policy	0.272**(0.006)	NSC	NSC	NSC
PM20 Ethical business	0.275**(0.006)	NSC	NSC	NSC
PM21 Investment in charitable programmes	0.307**(0.002)	NSC	NSC	NSC

*Correlation is significant at .05 levels (2-tailed). **Correlation is significant at .01 levels (2-tailed). NSC: No significance correlation

Looking at Prospector, it was correlated with seventeen performance measures. Out of these measures, it was highly correlated with innovation measures which are innovation in operation, technology innovation, and innovations idea generated. The correlation values for each measure are 0.542, 0.518, and 0.445 accordingly at a significance level of 0.00. As expected, the strategy adopted by the organisations influenced the choice of performance measures of that organisation. Prospector consists of three attributes which are search for a new market with new growth opportunities, lead the market in introducing new product/ services, and focus on maintaining stable growth. In essence, the company that adopted this strategy is focusing on innovating new products or services to be introduced into the market. Helmig et al. (2014) contend that innovation can create a competitive advantage for the organisation in a high turbulence environment. Thus, it can be understood why this strategy was highly correlated with innovation measures. The correlation between Prospector and performance measures prove that there is an association between organisational strategies and the way they manage their performance.

Also, Prospector was found to be the only strategy that is correlated with environmental and social responsibilities measures. The highly innovative and lead in the market with new products and services characteristics could explain Prospector positions in these measures.

The next organisational adaptation, Analyser, presents a positive correlation with two performance measures: supplier reliability and product or services quality. Supplier reliability shows a correlation value of 0.318 (0.001) while product/ services quality reads as 0.266 (0.008). There are two main attributes that underlie this strategy; a relatively stable product market and priorities in maintaining the current market. Analyser organisations grow through entering market and product development by balancing technological flexibility and stability (Helmig et al., 2014). This strategy aims at minimising risk which may suggest the correlation with supplier reliability and services quality (Kazaz et al., 2015; Miles et al., 1978). Organisations which adopt the Analyser strategy are somewhere in between Prospector and Defender (Afiff et al., 2013; Meier et al., 2010; Zahra, 1987). However, the mean value for Analyser in this study is ranked as the third prevalent strategy for this industry.

Defender is made up of two attributes which are focus on single market segment and possession of a market niche with a limited range of products. Despite introducing new products or services, this type of organisation focuses on minimising costs through resources efficiency and process improvements (Kazaz et al., 2015; Desarbo et al., 2005). It was found that there is a correlation between Defender with the following performance measures: forecast accuracy and technology innovation. The correlation value for forecast accuracy is 0.321 at a significance level of.001 while technology innovations show a correlation value of 0.206 at a significance level of 0.04. This can be interpreted as the closer an organisation is to defender adaptation, the higher the level of importance of forecast accuracy and technology innovation. As this strategy is concentrated on single market segments and limited ranges of products, forecast accuracy is very important to manage the inventory level. This eventually will improve their resources management. Accordingly, resources efficiency can be improved by emphasising on technology innovation (Lin et al., 2010). This might infer the association of Defender with the technology innovation measure. In support, some researchers contend that technology competencies can enhance their services/ product delivery at a minimal cost (Coates and Mcdermott, 2002). For this reason, technology innovations might be suitable for organisations that adopt Defender.

Reactor indicates a correlation with thirteen performance measures as shown in Table 6-20. Reactor is represented by three attributes which are high degree of centralisation, tight cost control, and strategy based around reacting to change in the marketplace. This strategy is somewhat lacking in terms of its structure and was designed to only achieve short-term goals, which primarily focused on urgent matters (Helmig et al., 2014). The three highest correlation measures were; forecast accuracy, product/ services reliability, and flexibility meeting customers' needs. Forecast accuracy indicates the highest correlation value of 0.382 at the significance level of 0.05. This seems rather contradictory as the importance of forecast is more prevalent in a more structured strategy. However, a short-term forecast accuracy such as inventory level and cash flow forecast might contribute to this. The second highest correlation value is with product/ services reliability (0.348) at the significance level of 0.00. This implies that this strategy is either product-oriented or service-oriented. Finally, the correlation with Flexibility in meeting customers' needs indicates a correlation value of 0.320 at a significance level of .001. Flexibility is defined as the ability of organisations to respond to uncertainty in the market environment (Vickery, Calantone and Dröge, 1999). One of the elements of Reactor, 'strategy based around reacting to change in the market place' may contribute to the correlation with flexibility in meeting customers' needs'.

In general, Prospector and Reactor dominated the participating organisations. These strategies indicate the highest number of correlation with the performance measures in this survey. Nevertheless, there is no evidence to show that the measures which were not correlated with any strategy are not relevant to them. For instance, safety compliance, which indicates the highest mean based on the level of importance demonstrates no significant correlation with any organisational strategies. This may suggest that this measure is important to the oil and gas organisation regardless of the strategy adaptation. This finding answered the third research question;

R3: What is the impact of organisational classifications (organisational strategies) on the choice of performance measures?

6.7.1.4 Correlation between organisational size with organisational strategies and performance measures

The impact of organisations' strategy and the choice of performance measures have been discussed in the previous section. This section presents the link between; organisational size and organisational strategies, and organisational size and the choice of performance measures. The organisations' sizes studied are based on two categories. The categories are number of employees and turnover rates. Table 6-21 presents the correlation between organisational size and strategies adaptation.

Table 6-21: Correlation between organisational size and strategies adaptation

Strategies adaptation	**Organisations' size**	
	Number of employee	**Turnover**
Prospector	NSC	NSC
Analyser	NSC	NSC
Defender	-0.309** (0.002)	NSC
Reactor	NSC	NSC
*Correlation is significant at .05 levels (2-tailed). **Correlation is significant at .01 levels (2-tailed). NSC: No significance correlation		

The outcome of bivariate correlation analysis indicate that only number of employees is correlated with Defender in a reverse direction accounting -0.309 with the significance level at 0.002. This means with the increase in the number of employees, there is a decrease in the number of organisations in adopting Defender strategy. This finding is contradictory to the findings from a previous study by O'Regan and Ghobadian (2006) who studied the applicability of Miles and Snow typology in the

SME electronic manufacturers in the UK. They found that Defenders increase in each category as the organisational size increase. They explain the findings to the need to defend the market share as the priority in that industry. In the case of oil and gas industry, one possible reason could be that Defender is more common in the mature and stable environment. The previous discussions indicate that this industry is dominated by Prospector and Reactor. These two strategies show that this industry has mixed environment: innovative and dynamic and high regulated environment. Also, the finding is contradictory with other study by Helmig et al. (2014) that found Prospector strategy normally adopted by large size hospital, while Reactor strategy is more common amongst small-size hospital. Nevertheless, the non-significance correlation value for other strategies with organisational size suggests that there is a possibility that the association between number of employees and Defender strategy might be contributed by other factors. This finding answered the second research question:

R2: What is the impact of the size of organisation on organisational strategies

Table 6-22 depicts the correlation between organisational size in terms of number of employees and turnover with the choice of performance measures. This table shows that there is a correlation between cost savings and organisations' size. The correlation between cost savings and number of employees is at 0.211 and 0.199 with turnover rates. This suggests that the emphasis on cost saving efforts increases with the increase in the size of companies.

In addition, there is a correlation between turnover with flexibility in meeting customers' needs in an inverse direction (-0.248) and a direct correlation with safety training (0.212). The negative correlation between turnover rates and 'flexibility in meeting customers' needs' indicates that it is not prevalent in a large company. The correlation values are rather low as the values are less than 0.3.

There is also direct relationship between number of employees and investment in charitable programmes with a correlation value of 0.272. This suggests that the investment of charitable programme has a direct relationship with organisations' size in terms of number of employees. This finding is supported by previous studies that suggest a positive link between corporate social responsibility practices and organisations' size (Stanwick and Stanwick, 1998; Udayasankar, 2008; Laudal, 2011). A study by Udayasankar (2008) reveals that the relationship between firms' size and CSR practices is U-shape in nature. In essence, the CSR practices are more prevalent in small and large companies and are not common in the middle-size companies. Nevertheless, external factors and industry context may also influence the CSR implementations (Udayasankar, 2008; Blombäck and Wigren, 2009).

Table 6-22: Correlation between organisational sizes and the choice of performance measures

Performance measures	Organisational sizes	
	Employees	Turnover
PM1 Cost savings	0.211* (0.038)	0.199*(0.047)
PM2 Return on investment	NSC	NSC
PM3 Accuracy of schedule	NSC	NSC
PM4 Timeliness	NSC	NSC
PM5 Product/ services reliability	NSC	NSC
PM6 Supplier reliability	NSC	NSC
PM7 Flexibility in meeting customers' needs	NSC	0.248*(0.013)
PM8 Supplier flexibility	NSC	NSC
PM9 Products/ services quality	NSC	NSC
PM10 Forecast accuracy	NSC	NSC
PM11 Process compliance	NSC	NSC
PM12 Innovation ideas generated	NSC	NSC
PM13 Innovation in operations	NSC	NSC
PM14 Technology innovations	NSC	NSC
PM15 Environmental pollutant control	NSC	NSC
PM16 Reduction of waste	NSC	NSC
PM17 Safety compliance	NSC	NSC
PM18 Safety training	NSC	0.212 (0.034)
PM19 Supplier compliance on social responsibilities policy	NSC	NSC
PM20 Ethical business	NSC	NSC
PM21 Investment in charitable programmes	0.272**(0.007)	NSC

*Correlation is significant at .05 levels (2-tailed). **Correlation is significant at .01 levels (2-tailed). NSC: No significance correlation

A partial correlation is conducted to examine if there is country effect of the correlation between PM21 (Investment in charitable programmes) and organisational size based on number of employees. It was found that, the correlation value is decreased to 0.262 after the countries are controlled. Thus, a separate correlation is conducted for Malaysia and the UK for investment in charitable programmes with number of employees. The outcome of this analysis is presented in Table 6-23. For the UK, the result shows a correlation value of 0.321 between PM21(Investment in charitable programmes) and number of employees. While, for Malaysia there is no significance correlation for the same variables. This shows that investment in charitable programmes is increase with the increase in the size of companies based on number of employees in the UK. The trend is difference for Malaysia companies where the size of companies not influence the level of investment in charitable programmes. Therefore, there might be other factors that attributed to the level of charitable investment in Malaysia companies, such as altruistic reasons. Nevertheless, there is no sufficient information to suggest the actual reason behind the trend in Malaysia.

Table 6-23: Correlation between PM 21 and number of employees according to country

Performance measure	Country	Number of employee
PM 21 investment in charitable programmes	UK	0.321(0.014)
	Malaysia	NSC

Overall, the organisational size indicates that there is no significant correlation with most of the performance measures. In fact, five correlation values in Table 6-22 are relatively low (less than 0.3). This shows that there is no link between organisational sizes and the choice of performance measures. This finding is in line with a previous study by Wu et al. (2006) that reveals there is no effect of firms' size on their performance attributes. A study by Ketchen and Hult (2007) also indicates that firms' size has no impact on the performance measures they studied, lead-time. In support, a research on supply chain integration in Australian firms also reveals that firms' size, in terms of number of employees has no significant impact on operational performance (Prajogo and Olhager, 2012). This finding served the following research question:

R3: What is the impact of organisational classification (organisational sizes) on the choice of performance measures

6.7.2 Relationship between organisational classifications and organisational performance

The organisational classifications studied in this section involve strategic adaptations and organisational sizes. Research derived from organisational fit theory by Miles and Snow (1978) suggests that type of strategies influence organisational performance (Miles and Snow, 1978; Gimenez, 2000; Afiff, Fontana and Zubaedah, 2013). Miles and Snow (1978) argued that Prospector tends to succeed in an innovative and dynamic environment. On the other hand, Defender would outperform other strategies in a more stable and mature environment. The third strategy, Analyser, focuses on both stable and turbulent markets. Most researchers contend that all these three strategies can lead to better performance with a condition that there is a strong alignment between their structure and process (Gimenez, 2000). However, attaining competitive advantage is rather difficult for Reactor due to its unclear strategy. Despite that, some studies have suggested that Reactor can outperform other strategies in a certain environment. They contended that monopolised and high regulated environment may be suitable for a Reactor (Wronka-Pośpiech and Frączkiewicz-Wronka 2016; Gimenez 2000).

Many researches were conducted to understand the impact of organisational strategies on the overall organisational performance. For instance, Wronka-Pośpiech and Frączkiewicz-Wronka (2016) studied the public organisation in Poland, Gnjidi (2014) focused on Food and beverage industry in Croatia, Kazaz et al. (2015) explored construction industry in Turkey, Helmig et al. (2014) investigated the hospital industry in Germany, etc. The outcomes of the research indicates that organisational strategy does impact the overall success of the organisation but is dependent on the external environment. In other words, the external environment or the type of industry would also influence the best-chosen strategy for an organisation to achieve competitive advantage (Wronka-Pośpiech and Frączkiewicz-Wronka 2016; Gimenez 2000; Hambrick 1983).

This study is aim to add to the current literature on Miles and Snow (1978) strategies in identifying the best strategy types for oil and gas industry. Therefore, this section will present the relationship between organisational strategy and organisational performance. Prior to that, the mean values for organisational performance will be presented and discussed. The descriptive statistics of organisational strategies will not be presented in this section as it has been previously reported and discussed in section 6.7.1. In addition, this study will also present the link between organisational sizes and their performance.

6.7.2.1 Mean value of organisational performance

For this section, participants were asked to rate their level of agreement on a Likert scale from 1 to 5, where 1 is strongly disagree and 5 is strongly agree on the sixteen organisational performance statements. The details of this question are in Appendix I, question number 13. Accordingly, Table 6-23 presents the computed mode, frequency, and mean for each organisations' performance attributes.

Table 6-24: Mean values for actual organisational performance

Organisational performance attributes	Mode	Freq.	Mean	SD
1.Cost savings have improved	4	52	3.97	0.758
2.Return of investments have increased	3	45	3.19	0.873
3.Delivery speed are managed properly	4	56	3.69	0.634
4.Planned schedule can be met	4	66	3.75	0.609
5.Company delivery is reliable	4	67	4.05	0.626
6.Supplier delivery reliability has improved	4	47	3.47	0.758
7.Company is flexible on supply chain strategies	4	49	3.73	0.84
8.Company is flexible on operation strategies	4	55	3.78	0.746
9.Number of product/ services defects have decreased	3	41	3.5	0.859
10.Innovation of products/ services are part of company's culture	4	42	3.65	0.947
11.Innovation of systems of works is part of company's culture	4	47	3.72	0.944
12.Corporate social responsibilities programme have increased	3	52	3.32	0.827
13.Company strategies always consider that environmental aspects are protected	4	59	3.95	0.687
14.Safety has become company's culture	5	54	4.49	0.595
15.Forecast are highly accurate	4	44	3.5	0.759
16.Process compliance of your company are properly managed	4	58	3.87	0.661

Table 6-23 suggests that safety has become company's culture has recorded the highest mean (4.49) out of the 16 attributes. This is followed by delivery reliability with a mean of 4.05. Cost savings have improved with a mean value of 3.97, and the mean value for environmental aspects are protected read as 3.95. This result indicates that safety is the first priority in most oil and gas organisations. It can be observed that it was not only recorded as the highest mean, but also the only performance attribute that posits a mode of 5. This scenario is in line with Varma, Wadhwa and Deshmukh (2008), who contend that the risks involved in the oil and gas supply chain are high in comparison to other industry. This could suggest the highest mean and mode for the safety performance.

Table 6-24 presents 'safety has become organisations' culture' based on the turnover rates.

Table 6-25: Safety has become organisations' culture according to turnover rates

Turnover	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Less than £25 million Less than MYR 20 million	-	-	5	20	28
£26- £50million MYR 21 – 50million	-	-	-	4	5
£51 - £100 million MYR 51 – 100 million	-	-	-	3	3
£101- £500 million MYR101 – 500million	-	-	-	4	9
> £500 million >MYR500 million	-	-	-	10	9
Total			5	41	54

It can be observed that the distribution of scores on safety has become organisations' culture were concentrated towards the positive side (rated 4 and 5). This resulted in the highest mean among other performance attributes. Only five companies rated safety performance as Neutral and were from the lowest turnover rates band. Nevertheless, this is not sufficient to suggest that safety performances are influenced by the turnover rates.

Interestingly, the delivery reliability, which was rated as the second highest performance attribute in this study was in line with the findings from a previous study by Yusuf, et al. (2014). In their survey on the competitive objective of the oil and gas company in the UK, delivery reliability was rated as the second important mean after quality.

Even though the cost savings is important for this industry, the findings might be influenced by the current low oil prices environment where cost savings have become a priority for most companies. This eventually improved their cost savings performance.

Accordingly, the importance of aligning the oil and gas operations and environmental sustainability received heated debates by many associations such as IEA, OPEC, and European environment energy (European Environment Agency, 2006; Organisation of Petroleum Exporting Countries, 2015). Moreover, Asrilhant et al. (2007) propose that environmental impact is considered as both important and received adequate attention by the oil and gas sector in the UK. In view of that, the pressure to attain sustainable environment by the local government and non-government organisations might suggest the highest performance score for 'environmental factors are protected' attribute.

Also, the finding shows the 'return on investments have increased' as the least rated performance attribute with a mean value of 3.19 and is followed by corporate social responsibilities which have increased (3.32).

The ROI performance might be influenced by the same factor as in the case of cost savings albeit it was rated very low. The low oil prices environment (Krauss, 2016; Tarver, 2015) has deflated the return on investment for the oil and gas companies regardless of the cost savings efforts they have made. In fact, one large international company in this study commented that the sales turnover in the year 2015 halved compared to the previous year. The company has forecasted lower sales turnover in the year 2016.

The Corporate social responsibility (CSR) issues have received a great number of attention from both academics and top managers in the beginning of the 21st century (Zhang *et al.*, 2013). Nevertheless, this study shows a low-performance score of this aspect, at least for the oil and gas industry in the UK and Malaysia contexts. This could be attributed to the distributions of participating organisations in this study that are categorised under small and medium-sized organisations. The reason is that CSR behaviour which is normally part of local content requirements is more prominent in the large-sized organisations and international organisations.

6.7.2.2 Correlation of organisational strategies and organisational performance

Bivariate correlation analysis was conducted in order to test the relationship of organisational strategies with organisational performances. This analysis involves sixteen actual organisational performances rated by participants with four strategic types; Prospector, Analyser, and Defender. Table 6-25 reveals the outcomes of correlations analysis between four types of strategies and organisational performances.

The table demonstrates that all strategies indicate at least one correlation with organisational performances. From the four strategies, Prospector reveals the highest number of correlations with organisational performances while Defender shows only one correlation with 'forecast accuracy'.

In Prospector, it can be observed that the highest correlations were with innovation performances (innovation of product/ services and system's innovations) with correlation values of 0.520 and 0.527 at the significance level of 0.00 respectively. As expected, prospecting organisations normally succeed in their innovation performance.

The second strategy, Analyser correlated with: return on investment (ROI), supplier delivery reliability, number of product/ services defects have decreased, cost savings, and forecast accuracy. Out of these performances, there were three performance attributes that show correlation values of more than 0.3. These include return on investment with a correlation value of 0.410, the number of product/ services defects have decreased (0.397), and supplier delivery reliability performance with 0.395. Analyser attributes that focus on stable and turbulent markets make them the only strategy that correlates with financial performances (ROI and cost savings). In addition, by observing Table 6-20 (Correlation between organisational strategy and performance measures), it was found that this strategy also correlates with supplier delivery reliability as their performance measures preferences.

Table 6-26: Correlation between type of strategies and organisational performance

Organisational strategies / Performance	Prospector	Analyser	Defender	Reactor
CP1 Cost savings have improved	NSC	0.254* (0.011)	NSC	NSC
CP2 Return of investments have increased	NSC	0.410** (0.00)	NSC	NSC
CP3 Delivery speed are managed properly	NSC	NSC	NSC	0.246* (0.013)
CP4 Planned schedule can be met	0.226* (0.024)	NSC	NSC	NSC
CP5 Company delivery is reliable	NSC	NSC	NSC	0.338** (0.001)
CP6 Supplier delivery reliability has improved	NSC	0.395** (0.00)	NSC	0.267** (0.007)
CP7 Company is flexible on supply chain Strategies	NSC	NSC	NSC	0.256* (0.010)
CP8 Company is flexible on operation strategies	NSC	NSC	NSC	NSC
CP9 Number of product/ services defects, have decreased	NSC	0.397** (0.00)	NSC	NSC
CP10 Innovation of products/ services are part of company's culture	0.520** (0.00)	NSC	NSC	NSC
CP 11Innovation of systems of works is part of company's culture	0.527** (0.00)	NSC	NSC	0.261** (0.009)
CP 12 Corporate social responsibilities programme have increased	0.202* (0.044)	NSC	NSC	NSC
CP 13 Company strategies always consider that environmental aspects are protected	0.250* (0.012)	NSC	NSC	NSC
CP 14 Safety has become company's culture	NSC	NSC	NSC	NSC
CP 15 Forecast are highly accurate	NSC	0.199* (0.047)	0.207* (0.039)	NSC
CP 16 Process compliance of your company are properly managed	0.264** (0.008)	NSC	NSC	NSC
*Correlation is significant at .05 levels (2-tailed). **Correlation is significant at .01 levels (2-tailed). NSC: No significance correlation				

Subsequently, Defender shows a correlation with only forecast accuracy performance. The nature of this strategy that focuses on the single market could infer why forecast works are both easy and increases with the closeness of an organisation adopting this strategy. Despite that, the correlation value is rather low; 0.207.

The final strategy, Reactor correlated with five organisational performance attributes: company delivery reliability, supplier delivery reliability, innovation of systems of works, flexibility on supply chain strategies, and delivery speed. However, only delivery reliability performance has a score of more than 0.3. The key character of this strategy that based around reacting to change to the environment might suggests the highest correlation with delivery reliability performance.

Also, Table 6-25 suggests that there is an absence of correlation between organisational strategies and safety performance despite the fact that it was rated as the top performance based on the mean scores. This situation might suggest that safety performances are the highest priority in this industry and is not driven by strategic types.

Accordingly, all sixteen organisational attributes were clustered into overall organisational performance. A correlation analysis was conducted between each type of strategy and overall organisational performance as presented in Table 6-26.

Table 6-27: Correlation between organisational strategies and overall performance

Organisational strategies	Overall performance
Prospector	0.416**(0.00)
Analyser	0.272**(0.006)
Defender	NSC
Reactor	0.355** (0.00)

It reveals that Prospector outperforms other strategies by demonstrating the highest correlation values of 0.466. This is followed by Reactor with a value of 0.355 and Analyser with 0.272. The table also suggests that, there is no significant relationship between organisations adopting Defender strategy and overall organisational performance. The result answered the fourth research question from strategic adaptations perspectives;

R4: What is the impact of organisational classification on organisational performance?

At the same time, it supports the idea of industry specific strategy choices (Hambrick, 1983; Zahra S. A., 1987; Helmig, Hinz and Ingerfurth, 2014). This scenario suggests that the oil and gas industry has a mixed environment; innovative, monopolised, and high regulated for certain sectors in which Prospector and Reactor outperform other strategic options.

6.7.2.3 Correlation between organisational sizes and organisational performance

The correlation between organisational sizes: number of employees and turnover with organisational performance resulted with no significant correlations. In other words, the size of companies would not determine their level of performance. In essence, organisational size is not the factor that influence the performance of an organisation. This finding is in line with previous study by (Wu *et al.*, 2006) that reveal no effect of firms' size on their performance. Another study by Orlitzky, (2001) also proved that there is no link between organisational size with social and financial performance. This finding signifies that there is no impact of organisational classifications in term of sizes on their performance. Thus, it answering the fourth research questions:

R4: What is the impact of organisational classification on organisational performance?

6.7.3 Relationship between performance measures and organisational performance

Previous literature supports the notion that the usage of performance measurement framework (PMF) has a positive impact on the organisational performance. For instance, Lee and Yang (2010) found that the use of integrated performance measures positively enhances organisational performance. In particular, they claimed the usage of PMF facilitates organisation with relevant information can assist in obtaining a competitive edge. In addition, Garengo, Biazzo and Bititci, (2005) conducted a case study on the implementation of performance measurement system (PMS) and found that the use of PMS impacts the organisations' culture and management style. It was evident that the effective implementation of PMS will eventually lead to significant performance improvement. In support to this, Davis and Albright (2004) conducted an empirical investigation to compare the bank that uses balanced scorecard with the non-BSC branches on financial performances. It indicates that the branches utilised BSC outperformed the non-BSC branches. In another instance, Greatbanks (2007) studies the impact of BSC on the public institutions. This study illustrates the relationship between the usage of PMF on the employee motivations on the performance-related measures. Accordingly, the employee motivations mediate the delivery of customer services.

Moreover, PMF is also considered as one of the key competencies in achieving worlds' class performance (Gunasekaran and Kobu, 2007). Nevertheless, in choosing performance measures, they emphasised the need to consider organisation goals, type of business, nature of the market, and technological competencies. Therefore, the investigation of performance measures in multiple industries is highly required.

To expand the existing literature, this study presents the relationship between the choice of performance measures and the organisational performance in the oil and gas industry. The bivariate correlation analysis is conducted between twenty-one performance measures and sixteen organisational performance attributes. Accordingly, the correlation between twenty-one performance measures and aggregated organisational performance attributes is conducted. This analysis is undertaken to identify what are the performance measures that have a greater impact on the overall organisational performance in this industry. For parsimony purposes, the mean value of performance measures and organisational performance will not be presented in this section. The descriptive information of performance measures and organisational performance have been presented and discussed in section 6.7.1.2 and 6.7.2.1 respectively.

6.7.3.1 Correlation of performance measures and organisational performances

Table 6-28 presents the outcomes of bivariate correlation between performance measures and organisational performance. Single asterisk (*) denotes that correlation is significant at 0.05 levels (2-tailed), while double asterisks (**) indicate the correlation is significant at 0.01 levels (2-tailed). NSC remarks mean that there is no significance correlation between the variables. In general, the outcomes of the present research indicate that there is a correlation between performance measures and organisational performance accounting to the same factor. In fact, most of the highest correlation was found to be between the performance measures and the corresponding organisational performance of the same attributes. For instance, it was apparent that cost savings demonstrated the highest correlation with organisational performance ‘cost savings have improved’. This signifies that the way an organisation concentrated on particular performance measures significantly impacted their performance in that regard. Thus, it advocates the notion that the choice of performance measure has significantly positive impact on the organisational performance. Also, it can be observed that innovation and safety measures indicate amongst the highest correlation values with the organisational performance attribute of the same factors. For example, one of the performance measure, PM13: innovation in operation accounts correlation value of 0.641 and 0.624 with the following organisational performances; CP10: innovation of products/ services and CP11: innovation of system of works, respectively. On the other hand, the PM17: safety compliance measure records a correlation value of 0.599 with the CP14: safety has become company’s culture. This might explain that the emphasis on the innovation and safety measures have a greater impact on their performance of the same factor as compared to other performance measures.

Also, PM11(process compliance) records the highest number of correlation with the listed organisational performances. This measure correlates with thirteen organisational performance in which the highest correlation value is with CP 16 (process compliance performance). Moreover, it can be observed that all of the twenty-one (21) performance measures have at least one direct positive association with the organisational performance attribute. Nevertheless, there is only one organisational performance attribute CP2 (return on investment has increased) that has no direct association with any of the performance measures. This might be due to the current drop of oil prices during the questionnaire distributions stage. In support of this, Table 6-10 that outlines the descriptive statistics on organisational performance reports that CP2 (return on investment has increased) has a mode of three (3) and recorded the lowest mean (3.19) out of all sixteen numbers of organisational performance.

Table 6-28: Correlation between performance measures and organisational performance

Variables	PM1 Cost savings	PM2 ROI	PM3 Acc. of schedule	PM4 Timeliness	PM5 Services reliability	PM6 Supplier Reliab.	PM7 Flex. in customers'	PM8 Supplier flex.	PM9 Prod./serv. quality	PM10 Forecast accuracy	PM11 Process compl.
CP1 Cost savings have improved	0.356** (0.00)	NSC	0.278** (0.005)	NSC	NSC	0.235* (0.019)	NSC	0.279** (0.005)	NSC	0.217* (0.03)	0.238* (0.017)
CP2 Return of investments have increased	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC
CP3 Delivery speed are managed properly	NSC	NSC	0.208* (0.038)	NSC	0.229* (0.022)	0.251* (0.012)	0.290** (0.003)	NSC	0.221* (0.027)	NSC	0.265** (0.008)
CP4 Planned schedule can be met	NSC	NSC	0.315** (0.001)	0.259** (0.009)	0.327** (0.001)	NSC	0.233* (0.02)	0.269** (0.007)	0.246* (0.014)	0.285** (0.004)	0.342** (0.0)
CP5 Company delivery is reliable	NSC	NSC	NSC	NSC	0.378** (0.00)	NSC	0.367** (0.0)	NSC	0.302** (0.002)	NSC	0.371** (0.0)
CP6 Supplier delivery reliability has improved	NSC	NSC	NSC	NSC	0.197* (0.049)	0.385** (0.0)	NSC	0.362** (0.0)	0.345** (0.0)	0.208* (0.037)	0.328** (0.001)
CP7 Company is flexible on supply chain Strategies	NSC	NSC	NSC	0.269** (0.007)	0.294** (0.003)	NSC	0.278** (0.005)	0.283** (0.004)	0.321** (0.001)	NSC	0.221* (0.027)
CP8 Company is flexible on operation strategies	NSC	NSC	NSC	0.302** (0.002)	0.218* (0.029)	NSC	0.341** (0.001)	NSC	NSC	NSC	NSC
CP9 Number of product/ services defects have decreased	NSC	NSC	NSC	NSC	0.288** (0.004)	0.258** (0.01)	0.315** (0.001)	0.323** (0.001)	0.384** (0.0)	NSC	0.329** (0.001)
CP10 Innovation of products/ services are part of company's culture	NSC	NSC	0.229* (0.022)	0.233* (0.019)	0.352** (0.0)	NSC	0.280** (0.005)	NSC	0.218* (0.029)	NSC	0.212* (0.034)
CP 11Innovation of systems of works is part of company's culture	NSC	NSC	0.234* (0.019)	0.227* (0.023)	0.332** (0.001)	NSC	0.295** (0.003)	NSC	0.198* (0.049)	0.233* (0.019)	0.310** (0.002)
CP 12 Corporate social responsibilities programme have increased	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC	0.235* (0.019)	NSC
CP 13 Company strategies always consider that environmental aspects are protected	NSC	NSC	0.227* (0.023)	NSC	NSC	NSC	NSC	NSC	NSC	NSC	0.248* (0.013)
CP 14 Safety has become company's culture	0.211* (0.035)	NSC	NSC	NSC	0.275** (0.006)	NSC	NSC	0.211* (0.035)	0.289** (0.003)	NSC	0.340** (0.001)
CP 15 Forecast are highly accurate	NSC	0.368** (0.00)	NSC	NSC	NSC	NSC	NSC	NSC	NSC	0.354** (0.0)	0.231* (0.021)
CP 16 Process compliance of your company are properly managed	NSC	NSC	0.228* (0.022)	NSC	NSC	NSC	0.205* (0.041)	NSC	NSC	0.378** (0.0)	0.382** (0.0)

(Continue) Table 6-28: Correlation between performance measures and organisational performance

Variables	PM12 No. innovation ideas generated	PM13 Innovation in operations	PM14 Technology innovations	PM15 Environ. pollutant control	PM16 Reduction of waste	PM17 Safety compliance	PM18 Safety training	PM19 Supplier compliance on CSR policy	PM20 Ethical business	PM21 Investment in charitable programmes
CP1 Cost savings have improved	NSC	NSC	0.233* (0.019)	0.257** (0.01)	0.208* (0.038)	NSC	0.299** (0.002)	NSC	NSC	0.223* (0.026)
CP2 Return of investments have increased	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC
CP3 Delivery speed are managed properly	NSC	0.279** (0.005)	0.199* (0.047)	NSC	NSC	NSC	NSC	NSC	NSC	NSC
CP4 Planned schedule can be met	NSC	0.281** (0.005)	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC
CP5 Company delivery is reliable	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC
CP6 Supplier delivery reliability has improved	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC
CP7 Company is flexible on supply chain Strategies	NSC	NSC	NSC	NSC	NSC	NSC	0.240* (0.016)	NSC	NSC	NSC
CP8 Company is flexible on operation strategies	0.341** (0.001)	0.202* (0.044)	NSC	NSC	NSC	NSC	NSC	NSC	NSC	NSC
CP9 Number of product/ services defects, have decreased	NSC	0.325** (0.001)	0.293** (0.003)	0.208* (0.038)	NSC	NSC	NSC	NSC	NSC	0.266** (0.007)
CP10 Innovation of products/ services are part of company's culture	0.49**(0.00)	0.641** (0.00)	0.647** (0.0)	NSC	0.219* (0.028)	NSC	0.230* (0.021)	NSC	NSC	0.360** (0.0)
CP 11Innovation of systems of works is part of company's culture	0.488** (0.00)	0.624** (0.00)	0.608** (0.00)	NSC	0.334** (0.001)	NSC	0.271** (0.006)	0.213* (0.033)	0.247* (0.013)	0.311** (0.002)
CP 12 Corporate social responsibilities programme have increased	0.241*(.016)	0.308** (0.002)	0.235* (0.019)	0.250* (0.012)	0.282** (0.004)	NSC	NSC	0.397** (0.0)	NSC	0.383** (0.0)
CP 13 Company strategies always consider that environmental aspects are protected	NSC	0.237* (0.018)	0.273** (0.006)	0.497** (0.00)	0.464** (0.0)	0.360** (0.0)	0.397** (0.0)	0.364** (0.0)	0.362** (0.0)	0.294** (0.003)
CP 14 Safety has become company's culture	NSC	NSC	NSC	0.432** (0.00)	0.277 (0.005)	0.599** (0.0)	0.551** (0.0)	0.309** (0.002)	0.323** (0.001)	0.229* (0.022)
CP 15 Forecast are highly accurate	NSC	0.205* (0.041)	NSC	NSC	0.207* (0.038)	NSC	NSC	0.317** (0.001)	NSC	NSC
CP 16 Process compliance of your company are properly managed	NSC	0.258** (0.01)	0.250* (0.012)	0.307** (0.002)	0.283** (0.004)	0.232* (0.02)	0.322** (0.001)	0.293** (0.003)	0.280** (0.005)	NSC

The finding is also in line with one of the remarks given by respondents that suggested the turnover of their organisation were decreased in the year 2015 and they forecasted further decline in the year 2016. This apparently affects their return on investment. Therefore, the absence of correlation of performance measure with this organisational performance would not be enough to reject the theory that the way organisations manage their performance will impact their overall performance.

Table 6-29 reports the outcomes of the correlation analysis between performance measures and aggregated organisational performance.

Table 6-29: Correlation between performance measures and overall organisation performance

Performance measures	Overall organisational performance
PM1 Cost savings	NSC
PM2 Return on investment	0.248*
PM3 Accuracy of schedule	0.359**
PM4 Timeliness	0.313**
PM5 Product/ services reliability	0.450**
PM6 Supplier reliability	0.257**
PM7 Flexibility in meeting customers' needs	0.417**
PM8 Supplier flexibility	0.382**
PM9 Products/ services quality	0.389**
PM10 Forecast accuracy	0.347**
PM11 Process compliance	0.527**
PM12 Innovation ideas generated	0.377**
PM13 Innovation in operations	0.561**
PM14 Technology innovations	0.529**
PM15 Environmental pollutant control	0.320**
PM16 Reduction of waste	0.387**
PM17 Safety compliance	0.371**
PM18 Safety training	0.440**
PM19 Supplier compliance on social responsibilities policy	0.367**
PM20 Ethical business	0.211**
PM21 Investment in charitable programmes	0.394**
*Correlation is significant at .05 levels (2-tailed). **Correlation is significant at .01 levels (2-tailed). NSC: No significance correlation	

Out of the twenty-one performance measures, PM13 (innovation in operation) demonstrates the highest correlation value of 0.561 and is followed by PM14 (technology innovation) (0.529). These signify that organisations that focus on these two measures have a greater impact on the overall organisational performance in comparison to the rest of the performance measures. The usage of innovation measures in a PMF has been widely discussed by many researchers (Bhagwat and Sharma, 2007; Yeh et al., 2007; Varma et al., 2008; Thakkar et al., 2009; Halman and Voordijk, 2012). One of the studies is by Terziovski (2010) and the study shows a positive impact of innovation strategy on the performance of SME manufacturers in Taiwan. Another study in Chinese manufacturing firms demonstrates positive relationship between innovation capabilities and supply chain performance (Yang, 2012). Apart from the innovation capabilities investigated in that study, technology innovation and company initiative were identified to create added value to the organisation, which is similar to technology innovations and innovation in operation of this research. Therefore, the highest correlation posits in innovation is similar to the findings by Yang (2012).

The third highest correlation is PM11 (process compliance), 0.527. A possible explanation for this is that an organisation that emphasises process compliance is presumed to have a well-structured governance. Therefore, most of the areas of performance in these organisations received comprehensive attention by the manager, which then leads to a better performance. In fact, one research on corporate governance in Japan demonstrates that well-governed organisations outperform loose-governed organisations by 15% (Bauer et al., 2008). Another study that focuses on the maritime industry presents evidence, which highlights a positive association between corporate governance and organisational performance (Andreou et al., 2014). Despite the importance of process compliance for garnering enterprise governance, it has not received adequate attention from the performance measurement perspective. The outcomes of the correlation in Table 6-28 and Table 6-29 answered the fifth research question:

R5: What is the impact of the choice of performance measures on organisational performance?

6.7.3.2 Regression analysis between clustered performance measures and overall organisational performance

Multiple regression analysis is conducted between clustered performance measures (predictors) and the overall organisational performance (dependent variable). This test is undertaken to test the impact of a set of performance measures (performance measurement framework) on overall organisational performance. Four clustered performance measures (predictors) are involved in this analysis. These include: financial measures, operation measures, safety measures, and social responsibility measures. These clustered performance measures are derived from the factor analysis and theoretical consideration as explained in Section 6.5.4. Table 6-30 shows the Pearson correlation coefficient between each pair of predictor variables was less than 0.7 which indicates multicollinearity would not be a problem in the regression analysis (Tabachnick and Fidell, 2007). This also means that none of the variables needs to be omitted or modified.

Table 6-30: Correlation of performance measures preferences and organisational performance

		Org. Performance	Financial	Operation	Safety	Social responsibility
Pearson correlation	Org. performance	1.000	0.300	0.659	0.472	0.442
	Financial	0.300	1.000	0.505	0.420	0.430
	Operation	0.659	0.505	1.000	0.512	0.442
	Safety	0.472	0.420	0.512	1.000	0.578
	Social respons.	0.442	0.430	0.442	0.578	1.000
Sig. (1-tailed)	Org. performance		0.001	0.000	0.000	0.000
	Financial	0.001		0.000	0.000	0.000
	Operation	0.000	0.000		0.000	0.000
	Safety	0.000	0.000	0.000		0.000
	S. responsibility	0.000	0.000	0.000	0.000	

The result of regression analysis between clustered performance measures and overall organisational performance were presented in from Table 6-30 to Table 6-33. Table 6-30 illustrates the outcome of regression analysis of clustered performance measures and organisational performance. The R^2 value for this model is 0.48 which means that performance measures preferences explained 48% of the variance in organisational performance. In other words, this model predicts 48% of the overall organisational performance.

Table 6-31: Model summary for choice of performance measures and organisational performance

Model	R	R square	Adjusted R square	Std. Error of the Estimate
1	0.693[a]	0.480	0.458	0.26459

a. Predictors: (Constant), Financial measures, operation measures, safety measures, social responsibility measures b. Dependent variable: Organisational performance

The following table on ANOVA (Tables 6-32) indicates that this model reaches statistical significance (sig. =.000), which is less than 0.05. Thus, the null hypothesis that the model has no explanatory power on the organisational performance can be rejected. This means the usage of a set of performance measures can explain 48% of organisational performance. The results of regression analysis are shown as follows; F statistics = (4,95) 21.915, p <.01, R^2 =.48, R^2 adjusted 0.458.

Table 6-32: Analysis of variance (ANOVA)

Model		Sum of squares	df	Mean Square	F	Sig.
1	Regression	6.137	4	1.534	21.915	0.000[b]
	Residual	6.651	95	.070		
	Total	12.787	99			

Table 6-33 shows which independent variables (clustered performance measures) have unique contributions in predicting the dependent variable (organisational performance).

Table 6-33: Coefficients Beta

Model		Standardized Coefficients (Beta)	T	Sig.
1	(Constant)		6.959	0.000
	Financial measures	-0.117	-1.305	0.195
	Operation measures	0.580	6.197	0.000
	Safety measures	0.132	1.351	0.180
	Social responsibility measures	0.160	1.695	0.093

Also, the significant value in the column marked as Sig. indicates the variable that makes a statistically significant unique contribution to the equation. It can be observed that there was only one variable that is significant at the significance level of 0.00 (Sig value less than 0.05) which is operation measures. In brief, the result is shown as Beta =.58, t(94) = 6.197, p<0.05. It means this variable has 58% of unique contribution to the overall organisational performance when other variables in the model are held constant. This also suggests that operation measures are the most influential predictor of the organisational performance. Also, Table 6-33 reports that there is the absence of unique contribution to the organisational performance from the other three variables when all the other variables are held constant. The result are as follows; financial measures Beta =-.117 t (94) = 1.31, NS), safety measures Beta =.132, t(94) = 1.32, NS, social responsibility measures Beta =.16 t (94) = 1.695, NS.

In order to further explore the regression between clustered performance measures and organisational performance, the performance measures were re-assigned into five main clusters. These include: innovation measures, safety measures, financial measures, environment and social responsibility measures, and operation measures as stipulated in Table 6-34.

The clustered performance measures were grouped based on factor analysis, which has been explained in Section 6.6.4 where all innovation measures were compounded under the same component. Another consideration is in the balanced scorecard perspective. Through this perspective, innovation measures are classified as part of learning and development and not in the other three areas, which are customer perspective, internal business perspective, and financial perspective.

Table 6-34: Clustered performance measures

Component 1 Innovation measures	**Component 2** Safety measures	**Component 3** Financial measures	**Component 4** Environmental and social responsibility measures	**Component 5** Operation measures
PM 13: Innovation in operations PM 12: Number of innovation ideas generated PM 14: Technology innovations	PM 17: Safety compliance PM 18: Safety training	PM1: Cost saving PM2: Return on investment PM10: Forecast accuracy	PM 15: Environmental pollutant control PM16: Reduction of waste PM 19: Supplier compliance on social responsibilities policy PM20: Ethical business PM 21: Investment in charitable programmes	PM3: Accuracy of schedule PM 4: Timeliness PM5: Product/ services reliability PM7: Flexibility in meeting customers' needs PM9: Products/ services quality PM8: Supplier flexibility PM 6: Supplier reliability PM11: Process compliance

Accordingly, the five clustered performance measures were aggregated using SPSS. Then, a Pearson correlation analysis is conducted and the outcomes of this analysis is reported in Table 6-35.

Table 6-35: Correlation of performance measures preferences and organisational performance

		Org. Perform.	Innovation	Safety	Financial	Env. and CSR.	Operation
Pearson correlation	Org. performance	1.000	0.560	0.452	0.300	0.470	0.552
	Innovation	0.560	1.000	0.287	0.325	0.473	0.377
	Safety	0.452	0.287	1.000	0.305	0.522	0.422
	Financial	0.300	0.325	0.305	1.000	0.475	0.484
	Environment and CSR	0.470	0.473	0.522	0.475	1.000	0.396
	Operation	0.552	0.377	0.422	0.484	0.396	1.000
Sig. (1-tailed)	Org. performance		0.000	0.000	0.001	0.000	0.000
	Innovation	0.000		0.002	0.000	0.000	0.000
	Safety	0.000	0.002		0.001	0.000	0.000
	Financial	0.001	0.000	0.001		0.000	0.000
	Environment and CSR	0.000	0.000	0.000	0.000		0.000
	Operation	0.000	0.000	0.000	0.000	0.000	

It can be observed that no correlation value was less than 0.3 between each clustered performance measure (predictor) and organisational performance (dependent variable). Hence, it met the recommendation made by Pallant (2013) on the need to have correlation value more than 0.3 between each cluster. In addition, there is also the absence of multi-collinearity issue between each predictor where all of the correlation values were less than 0.7. As stated earlier, Field (2009) proposed that the correlation value between each predictor must less than 0.7 to avoid multi-collinearity issue.

Table 6-36 reports the regression model between five clustered performance measures and overall organisational performance.

Table 6-36: Model summary for clustered performance measures and organisational performance

Model	R	R square	Adjusted R square	Std. Error of the Estimate
2	.703[a]	.494	.467	.26241

It can be observed from the table above that the the R^2 for this model is slightly higher than the previous model 1 with a value of 0.494. The outcome suggests that this model has 49.4% explaining power in predicting organisational performance. Table 6-37 demonstrates the ANOVA table of this model. It reports the sum of squares, degree of freedom, mean square, degree of freedom ratio (F), and also the significance of the regression model (Sig.). The significance value of 0.000 indicates that this regression model is significant.

Table 6-37: ANOVA

Model		**Sum of squares**	**df**	**Mean Square**	**F**	**Sig.**
2	Regression	6.315	5	1.263	18.342	0.000[b]
	Residual	6.473	94	.069		
	Total	12.787	99			

Table 6-38 presents the Beta value of this regression model. The Beta value demonstrates the unique contribution of each predictor in determining organisational performance when all other predictors were held constant. The final column of this table, (VIF) is the result of multicollinearity statistics. This is another option to check multicollinearity between predictors. The values for all predictors in this table indicate the absence of multicollinearity issue in this model. According to Field (2009), the VIF value of less than ten imposes the absence of multicollinearity between the predictors.

Table 6-38: Coefficient Beta

Model		Standardized Coefficients (Beta)	t	Sig.	VIF
2	(Constant)		6.390	.000	
	Innovation measures	0.354	4.128	.000	1.367
	Safety measures	0.171	1.906	.060	1.488
	Financial measures	-0.090	-1.002	.319	1.496
	Environment and social responsibility	0.120	1.211	.229	1.819
	Operation measures	0.343	3.768	.000	1.535

Based on the significance value in Table 6-38, there are three predictors that imposed a unique contribution in explaining dependent variable (organisational performance). These include innovation measures, safety measures, and operation measures. Out of these three predictors, the innovation measures demonstrate the highest contribution factor of 0.354 and is followed by operation measure at 0.343, and safety measure at 0.171. This also means innovation measure is the most influential measure in determining the organisational performance.

The outcomes of the regression analysis in both models indicate strong evidence to suggest that the usage of performance measurement framework has a significant positive impact on organisational performance.

6.8 Challenges in managing supply chain performance

This section reports the challenges faced by oil and gas organisations in managing their supply chain performance. These challenges are lack of data consistency, lack of inter-departmental cooperation, compliance with local content requirement, instability of global oil prices, the need for fast completion at minimal costs, and the need to manage urgency at minimal cost. The listed challenges were derived from the exploratory interviews with five supply chain experts, which have been earlier discussed in Chapter 5. In this question, participants were asked to identify the level of each challenge on a Likert scale ranging from 1 (very low) to 5 (very high). Table 6-38 presents the mean values on the challenges in supply chain performance.

Table 6-39: Mean value on challenges in managing supply chain performance

Challenges in managing supply chain performance	Mean	SD	Mode	Freq.
Lack of data consistency	3.14	0.829	3	44
Lack of inter-departmental cooperation	2.9	0.937	3	44
Compliance with local content requirement	3.01	1.01	3	41
Instability of world oil prices	3.75	1.12	4	32
The need for fast completion at minimal cost	3.95	0.88	4	53
The need to manage urgency at minimal cost	3.96	0.8	4	52

It can be observed that ‘The need for fast completion at minimal cost’ and ‘The need to manage urgency at minimal cost’ recorded the highest mean of 3.95 and 3.96, respectively. Both attributes are concerned with the time aspect, which would always affect the cost. These two challenges are influenced by the higher cost involved in the industry. In this industry, the high cost is not only caused by transportation activities to deliver goods and services offshore, but is also added from the operation activities that involve multiple expertise. One of the ways to deal with these challenges is by having supply chain partners that are flexible on delivery term and agile in response to urgency (Sambasivan, Mohamed and Nandan, 2009). Nevertheless, the issue here is not only to deliver the services or goods, but instead to also deliver it at minimal cost. Thus, there is the need to have flexible contract with supply chain partners with agreed upon prices on urgent requirement. Although, suppliers would definitely increase the price for a shorter lead-time. But, advanced agreement may limit their bargaining power to put unnecessary cost in such event.

The next challenge is instability of global oil prices with a mean value of 3.75. This challenge has been cited in many researches in the oil and gas industry (Villar and Joutz, 2006; Al-Othman et al., 2008; Varma et al., 2008; Lima, Relvas and Barbosa-Póvoa, 2016). Not only that, this issue has also been discussed by the oil and gas institutions (Ernst and Young, 2016). In fact, Varma et. al., (2008) considered raw oil prices as one of the strategic objectives in supply chain.

The least challenge perceived by participants is the lack of interdepartmental cooperation. This might suggest that inter-department cooperation is not an issue in most oil and gas organisations. However, the size of companies involved in this study might also contributes to this outcome. Around 50% of the respondents came from small-sized organisations (less than 250 employees). Thus, these companies might not have clear segregation of functions due to their limited number of staff. Hence, the respondents perceived lack of inter-department cooperation issue as less relevant.

6.9 Determinant factors in choosing performance measures

Table 6-40 tabulates the details of determinant factors in choosing performance measures. At a glance, it can be clearly seen that the highest frequency (65) chosen by the organisations was profitability potential with mode of four. However, 'Desire for safety' was rated with the highest mean (4.4) in this construct. This is followed closely by company reputations with a mean value of 4.38.

The desire for safety implies the importance of this factor in managing supply chain performance. The oil and gas industry is exposed to high risks, thus, safety considerations are critical in determining safety performances. This is in line with the safety compliances measure, which is rated by surveyed organisations as the most important factor in Section 6.7.1.2.

Table 6-40: Determinant factors in choosing performance measures

Determinant factors in choosing performance measures	Mean	Mode	Freq	SD
Company objectives	4.18	4	57	0.702
Requirement of local content	3.37	4	44	0.914
Role of company in supply chain	3.45	4	45	0.936
Profitability potential	4.07	4	65	0.655
Desire for safety	4.4	5	53	0.791
Company reputation	4.38	4	50	0.663
Risk mitigations	4.05	4	53	0.744
World oil prices per barrel	3.7	4	39	1.132

Company's reputation is very important to the oil and gas companies. This is due to the fact that their operations required license to operate from the local government. In fact, reputational damage caused by environmental or ethical issues might result in high penalty by the local government. Moreover, pressures from the public such as environmental associations may lead the oil companies to discontinue their operation. The decision of Shell to quit their operation in the Arctic is one of those examples. This decision was made after they had spent around USD 7billion from the early stage of the project (Macalister, 2015).

The rest of the variables have mean values of greater than 4, except for global oil prices per barrel, role of company in the supply chain, and requirement of local content. The mean value for these three factors are 3.7, 3.45, and 3.37 respectively. The least score of requirement of local content raised further questions on which countries that rated this factor as the least scores. Based on the interview conducted in this research, it was suggested that the pressure on local content requirements is more on the companies that operated in developing countries than those in the developed countries. Apart from environmental protections and socially responsible practices, the local content in developing countries requires oil and gas companies to engage local suppliers. The following interview extracts explained this trend:

"The local content required us to deal with the local supplier where most of them are the middle person and do not have sufficient knowledge on product or services they provided." [Participant C]

"In my opinion, the following also applies when companies are working in a developed country such as the USA. Companies do not want to have environmental

issues, do not want to have oil spills, and do not want to have safety incidents. So, I think that has the big impact on companies. I think those factors are more important than cost and schedule. I mean, companies should be socially responsible, should protect the environment, and should operate safely" [Participant B]

"The local content can also be important in a developed country. This requirement includes to hire suppliers and workers from the country in operation". [Participant B]

In the extracts, Participant B is the supply chain expert from a developed country (USA) while Participant C is from developing country (Indonesia).

Table 6.40 indicates that 44% of UK organisations rated this determinant factor as high and very high. Meanwhile, 59% of Malaysian organisations rated this factor in similar range as the UK organisations. This finding is in accordance with the exploratory interview in the earlier phase of this research.

Table 6-41: Local content requirement according to country

Local content requirement	UK		Malaysia	
Very low	2	3.27%	2	5.1%
Low	7	11.5%	5	12.8%
Neutral	25	41%	9	23%
High	25	41%	19	48.7%
Very high	2	3.22%	4	10.3%
Total	61		39	

The understanding of the most important determinant factors rated by oil and gas companies provides some insight to academicians for further research in this field. On the other hand, practitioners may consider these factors as a guideline in devising their PMF.

6.9 Conclusion

This chapter has reported the outcomes of questionnaire survey undertaken in this research. This survey was conducted amongst oil and gas companies in the UK and Malaysia. The responses of the survey show that there is no major distinction between the UK and Malaysia on most constructs of this research. This implies that a separate analysis on the individual countries is not required.

This chapter also presented the prevalence of performance measures used in this industry. This validated the proposed performance measures for this research, which have been derived from the literature review in **Chapter 2** and interviews in Chapter 5. Moreover, this study also presents the performance measures based on the level of importance to the industry.

Additionally, the outcomes of the survey indicate that a majority of organisations in this industry prefers to adopt Prospector and Reactor strategies. Even though there is not much proof of organisations adopting Reactor in the previous research, there are some studies that support this outcome. Some examples of these industries are hospital industry and public sectors where innovations are a bit restricted. Furthermore, this research supported the assumption that the type of organisational strategy impacted the choice of performance measures. This is consistent with the organisational theory by Miles and Snow (1978) and the literature on this subject. The theory and literature claimed that organisational strategy influences the way organisations manage their business (Parnell and Wright, 1998; Miles and Snow, 1978).

Apart from that, this study demonstrated the link between organisational strategy and overall organisational performance. It reveals that Prospector indicates the highest correlation with overall organisational performance. This is followed by Reactor and then Analyser. This means that these strategies are able to produce superior performance in the oil and gas market environment. Accordingly, the link between the adopted strategy and each attribute of organisational performance is also presented. This provides information on the impact of each strategic adaptation on the specific organisational performance attributes. In essence, it reveals which performance attributes are largely influenced by the adopted strategy.

This study also proved that the usage of performance measures has a positive impact on organisational performances. This supports the RBV theory and the literature that claimed PMF is a critical tool in determining organisations' success. Furthermore, it also reveals the most influential measures that lead to superior organisations' performance.

The challenges in managing supply chain performance are also discussed in this chapter. The highest challenges rated by the industry are the need to manage urgency at minimal cost and the need for fast completion at minimal cost. Understanding challenges in managing supply chain performance would help organisations to prepare alternative solutions in advance.

The last section of this chapter discussed the determinant factors in choosing performance measures for this industry. The factors that need consideration in designing performance measurement framework are revealed.

This chapter provides useful information for researchers and practitioners with regards to supply chain performance measurement. Findings and analyses in this chapter expand the literature on organisational theory, RBV, performance measurement framework, and its impact on organisational performance. Further research can be conducted to explore the prevalence measures, strategic types, most influential measures, its determinant factors and challenges in a more in-depth manner. On the other hand, industrial practitioners can utilise the information to strategies their supply chain management. In particular, this information aids in the decision-making processes that are related to organisational strategies and performance measures options to attain the intended performance outcomes.

CHAPTER 7

THE DEVELOPMENT OF PERFORMANCE MEASUREMENT FRAMEWORK

7.1 Introduction

This chapter will discuss the outcomes of the interview as explained Chapter 5 and questionnaire in Chapter 6. The chapter begins by discussing the development of performance measurement framework and its application. The understanding of the usage of performance measurement framework as a tool to gain competitive advantage will also be discussed from RBV perspectives. This is followed by a discussion on the application of performance measurement framework from strategic perspectives based on the organisational fit theory.

7.2 Performance measurement framework

The literature review of the supply chain performance measurement in general, oil and gas supply chain, and oil and gas reports were studied. The literature has assisted in the creation of the interview questions. The interviews were conducted with five supply chain experts to explore the performance measurement framework for the oil and gas supply chain. The outcomes of the interviews have provided an overview on the performance measurement issues in the oil and gas industry. These issues include the importance of performance measurement in the oil and gas industry, the characteristics of upstream and downstream sectors of the industry, determinant factors in choosing performance measures, and challenges in managing supply chain performance. The interviews reveal that measuring supply chain performance is very important in the oil and gas industry. This is due to the high reliance on supply chain networks in accomplishing the operations. This emphasises that a study on supply chain performance measurement framework of the oil and gas industry is worth exploring.

The interviews have discovered the application of commonly used performance measures from the literature in the oil and gas industry. The application of the performance measures in the oil and gas industry which has been discussed in Chapter 5 is used as a basis to propose a list of performance measures. Table 7.1 presents a summary of the discussion which was restated from Chapter 5, Table 5-10.

Table 7-1: The application of most common performance measures in the oil and gas industry

Performance measures	**Issues**	**Application in the oil and gas industry**
Quality measures	-Very important - Requires involvement of multiple departments to assess services quality	-Actual performance to the specifications -Quality compliance certification -Number of reworks -Number of rejects
Flexibility	-Very subjective and less common in this industry	-Flexibility in supply chain strategies based on the current market
Innovation	-Very subjective and less common in this industry -Need to plan prior to project execution -Focus on operating systems -Relevant to the strategic level	-By getting more oil out, or getting oil faster or moving it faster -Packaging or contracting strategy or terms and condition -Developing environmental friendly working conditions -Supplier initiative in facilitating organisation on financial and non- financial aspects
Cost/price	-Straight forward -Easy to quantify -Can be easily compared with financial target	-Total cost of ownership/ return on investment -Use world oil price per barrel as a benchmark -Compare against the lowest offer from the market
Delivery reliability	-Very important -Straight forward and can be quantified easily	-Used to assess supplier performance
Delivery speed	-Relevant and straightforward to measure	-Use no– delay of the main work-barge vessel as an indicator for delivery speed
Safety measures	-First priority in the oil and gas industry	-Use safety monitoring record to manage this measure -Number of safety compliance records -Safety to the people, equipment, and environment -Safety training -Safety requirements that are stated in the contract will be cascaded down to all the vendors
Environmental and corporate social responsibility	-Important to the oil and gas industry -Part of local content requirements -Can improve corporate image of company	-Not buying goods or services from companies that use child labours -Providing job opportunities for local communities through on the job training -Engaging local suppliers -Feed the poor and less fortunate -Financial support for orphanage shelter -Environmental campaigns

There are also some additional performance measures proposed by the interviewees which resulted into the final list of 21 performance measures.

This list is included in the questionnaire for the survey to be conducted amongst the UK and Malaysia oil and gas companies. The quantitative analysis was conducted to compute the mean for each performance measure to identify the level of importance of each measure. Table 7-2 presents the list of performance measures based on the level of importance.

Table 7-2: Performance measures based on the level of importance

Ranking	**Performance measures**	**Mean**	**SD**
1	Safety compliance	4.59	0.57
2	Product/ services quality	4.48	0.674
3	Product/ services reliability	4.39	0.6
4	Cost saving	4.33	0.711
5	Flexibility in meeting customers' needs	4.29	0.729
6	Safety training	4.29	0.795
7	Timeliness	4.21	0.656
8	Return on investment	4.18	0.687
9	Process compliance	4.14	0.752
10	Ethical business	4.12	0.795
11	Supplier reliability	4.09	0.754
12	Accuracy of schedule	4.08	0.734
13	Supplier flexibility	3.92	0.8
14	Environmental pollutant control	3.88	1.017
15	Forecast accuracy	3.85	0.77
16	Reduction of waste	3.68	0.963
17	Technology innovations	3.62	0.94
18	Innovation in operations	3.59	0.865
19	Supplier compliance on social responsibilities policy	3.58	0.966
20	Number of innovation ideas generated	3.45	0.89
21	Investment in charitable programmes	3.08	0.976

The list of performance measures based on the level of importance gave an insight on the main concern of the area of performance in the oil and gas industry. It can be observed that safety compliance was found to be the most important measure to the industry more than any monetary performance. The rank of performance measures also indicated that the cost savings is ranked as the fourth important measure which is contradictory with the research on the competitive priority conducted in the oil and gas industry. Nevertheless, the current low oil environment might influence the level of importance of cost savings in this research. The mean scores of the performance measures are more identified to be more than 3.5 out of 5 with the exception of number of innovation ideas generated and investment in charitable programmes, hence, it is substantial to put these measures under consideration. One possible reason for the low mean value for number of ideas generated since it is not a measure that is always required throughout day-to-day operations. On the other hand, investment in charitable programmes is normally tackled from the organisation level and is not necessarily handled by supply chain operation. In fact, based on Table 3, investment in charitable programmes is part of the environmental and social responsibility dimension where other performance measures under the same dimensions have mean values larger than 3.5. Thus, it can be concluded that the investment in charitable programmes measure might not be directly handled by supply chain management of an organisation.

7-2 The application of performance measurement framework

Survey and followed by statistical analysis were undertaken to investigate the impact of the usage of performance measures. In this regard, a correlation analysis is conducted to examine the link between performance measures and organisational performance. The study shows that the usage of performance measure has led to better performance. In essence, organisation that emphasises on cost savings has a better cost savings performance. This applies for other performance. Not only that, the outcomes of the analysis demonstrated the most influential performance measures in determining organisational performance. Innovation measures were found to be the most influential measures in determining the overall organisational performance. This is followed by process compliance measure which suggests a well-governed organisation is an organisation that places great emphasis on process compliance has a better overall performance.

A regression analysis is conducted to investigate the combined effects of performance measures on the organisational performance. It was found that the usage of performance measures has 48% explanatory power in predicting organisational performance.

Based on that outcome, the following performance measurement framework is proposed in Table 7-3.

Table 7-3: Performance measurement framework for the oil and gas industry

Dimensions	Performance measures	Mean	SD
Operation	Products/ services quality Product/ services reliability Flexibility in meeting customers' needs Timeliness Process compliance Supplier reliability Accuracy of schedule Supplier flexibility	4.48 4.39 4.29 4.21 4.14 4.09 4.08 3.92	0.674 0.6 0.729 0.656 0.752 0.754 0.734 0.8
Safety	Safety compliance Safety training	4.59 4.29	0.57 0.795
Innovation	Technology innovations Innovation in operations Number of innovation ideas generated	3.62 3.59 3.45	0.94 0.865 0.89
Environmental and corporate social responsibility	Ethical business Environmental pollutant control Reduction of waste Supplier compliance on social responsibilities policy Investment in charitable programmes	4.12 3.88 3.68 3.58 3.08	0.795 1.017 0.963 0.966 0.976
Financial	Cost saving Return on investment Forecast accuracy	4.33 4.18 3.85	0.711 0.687 0.77

Five main dimensions are proposed based on the outcomes of regression analysis. The dimensions are operation, safety, innovation, environmental and corporate social responsibility, and financial. The performance measures of each dimension are arranged according to the level of importance based on the mean value. The framework is not rigid, but can be used as a guide in measuring supply chain performance for the oil and gas supply chain. From this framework, an individual company can make some adjustments to suit their business activities.

7.3 Theoretical implications

7.3.1 RBV theory

RBV theory suggests that in order to sustain competitive advantage, the capability to create the advantage is supported by valuable, rare, non-transferable, and difficult-to-replicate resources (Sirmon et al., 2011; Barney, 2012). This research attempted to position performance measurement framework as an important resource in line with RBV theory. The findings from interviews and quantitative findings support this theory.

The importance of managing supply chain performance or internal resources as a core for competitive advantage has been presented in Chapter 3. Nevertheless, in order to deploy performance measurement framework as a basis for competitive advantage, it essential for it to be designed in a way that is valuable, inimitable, and non-transferable. Table 7-4 depicted PMF from RBV perspective.

First, from the valuable aspect, the performance measurement framework has to be designed with the consideration of a balanced approach and should be able to give true meaning to measure organisational performance. In addition, it is important to know the most important measures in evaluating organisational performance. Then, the responses from the interviews suggested that it is equally important to have a culture than wanting to use the performance measurement framework.

"People who are so experience tend to say, I will use my experience and judgement rather than driving hard to insist the accurate information is captured." [Participant A]

"I think there are companies who have bought a lot of gadgets to measuring performance but haven't put it into the culture." [Participant A]

"Then, getting people outside of supply chain to focus on performance measurement can be very difficult. Because most of the time they are being asked to get the job completed and when you say we should be measuring stuff, they might probably come back and say I'm not interested in it and it has no value to me." [Participant B]

In other words, the ability and willingness of employees to integrate the usage of the framework to facilitate continuous improvement is one of the RBV key competencies that will create competitive advantage. This commitment is considered to be socially complex skills which requires time to develop since itis a Rareness aspect of capability.

From a non-transferrable aspect, the PMF needs to be updated by the organisations to reflect their organisations' needs. This requires joint efforts from multiple departments to make it successful. The need to constantly update performance measurement and metrics which depend on business advancement has been highlighted by Gunasekaran et al. (2007) and Neely et al. (2005). Finally, the complex skills set in managing performance measurement framework including the use of systematic data recording system should be able to hinder this resource from being imitated by other competitors. This also includes having frequent meetings to identify current progress and ways of improving it (Gunasekaran and Kobu, 2007). In essence, this study argues the design and management commitment in implementing PMF is a key RBV competency in attaining success.

Table 7-4: Performance measurement framework from resource-based view perspectives

RBV characteristics	Valuable	Rareness	Non – transferable	Inimitable
Performance measurement framework	The design of performance measurement framework that consider balanced approach and able to give the true meaning of company performance.	A socially complex resource involving a culture that wanting to use PMF as a tool in improving performance	A socially complex resource involving multiple departments in providing inputs in updating the measures where necessary	The complex skills set in managing performance measurement framework including the use of systematic data recording system create competitive advantage which difficult to imitate.

7.3.2 Organisational fit theory

This research shows that the oil and gas industry can be classified according to strategies adaptation is consistent with Miles and Snow (1978) organisational fit theory. This study reveals that there is an association between organisational strategies with the choice of performance measures. In other words, it supports most performance measurement literature that suggests the need to derive performance measurement framework from firms' strategies (Parker, 2000; Gunasekaran, Patel and McGaughey, 2004; Neely, 2005). The marginal support on the effect of the size of organisational strategies indicates that strategies adaptations are not influenced by the size of organisation. The oil and gas industry has found to have more Prospector and Reactor strategies based on the mean values. On top of that, it was revealed that Prospector is the most influential strategy in determining success of an organisation. This is closely followed by Reactor. The third strategy that indicates a significant correlation with overall organisational performance is Analyser while there is no association between Defender and overall organisational performance. The association between organisational strategies with the choice of performance and organisational performance shows that the usage of performance measurement framework can be understood from a strategic perspective.

7.4 Conclusion

This chapter has presented the understanding of performance measurement framework for the oil and gas industry from both the exploratory interviews and survey. Also, the discussion demonstrates how the findings of this research support both RBV and organisational fit theories.

CHAPTER 8

CONCLUSION

8.1 Introduction

This chapter discusses the conclusion drawn from this study. The chapter begins by restating the research aims and objectives, research methodology, and major processes performed in this study. Moreover, it presents the conclusion by restating the research questions and providing the findings and justifications. The chapter also outlines the unique contributions of the research, limitations, and recommendations for further research.

8.2 An overview of the research

The main aim of this research was to study the performance measurement framework of the oil and gas supply chain. In particular, the study aims to identify the prevalence of performance measures in the industry and the influence of performance measures on organisational performance. In addition, it also investigates the impact of organisational classifications on both the choice of performance measures and organisational performance.

In order to understand performance measurement framework of the industry, extensive review of literature on supply chain management, oil and gas industry, and performance measurement was conducted. The term, Supply Chain Management (SCM) was introduced in the late 1980s and became widely used decades later (Cooper et al., 1997; Gunasekaran et al., 2004). The initial idea of SCM which was internally focused on logistics activities (Bechtel and Jayaram, 1997) and inventory management (Cooper et al., 1997) has now evolved into bringing supply chain functions together. The aim of the functional integration was to achieve common goals of efficiency and enhance customer satisfaction (Narasimhan et al., 2008). This development of supply chain functions indicates that integration is no longer between two organisations. Instead, it involves multiple internal and external functions across many organisations. The development of SCM was influenced, according to Gunasekaran *et al.* (2004), by a number of factors including an increase in business globalisation, the growth of international trade, ease of access to information, and environmental awareness. In addition, the increase in the importance of local content requirements, especially in developing countries and the guidelines of World Trade Organisation (WTO) have contributed to the development of SCM.

SCM has been viewed as a vital part of attaining competitive advantage through organisational efficiency and profitability (Gunasekaran et al., 2004; Hsu et al., 2009; Wildgoose et al., 2012). Kannan and Tan (2005) argued that an effective supply chain management is able to enhance firms' performance through managing lead-time, cost, product/ service quality, and responsiveness. Moreover, the increase in reliance on outsourcing activities in the non-core functions of organisations places more importance on the role of SCM (Wisner, 2003; Chen et al., 2004; Gunasekaran, et al., 2004; Pillai et al., 2010; Youn et al., 2014; Yusuf et al., 2014).

In line with this, there is a significant body of research which demonstrated the need for performance measurement to enhance supply chain improvement (Gunasekaran and Kobu, 2007; Elrod et al., 2013; Arif-Uz-Zaman and Ahsan, 2014; Shafiee, et al., 2014). Academic interest in the supply chain performance measurement can be observed from the high number of research discussions on this subject. The research on this subject has started in the early 1980s when authors expressed the need for the development of a balanced and comprehensive performance measurement (Bourne, 2000). They argued that new frameworks should be designed to encompass the need to evaluate both financial and non-financial measures (Kaplan and Norton, 1992; Bourne, 2000).

Despite the fact that research interest in supply chain performance measurement has gained popularity over the years, Maestrini *et al.* (2017) argued that it is still new and incomplete for various reasons. Firstly, the SCM scope began to evolve from being identified as integrated logistics functions only two decades ago (Cooper et al., 1997). Secondly, different functions such as operations management, information management, and accounting usually used different labels. Similar to the supply chain concept, performance measures are unique to individual organisations (Bai and

Sarkis, 2012). This underlines the need for research in performance measurement in specific industrial settings. There are a number of empirical studies which have been conducted on performance measurement in various industries, but the oil and gas sector is still considered underexplored.

The literature and corporate reports on the oil and gas industry were studied to understand the nature of the industry. The literature suggests that there are several distinguishing characteristics of the oil and gas supply chain. These include long supply chain links which require the involvement of multiple business sectors, the use of expensive machinery requires specialised logistic services, influence from political factors and regulations by local government, the locations of business activities in the upstream sector are influenced by locations of their natural resources, and the high exposure to risks. Hence, there is the need to consider these characteristics in the management of oil and gas supply chains.

Furthermore, the discussion on performance measures in **Chapter Two** indicates the growing need for incorporating sustainability measures such as environmental and social responsibility measures (Chenhall and Langfield-Smith, 2007; Shell Royal Dutch, 2009; BP p.l.c, 2016; Exxon Mobil Corporation, 2016) in the performance measurement system of the industry. In addition, the corporate reports from major oil and gas producers emphasise the criticality of safety measures in this industry (Shell, 2009; BP p.l.c, 2016; Exxon Mobil Corporation, 2016). These factors were taken into consideration in proposing a final set of performance measures for the industry.

This research adopted a mixed method approach which is initiated with exploratory interviews and a survey. The interview serves as an exploratory study due to limited academic research on the oil and gas supply chain. Five supply chain experts were involved in this interview to discover the most important performance measures of the industry and explore other relevant issues such as the contextual meanings of the individual measures as identified from the literature review. This activity produced a refined set of performance measures. A conceptual model was then developed consisting of three major constructs, namely, organisations' classifications, a set of performance measures, and organisational performance. Following the outcomes of these interviews, a questionnaire was developed to empirically test the proposed set of performance measures. The findings also verified the relationships demonstrated in the proposed conceptual model with a larger group of respondents. The survey was undertaken amongst randomly selected oil and gas companies in the UK and Malaysia. The questionnaires were mailed to 550 companies drawn from the UK and electronic survey of 120 companies in Malaysia. The questionnaires were addressed to the CEOs and supply chain managers.

The outcomes of the survey provide information on the prevalence of performance measures in this industry. In addition, it also proved that there is a significant relationship between the strategy adopted by an organisation with the choice of performance measures and organisational performance. Furthermore, it demonstrated the significant link between the usage of performance measures and organisational performance. Other than that, it presents other relevant performance management issues such as determinant factors in choosing performance measures and challenges in managing performance. The details of these findings have been presented in **Chapter Six** of this thesis.

8.3 Findings of the research

The purpose of this research is to study the performance measurement framework in the oil and gas supply chain. In doing this, four research questions were investigated. The research questions and their relevant findings are as follows:

8.3.1 Research question 1

R1: What is the prevalence of performance measures in the oil and gas industry?

A number of authors have suggested that supply chain management is influenced by the industry that the related organisations are operating in (Otto and Kotzab, 2003; Gunasekaran and Kobu, 2007; Kumar and Markeset, 2007; Hsu et al., 2009; Kumar and Nambirajan, 2013). Similarly, supply chain performance measurements are also unique to each individual organisations (Bai and Sarkis, 2012) and are influenced by business strategies adopted by the organisations or industry. Therefore, there is a need for further research on industry-specific performance measures (Gunasekaran et al., 2004; Shepherd and Günter, 2006; Gunasekaran and Kobu, 2007; Taticchi et al., 2013).

The findings of this research indicate the prevalence of performance measures based on the level of importance in the oil and gas industry. In this regard, safety compliance was found to be the most important performance measure based on the mean value (4.59). This is followed by services/ product quality (4.48) and product and services reliability (4.39). This is in line with previous research on performance measurement which suggests that customer satisfaction is the main focus of the organisation. Researchers argued that quality and reliability are the main factors in achieving customer satisfaction (Chen et al., 2013; Varma et al., 2008b; Gunasekaran et al., 2004). Even though safety compliance was not widely discussed within the supply chain literature, it is recognised as the most important measure in the oil and gas industry due to the high exposure of risks. The finding also reveals that most of the innovation measures were ranked among the least important performance measures. Unlike other industries such as automotive, electronic, and fashion industries (Sukwadi et al., 2013), the final products/ services of the oil and gas industry have very minimal differentiation (Chima and Hills, 2007). Therefore, innovation measures are less prevalent in this industry.

8.3.2 Research question 2

R2: What is the impact of the size of organisation on the organisational strategies?

The correlation analysis conducted between the size of organisations based on a number of employees and turnover shows no significant correlation with the majority of strategies. The only exception is between the number of employees and Defender that indicates a correlation value of -0.309 which is in a reversed direction. The finding contradicts findings from a previous research conducted in an SME manufacturing company in the UK (O'Regan and Ghobadian, 2006). One possible explanation for this is that Defender strategy is more common in a mature and stable environment. Thus, the bigger the organisation, the less likely it is to adopt Defender strategy in order to survive in the oil and gas industry. This is due to the fact that the oil and gas industry is considered as having mixed-environment turbulence and highly regulated based on the most dominated strategies: Prospector and Reactor. Nevertheless, the insignificant correlation between the size of organisations in terms of number of employees and turnover with other types of strategies suggests that the result might be driven by other factors. Therefore, based on this finding, there is no strong evidence to support the link between the size of organisation and organisational strategies.

8.3.3 Research question 3

R3 What is the impact of organisational classifications on the choice of performance measures?

The organisational classifications investigated in this research are organisational strategies and organisational size.

8.3.3.1 The impact of organisational strategies on the choice of performance measures

This research has shown that there is a correlation between organisational strategies and their choice of performance measures. Two of the strategies, Prospector and Reactor correlated with a broader range of performance measures in comparison to Analyser and Defender. Looking at Prospector, it correlated with seventeen performance measures. Out of these measures, it highly correlated with innovation measures which are innovation in operation, technology innovation, and innovations idea generated.

Prospector was found to be the only strategy that correlated with environmental and social responsibilities measures. The characteristics of Prospector which are highly innovative and leading the market with new products and services would explain their association with these measures. Analyser presents a positive correlation with two performance measures of supplier reliability and product or services quality. Supplier reliability shows a correlation value of 0.318 whilst product or service quality reads as 0.266. This strategy aims at minimising risk which explains the correlation with supplier reliability and services quality (Kazaz et al., 2015; Miles et al., 1978). The organisation adopting Analyser strategy is somewhere in between

Prospector and Defender (Afiff et al., 2013; Meier et al., 2010; Zahra, 1987). However, the mean value for Analyser in this study is ranked as the third most common strategy for this industry.

It was found that there is a correlation between Defender with the following performance measures: forecast accuracy and technology innovation. The correlation value for forecast accuracy is 0.321 at a significance level of 0.001 while technology innovations show a correlation value of 0.206 at a significance level of 0.04. As this strategy concentrated on single market segments and limited range of products, forecast accuracy is very important in managing the inventory level. This eventually will improve the management of resources. The resource efficiency can be improved by emphasising technology innovation (Lin et al., 2010). Thus, it could explain the association of Defender with technology innovation measure.

Reactor indicates a correlation with thirteen performance measures. Reactor is represented by three attributes which are high degree of centralisation, tight cost control, and strategy based on the reaction to change in the marketplace. This strategy was known due to its lacking in terms of its structure and was designed to only achieve short-term goals, which primarily focus on urgent matters (Helmig et al., 2014). The three highest correlation measures with Reactor were forecast accuracy, product/ services reliability, and flexibility in meeting customers' needs. Forecast accuracy indicates the highest correlation value of 0.382 at significance level 0.043. This seems rather contradictory as the importance of forecast is more prevalent in a structured strategy. However, a short-term forecast accuracy such as inventory level and cash flow forecast might contribute to this. The second highest correlation value is with product or services reliability (0.348) at the significance level of 0.00. This implies that this strategy is either product-oriented or service-oriented. Finally, the correlation with 'flexibility in meeting customers' needs indicates a correlation value of 0.320 at a significance level of 0.001. Flexibility is defined as the ability of organisations to respond to uncertainty in the market environment (Vickery et al., 1999). One of the elements of Reactor, 'strategy based on reacting to change in the marketplace may contribute to its correlation with flexibility in meeting customers' needs'.

In general, these two strategies: Prospector and Reactor, which dominated the participating organisations, indicate the highest number of correlations with performance measures. Nevertheless, there is no evidence that performance measures which did not correlate with any strategy are not relevant to these organisations. For instance, safety compliance indicates the highest mean based on the level of importance but demonstrates no significant correlation with any organisation strategy. It can be inferred that safety compliance is important for the oil and gas organisations regardless of their strategic adaptations.

8.3.3.2 The impact of organisational sizes on the choice of performance measures

The size of organisation studied was determined by the number of employees and the rate of annual turnover. There are correlations between both categories of organisations sizes (number of employees and turnover rates) and cost savings with correlation values of 0.211 and 0.199, respectively. This shows that the emphasis on cost-saving efforts increases with the increase in the size of companies. Other than that, the size of companies based on number of employees demonstrated a positive link with investment in a charitable programme. This finding is supported by previous studies that suggest a positive link between corporate social responsibility practices and size of organisations (Stanwick and Stanwick, 1998; Udayasankar, 2008; Laudal, 2011).

In addition, there is also a correlation between turnover rates and safety training measure with a correlation value of 0.212. Overall, the organisations’ size indicates no significant correlation with most of the performance measures. In fact, the four correlation values stated earlier are relatively low (less than 0.3). This shows that there is no strong evidence to support the link between the choice of performance measures and organisations’ size. This finding is in line with previous research by Lee and Yang (2010) who found no significant evidence to suggest a link between the size of organisations and the usage of performance measures.

8.3.4 Research question 4

R4: What is the impact of organisational classifications on organisational performance?

8.3.4.1 The relationship between organisational strategies and organisational performance

Out of the four strategies, Prospector reveals the highest number of correlations with organisational performance while Defender shows only correlation with 'forecast accuracy'. Looking at the Prospector, it can be observed that the highest correlations were with innovation performance (innovation of products/ services and system's innovations) with correlation values of 0.520 and 0.527. respectively at significance level of 0.00. As expected, prospecting organisations are succeeding in their innovation performance.

The third most common strategy, Analyser correlated with return on investment (ROI), supplier delivery reliability, the number of product/service defects have decreased, cost savings, and forecast accuracy. These are the performance attributes that show correlation values with Analyser of more than 0.3. These include return on investment with a correlation value of 0.410, the number of product/ services defects has decreased (0.397), and supplier delivery reliability with 0.395. Analyser attributes that focus on stable and turbulent markets make them the only strategy that correlates with the financial performance of ROI and cost savings.

Defender shows a correlation with only forecast accuracy performance. This strategy focuses on single market and this could explain why forecast accuracy is one of the main concerns. Despite that, the correlation value is rather low, at around 0.27.

Reactor correlated with five organisational performance attributes: company delivery reliability, supplier delivery reliability, innovation of systems of works, flexibility on supply chain strategies, and delivery speed. However, only delivery reliability performance has a correlation value of more than 0.3. The key characteristic of this strategy is based on reacting to change to the environment and this explains the level of correlation with delivery reliability performance. Accordingly, all sixteen organisation attributes were grouped into overall organisation performance. Thereafter, a correlation analysis was conducted between each type of strategy and overall organisational performance. The results of analysis reveal that Prospector outperforms other strategies by demonstrating the highest correlation value of 0.466. This was followed by Reactor, 0.355 and Analyser with 0.272. It also indicates that there is no significant relationship between organisations adopting Defender strategy and overall organisational performance. The findings that demonstrated the superior performance for adopting Prospector and Reactor support the idea of industry-specific choice of strategies (Hambrick, 1983; Zahra, 1987; Helmig et al., 2014).

8.3.4.2 The impact of organisational sizes on organisational performance

Correlation analyses were undertaken between two categories of organisational size, number of employees, and turnover rates with overall organisations' performance. The outcomes of this analysis indicate that there is no significant correlation between organisations' size and overall organisational performance. In essence, organisational size is not a factor that influences the performance of an organisation. This finding is in line with a previous study by Wu et al. (2006) that reveals firms' size has no effect on their performance. Another study by Orlitzky, (2001) also proved that there is no link between organisational size and social and financial performance.

8.3.5 Research question 5

R5: What is the impact of the choice of performance measures on organisational performance?

8.3.5.1 Correlation analysis between the choice performance measures and organisational performance attributes

In general, the outcomes of the study indicate that there is a correlation between the chosen performance measures and the corresponding organisational performance attributes. There is a correlation between a chosen performance measure and how well organisations perform when evaluated using that measure. For instance, from the results of the analysis, cost savings demonstrated the highest correlation as cost savings have improved. This was the case for most of the performance measures. Thus, the choice of performance measure has significant positive impact on the organisational performance. Furthermore, the broader implications of this is that when organisations measure an aspect of what they do, they tend to do particularly well in that aspect of their business. This underscores the salient importance of performance measurement in that it focuses on what is being measured and facilitates monitoring and control leading to desired or better outcomes. But, more importantly, this is a conclusive proof that the usage of performance measures can enable overall organisational improvement. This finding is important in that it lends support to performance measurement system as a potential critical resource upon which a firm could compete in line with resource-based view theory.

Also, it was observed that innovation and safety measures show the highest correlation values with the corresponding similar organisational performance attributes. In other words, emphasis on innovation and safety measures has a greater impact on the corresponding similar organisational performance when compared to other performance measures.

The process compliance measure records the highest number of correlations with the stated organisational performance indicators. This measure correlates with thirteen organisational performance indicators in which the highest correlation value is with process compliance performance. This suggests that the choice of process compliance measure has an impact on various areas of performance of an oil and gas organisation.

8.3.5.2 Correlation analysis between choice of performance measures and aggregated organisational performance

The correlation analysis between performance measures and aggregated organisational performance was undertaken. Out of the twenty-one performance measures, PM13 (innovation in operation) demonstrates the highest correlation value of 0.561 and is followed by PM14 (technology innovation) with a correlation of 0.529. These signify that the use of these two measures has a greater impact on the overall organisational performance in comparison with the rest of the performance measures.

The third highest correlation with aggregated organisational performance is PM11 (process compliance) with a correlation value of 0.527. A possible explanation for that is an organisation that emphasises process compliance is presumed to have a well-structured governance. Therefore, most of the areas of performance in these organisations receive comprehensive attention by the manager which led to a better performance. This is in line with the previous studies that demonstrated a significant positive relationship between well-governed organisations and their performance (Bauer et al., 2008; Andreou et al., 2014).

8.3.5.3 Regression analysis between clustered performance measures and aggregated organisational performance

A regression analysis between clustered performance measures and aggregated organisations' performance was conducted. Prior to this analysis, a list of performance measures was clustered together into five main groups based on the outcome of a factor analysis. These clusters are Innovation, Safety, Financial, Environmental, and Social responsibility, and Operations. The findings validated the outcome of correlation analysis where performance measures have 49% predicting power in explaining aggregated performance. This also suggests that performance measure is a critical resource in enhancing organisation performance within this industry. In addition, it reveals that innovation has the highest contributing power in explaining the model.

Table 8-1 summarises the research questions and their findings which has been discussed earlier

Table 8-1: Summary of the research questions and findings

Research questions	Findings
R1: What is the prevalence of performance measures in the oil and gas industry?	The performance measures based on the level of importance are identified
R2: What is the impact of the size of organisation on organisational strategies	There is no strong evidence to suggest the link between the size of organisation and organisational strategies
R3: What is the impact of organisational classifications on the choice of performance measures?	i)There is a significant impact between strategic adaptation and the choice of performance measures ii)There is no strong evidence to suggest the impact of organisational size on the choice of performance measures
R4: What is the impact of organisational classifications on organisations' performance?	i)There is a significant impact between strategic adaptations and organisations' performance ii) There is no impact of organisational size on organisational performance
R5: What is the impact of the choice of performance measures on organisations' performance?	i) There is a positive relationship between the choice of performance measures and organisations' performance ii) There is a significant positive impact on the usage of a set of performance measures and overall organisations performance

8.3.5 Challenges in managing supply chain performance

There are six challenges in managing performance metrics as identified from the exploratory interviews which were discussed in **Chapter 5**. These challenges lack data consistency, lack inter-departmental cooperation, compliance with the local content requirement, instability of global oil prices, the need for fast completion at minimal costs, and the need to manage urgency at minimal cost. In the second phase of the research, participants were asked to rate the level of each challenge ranging from very low to very high faced by them within their organisation. 'The need for fast completion at minimal cost' and 'The need to manage urgency at minimal cost' were recognised as the highest challenges. Both challenges are concerned with the lead-time aspect which would always affect cost.

In addition, these two challenges are also influenced by the higher cost involved in the industry. One of the ways to deal with these challenges is by having supply chain partners that are flexible on delivery terms and agile in responding to urgency (Sambasivan et. al, 2009). Also, there might be the need to have a flexible contract with supply chain partners with agreed-upon prices on urgent requirement. On the other hand, the least challenge perceived by participants is the lack of interdepartmental cooperation. This might suggest that inter-departmental cooperation is not an issue in most oil and gas organisations

8.3.6 Determinant factors in choosing performance measures

The determinant factors in choosing performance measures from the most important to the least important were identified. The 'Desire for safety' was recognised as the most important determinant factor in choosing performance measures. This is followed closely by 'Company reputations' whilst the least important factor is 'Requirement of local content'. The position accorded to 'desire for safety' is indicative of its importance in managing oil and gas supply chain. The oil and gas industry is exposed to high risk, thus, safety considerations are critical in devising a set of performance measures. Also, 'Company reputation' is very important to the oil and gas companies. This is due to the fact that their operations require licenses from the local government to operate. In fact, reputational damage caused by environmental or ethical issues, for example, could result in a high penalty by the local government.

The local content requirement was considered as the least important factor in designing performance measurement framework. This is because the demand for the local content requirement is higher in companies that operate in developing countries than in developed nations. The surveyed organisations involved in this research are comprised of more UK companies than Malaysian companies which might contribute to this finding.

8.4 Contributions

With outsourcing on the increase, enhancing supply chain performance is critical to compete in today's marketplace (Lambert and Cooper, 2000; Fernandes, Barbosa-póvoa and Relvas, 2010; Wildgoose, Brennan and Thompson, 2012). In line with this trend, research on supply chain performance management has gained the attention of both the academic and supply chain practitioners.

Early research in performance management was of a generic nature such as the work of Neely, Gregory and Platts, (1995) and Beamon, 1999. Other works are industry-specific, for example, Chen et al. (2013) looked at the healthcare industry while Greatbanks, (2007), Zin et al., (2013) and Spekle and Verbeeten, (2014) focused on the public sector. There are also studies that focus on the manufacturing industry (Bourne, 2000; Sambasivan, Mohamed and Nandan, 2009; Khani and Ahmadi, 2012; Cheng, Lee and Chen, 2014; Lucato et al., 2014). But, the works on the manufacturing industry are mainly concerned with discrete manufacture whilst the oil and gas sectors remained under-researched.

Varma et al., (2008) studied the performance measures in the oil and gas industry. However, their research was only concerned with the downstream sector of the industry and neglected the equally important upstream segment. Kumar and Markeset (2007) stated that operators of complex oil and gas production facilities in the upstream sector are becoming increasingly dependent on service providers to support their efforts to perform according to demands. This highlights why it is important to consider this sector in attempting to understand the supply chain performance of the whole industry. More importantly, the research by Varma et al. (2008) simply presented the prevalence of performance measures without exploring them as organisational resources. The research reported in this thesis has empirically demonstrated for the first time that performance measures are organisational resources and potential enablers of competitiveness in consonance with the resource-based view of the firm.

Also, given that not all of the performance measures will be used simultaneously at all time by individual organisations, there is the need to explore what informed the choice of the set of measures being used. In addition, it is also important to determine the impact of this choice on organisational performance.

Despite many studies have stressed the importance of performance measures in determining the success of organisations, there has not been empirical evidence offered to support this claim. This study provides a firm empirical basis underpinning the roles of performance measures in organisational success. Furthermore, the outcomes of this study not only demonstrated a significant relationship between performance measures and organisational performance but also identified the most influential measures that led to better performance. This study revealed that innovation measures have a greater impact on performance than other measures. However, the innovation measures are less prevalent within the oil and gas industry. Finally, it has been clarified that innovation measures are most influential in determining the success of the oil and gas supply chain.

Secondly, this research demonstrates the influence of strategic adaptations on the choice of performance measures. For the first time, the research reported in this thesis has correlated typologies of organisations, based on Miles and Snow's organisational fit theory, to the choice of performance measures for the oil and gas industry. This is important as the research brings clarity to which set of measures to choose depending on the strategic adaptation of an organisation. In addition, it expands the literature on organisational fit theory by Miles and Snow (1978) on strategies adaptation in the oil and gas industry. In essence, the findings of this research on strategic adaptations provide another perspective on the type of strategies adopted by organisation and its correspondence organisational performance. It was found in this research that both Prospector and Reactor strategies are excellent in contributing to organisational performance in the oil and gas industry. This finding contradicts with a majority of previous research that has proven Reactor strategy is less common in most high-performing organisation. Nevertheless, it supports some research that organisations that adopted Reactor strategy outperformed organisations that adopted the other three strategies in a public sector as in the case of hospital organisation (Gimenez, 2000).

Thirdly, this research provides some insights on the effect of the size of organisation on the strategies adaptations, choice of performance measures, and organisational performance. Drawing from the findings, there is no strong evidence to support the link between the size of organisations in terms of number of employees and turnover with the strategies adaptation, choice of performance measures, and organisational performance. The previous literature on the effect of size on these three mentioned variables is inconsistent. Therefore, these findings are opened for further research to examine the impact of size on that aspects.

Fourthly, this research has explored the determinant factors in choosing performance measures. These factors were sought from exploratory interviews with supply chain experts and are followed by survey in the form of questionnaires. The findings provide additional insight to understand the driving factors in devising a supply chain performance framework from the oil and gas perspectives. This study depicts the importance of desire for safety as the most important factor in the industry. Most literature on supply chain performance overlooked the importance of safety measure in their study. Despite that, there is one study on supply chain performance of the construction industry that highlights the need for safety measure (Halman and Voordijk, 2012). The need for safety factors in considering supply chain performance measures might be driven by the fact that this industry is exposed to high risk.

Finally, this research also presents some challenges in managing supply chain performance in the oil and gas industry. The understanding of these challenges will enhance academic knowledge pertaining to issues in the management of supply chain performance. Despite no link is examined for challenges with other research variables, it listed the challenges faced by the industry from the highest to the lowest. This might provide opportunities for more academic research to be conducted in understanding the challenges faced by the industrial practitioners and how they deal with that challenges.

8.5 Practical implications

The business characteristics of the oil and gas industry are influenced by external factors such as political climate, fluctuation of world oil prices per barrel, and geographical location of the oil and gas reservoirs. These factors are very least controlled by the oil and gas companies. Moreover, the long supply chain links and the involvements of multiple functions and expertise differentiate this industry from others. All these factors combined require an effective supply chain management. One of the ways to enhance supply chain performance is by measuring its performance. This study provides an understanding of the oil and gas supply chain in terms of the prevalence of performance measures across the industry, determinant factors in selecting performance measures, and challenges in managing performance. It also reveals the link between of strategic adaptations with the choice of performance measures and organisations performance. Hence, the findings of this research specify the factors that oil and gas companies need to focus on in designing performance measurement framework which can eventually improve their performance. The specific insights to aid managerial decisions are outlined as follows:

- The prevalence of performance measures provides general guidance to industrial practitioners in considering performance measures to be incorporated in their framework. In addition, it also highlights some determinant factors in choosing performance measures for organisations. This information will assist managers in designing an appropriate performance measurement framework for their organisations. Moreover, the findings of the study presented the challenges faced by the oil and gas industry in managing performance. This information is useful in order to draw alternatives in dealing with such challenges. Even though different companies might tackle this issue differently, this information can serve as a guideline for them.
- The significant positive relationship between performance measures and organisations' performance shows that the usage of performance measures will improve organisational performance. This suggests the need for oil and

gas companies to put great concern on devising appropriate performance measurement framework. In particular, this information aids in the decision-making processes that are related to performance measures options to attain the intended performance outcomes. Moreover, it specifies the potential measures in enhancing overall organisations' performance. The most influential measures in enhancing performance from the highest to the lowest are innovation in operation, technology innovation, and process compliance.

- The study also discussed the most common strategy adopted in the oil and gas industry and its impact on the choice of performance measures and organisations' performance. This information is useful for the industrial practitioners in deciding organisational strategy based on organisations' goals. The literature suggests that the strategy adopted by organisations will influence the way organisations manage their performance. As such, industrial practitioners may place emphasis on the specific performance measures that are closely related to their strategic options presented in this study.

8.6 Limitations of the research

This research was undertaken after an extensive review of the literature and the decision on methodologies was informed based on the understanding of various methods in the literature. The research also implemented some precautions to minimise research error and bias. Nevertheless, there are still some limitations to the study. The limitation could arise from research paradigm, methodology adopted, data collection methods, or bias from researcher interpretations. Some of the limitations of this study are as follows:

- There is a possibility of measurement error from the conceptual model devised by the researcher. Even though it has been justified and was developed from the extant literature, it is based on the researcher's interpretation on that subject. For instance, some of the performance measures which are the component of the conceptual model might be overlooked by the researcher. Therefore, other useful information might be excluded from this study.

- The development of the set of performance measures was also based on exploratory interviews with five supply chain experts. Thus, the nature of data using this method is subject to participants' perceptions toward the industry studied. Furthermore, only one participant from each organisation was interviewed which may not fully represent the population.
- The response rates of this research at 11% and 33% from the UK and Malaysia which are rather low. The total response rates from both countries amount to only 15%. Nevertheless, this response rate is acceptable considering that the survey is focused at the organisation level and not individual (Yusuf et al., 2014).
- The study was focused on the oil and gas industry in the UK and Malaysia. Therefore, generalisation cannot be made across other industries and regions.

8.7 Recommendations for further studies

The outcomes of this study have various implications for further research in the supply chain performance measurement framework. For instance, further research can be done to explore the most influential measures in the industry: innovation and process compliance. Since innovation measure was rated as amongst the least prevalent measure, a study can be done to investigate specific innovation efforts that are conducted within the industry and the drivers and barriers of innovation practices. This can be conducted either using case studies to explore innovation activities or through a survey to identify the most common innovation practices. Other than that, a relative study can be performed to explore innovation practices based on business operations within the oil and gas industry. A similar research can be conducted to study process compliance measures within the industry. From the organisational strategies, further research can also be conducted to explore the underlying reasons for the prevalence of Reactor and Prospector strategies within the oil and gas industry.

8.8 Summary

The main aim of this research was to examine supply chain performance measurement in the oil and gas supply chain. Based on the findings of this study, all the objectives have been met and research questions have been answered. The contributions to knowledge, practical implications, and limitations of the research have also been stated. Finally, recommendations for further research have been provided.

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APPENDIXES

Appendix I

Questionnaire

Appendix II

Cover letter for survey by questionnaire

Appendix III

List of questions for exploratory interview

Appendix IV

Letter of information for exploratory interview

Appendix V

Consent form for exploratory interview

APPENDIX I

University of Central Lancashire

1. Company name: ……………………………………………………………...

2. Respondent name: ……………………………………………………………

3. Respondent email: ……………………………………………………………

4. Respondent designation: …………………………………………………….

5. Number of employees work in this company: ……………………………….

6. Please indicate by a tick (√) the major area of operations of your company

Major area of operations	**Tick (√)**
Exploration and production	☐
Marine and subsea services	☐
Energy consultancies including geographical consultancies	☐
Transportation, storage, logistics, catering and allied services	☐
Well and drilling services	☐
Engineering services, facilities management, structure designs and fabricators	☐
Refining, refined oil distribution and marketing	☐
Others *(please specify)*:………………………………………	☐

7. What is the legal form of classification for your company? Please tick (√) one of the following;

- ◯ Sole proprietor
- ◯ Private limited company
- ◯ Public limited company
- ◯ Partnership
- ◯ Private unlimited company
- ◯ Others *(please specify)*: ……………………………..........

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

- ◯ Less than £25million
- ◯ £26million –£50million
- ◯ £ 51million – £100million
- ◯ £101million – £500million
- ◯ Above £500million *(please specify)*:……………………

9. Please indicate by a tick (√) the degree of the following statements that best reflect your company

Descriptions	**Very Low 1**	**Low 2**	**Neutral 3**	**High 4**	**Very High 5**
We focus on single market segments					
We do not encourage risk taking					
We encourage risk taking					
We search for new market with new growth opportunities					
We lead the market in introducing new product/ services					
We focus on maintaining stable growth					
We have high degree of centralization					
We have a market niche with a limited range of products					
We focus on relatively stable product market					
Our priority is on maintaining current markets					
We have a moderate emphasis on innovation					
We have tight cost control					
Our strategy is based around reacting to change in the market place					

10. Please indicate by a tick (√) the degree of the following factors that influence the choice of performance measures in your company.

Influencing factors	**Very low 1**	**Low 2**	**Neutral 3**	**High 4**	**Very high 5**
Company objectives					
Requirement of local contents					
Role of company in supply chain (i.e.operator or joint investor)					
Profitability potential					
Desire for safety					
Company reputation					
Risk mitigations					
World oil prices per barrel					
Others *(please specify):* ………………………………					

11. Please indicate by a tick (√) the level of importance of the following performance measures in your company

Performance measures	**Very low 1**	**Low 2**	**Neutral 3**	**High 4**	**Very high 5**
Cost saving					
Return on investment					
Accuracy of schedule					
Timeliness					
Product/ services reliability					
Supplier reliability					
Flexibility in meeting customers' needs					
Supplier flexibility					
Products/ services quality					
Forecast accuracy					
Process compliance					
Number of innovation ideas generated					
Innovation in operations					
Technology innovations					
Environmental pollutant control					
Reduction of waste					
Safety compliance					
Safety training					
Supplier compliance on social responsibilities policy					
Ethical business					
Investment in charitable programmes					

12. Please indicate by a tick (√) the degree of the following challenges in managing supply chain performance in your company

Challenges in managing supply chain performance	**Very low 1**	**Low 2**	**Neutral 3**	**High 4**	**Very high 5**
Lack of data consistency					
Lack of inter-departmental cooperation					
Compliance with local content requirement					
Instability of world oil prices					
The need for fast project completion at minimal cost					
The need to manage urgency at minimal cost					
Others *(please specify):*					

13. Please indicate by a tick (√) the degree of the following statements that best reflect the situation in your company

Descriptions	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly agree 5
Cost savings have improved					
Return of investment have increased					
Delivery speed are managed properly					
Planned schedule can be met					
Your company delivery is reliable					
Supplier delivery reliability has improved					
Your company is flexible on your supply chain strategies					
Your company is flexible on operation strategies					
The number of product/ services defects have decreased					
Innovation of products/ services are part of company's culture					
Innovation of systems of works is part of your company's culture					
Corporate social responsibilities programme have increased					
Company strategies always consider that environmental aspects are taken care					
Safety has become part of company's culture					
Company forecast are highly accurate					
Process compliance of your company are properly managed					

14. Do you have any other thoughts in regards to performance management of the oil and gas supply chain?

____

____

Thank you very much for your kind support

Please return this questionnaire to this address:

Masha Salsabiela Menhat (PhD student)
Greenbank Hub, School of Management
University of Central Lancashire
Preston, PR1 2HE **or email to: mnsmenhat@uclan.ac.uk**

APPENDIX II

Masha Salsabiela Menhat
Institute of Logistic and Operation Management
University of Central Lancashire
Date:

Dear Sir/ Madam

Re: Questionnaire survey on performance management of supply chain in oil and gas industry

I am undertaking a research project to investigate supply chain performance management in the oil and gas industry in the United Kingdom.

The research is conducted to study the prevalence of the performance measures in the industry, level of importance of the measures with the view to identifying the most influential measures based on types of organisations, and to identify the correlation between the way company manage their performance and their performance outcomes.

We would very much appreciate your contribution to this research by completing the enclosed survey form which would only takes around fifteen minutes of your time. It will be very helpful if the survey form could be returned within three weeks duration using the self-addressed paid envelope provided.

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

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

If you have any queries, please contact me on **+44(0)7513486994** or by e-mail at **mnsmenhat@uclan.ac.uk** **or** my supervisor, **Professor Yahaya Yusuf** on +44 (0) 1772 89 4534 or e-mail **yyusuf@uclan.ac.uk**.

Thanking you so much for your kind cooperation.

Sincerely,

MASHA SALSABIELA MENHAT
PhD. Student, Institute of Logistic and Operation Management
University of Central Lancashire

APPENDIX III

Semi – structured interview questions for performance measurement of supply chain in oil and gas industry

1. Please introduce yourself and briefly explain your experience in oil and gas supply chain.

2. As an experienced supply chain practitioner, what do you think of the importance of performance measurement in supply chain?

3. Is there any clear distinction in supply chain management between upstream, midstream, and downstream part of the oil and gas industry? If any, please explain the difference?

4. a) What are the performance measurement indicators that should be considered for performance evaluation of supply chain?

   b) What are the factors that influence the choice of performance indicators in oil and gas industry?

   c) What are the differences and similarities in performance measurement indicators at upstream, midstream, and downstream of the oil and gas supply chain?

5. Among the performance indicators mentioned earlier, what do you think are the most important indicators? Can you explain why?

6. In other industry like automotive, some practitioners believe that the supply chain performance indicators can be categorised into three hierarchical levels (i.e. strategic, tactical and operational levels). What do you think is the case in the oil and gas supply chain?

7. What are the obstacles you have experienced in managing the performance of supply chain in oil and gas industry?

Additional interview questions for performance measurement of supply chain in oil and gas industry

- Quality
- Flexibility
- Innovation
- Cost/ Price
- Delivery reliability
- Delivery speed
- Safety

The discussion will be based on the above list of performance indicators;

1) Are the performance indicators relevant to oil and gas industry?
2) How do you define each of the indicators in respect of oil and gas operations?
3) Do you use the above indicators in your own company?
4) Briefly explain the history of introducing the indicators in managing supply chain performance in your organisation
5) The impact and significance of the indicators.
6) Difficulties and challenges in using them as performance indicators.
7) Are the data of the indicators easily available and accessible when and where required?
8) Apart from the above indicators, what are the environmental and corporate social responsibility performance indicators in your organisation?
9) What are the financial and operation performance indicators in your organisation?

10) Do you have any other thoughts on the issue raised earlier?

Thank you very much

Masha Nur Salsabiela binti Menhat
PhD student, Institute of Logistic and Operation Management
Lancashire Business School
University of Central Lancashire
Preston, United Kingdom

APPENDIX IV

Masha Nur Salsabiela binti Menhat
Institute of Logistics and Operations
Management
University of Central Lancashire
Preston PR1 2HE, UK

Date: 30 March 2015

Dear Participant

This letter is an invitation to consider participating in a study I am conducting as part of my Doctoral Degree at the University of Central Lancashire under the supervision of Professor Yahaya Yusuf. I would like to provide you with more information about this project and what your involvement would entail if you decide to take part.

The main aim of this research is to develop a performance measurement framework for supply chain in the oil and gas industry. In order to do this, an exploratory study will be conducted by interviewing subject matter experts in the industry to gain insights into oil and gas supply chain performance measurement.

Participation in this study is voluntary. It will involve an interview session of approximately 30 to 45 minutes in length at a mutually agreed upon location in the UK or through video tele-conversation. The attached interview questions are also included in this email for your advance information. If, however, you feel uncomfortable in any way during the interview session, you have the right to decline to answer any questions or to end the interview.

Should you wish to withdraw your contribution from this research, you can do so at any point in time before the data analysis, which will commence seven (7) days after the interview. Any data collected from the interview will be deleted permanently should you decide to withdraw from participation.

With your permission, the interview will be audio recorded to facilitate collection of information, and later transcribed for analysis. Shortly after the interview has been completed, I will send you a copy of the transcript to give you an opportunity to confirm the accuracy of our conversation and to add or clarify any points that you wish.

All information you provide is considered completely confidential. Your name will not appear in any thesis or report resulting from this study, however, with your permission anonymous quotations may be used. Data collected during this study will be retained in the University of Central Lancashire network with restricted access to researcher and supervisor only

If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please contact me on **+44(0)7513486994** or by e-mail at **mnsmenhat@uclan.ac.uk.** You can also contact my supervisor, **Professor Yahaya Yusuf** on +44 **(0) 1772 89 4534** or e-mail **yyusuf@uclan.ac.uk**.

I hope that the results of my study will be of benefit to organizations directly involved in the study as well as to the broader research and industrial community.

I very much look forward to working with you and thank you in advance for your assistance in this project by returning the consent form attached in this email.

Sincerely,

MASHA NUR SALSABIELA BINTI MENHAT
PhD. Student, Institute of Logistics and Operations Management,
University of Central Lancashire,
Preston PR1 2HE, UK

Professor YAHAYA YUSUF
Director of the Institute of Logistics and Operations Management,
University of Central Lancashire,
Preston PR1 2HE, UK

APPENDIX V

CONSENT FORM

PERFORMANCE MEASUREMENT OF SUPPLY CHAIN MANAGEMENT IN OIL & GAS INDUSTRY

Masha Nur Salsabiela binti Menhat
Institute of Logistic and Operation Management
Greenbank 201, University of Central Lancashire
PR1 2HE, Preston, United Kingdom

Please read the following statements and initial the boxes to indicate your agreement

Please initial box

	Yes	No
I confirm that I have read and understood the information sheet, dated ………….for the above study and have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	☐	☐
I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason.	☐	☐
I agree to take part in the above study.	☐	☐
I understand that it will not be possible to withdraw my data from the study after the commencement of data analysis (7 days after interview).	☐	☐
I agree to the interview / consultation being audio recorded.	☐	☐
I agree to the use of anonymised quotations in publications arising from this study.	☐	☐

Name of Participant	Date	Signature
Name of Researcher	Date	Signature