FRAMEWORK FOR KNOWLEDGE MANAGEMENT IMPLEMENTATION IN OIL AND GAS PROJECTS: CASE NIGERIA AND UK

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DECLARATION

LIVERPOOL JOHN MOORES UNIVERSITY

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ABSTRACT

This thesis examined the efficacy of knowledge management based systems and best practices that could be used to address operational issues in Nigeria. The research focussed on the experiences of senior managers in Nigeria and the UK. The research employed both qualitative and quantitative methodologies to capture all the relevant experiences of senior managers. The findings revealed a number of knowledge management variables that either facilitated or limited the effectiveness of knowledge management based systems. These were synthesised into a framework capturing seven-well defined stages. All these steps emerged as being related; they are comprised of independent variables. These steps were found to comprise of knowledge management technology approaches, knowledge management people approaches, knowledge management strategies and value enhancing practices.

The framework delineates the key variables that influence knowledge management based systems and highlights how value enhancing practices can be managed and implemented. The framework was developed from the key variables identified from the qualitative and quantitative analysis. Framework validation was by follow-up deliberations, which were conducted with managers in selected organisations in Nigeria and the UK. Reflecting on their experiences, the participants confirmed that the proposed knowledge management framework and its seven well-defined stages were central to the effectiveness of knowledge management in oil and gas projects.

This thesis concludes by reiterating that the strategies proposed in this research cannot be expected to resolve all knowledge management operational issues in Nigeria. However, their use defines an approach that is superior to the traditional approaches typically adopted and consequently merits far wider application.

DEDICATION

This thesis is dedicated

To my husband Dr. Ogheneochuko Christopher Ovbagbedia

and

My precious gift from God Ogheneoruese Zachary Ovbagbedia and all my children yet unborn

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CHAPTER ONE: INTRODUCTION TO THE RESEARCH

1.1 INTRODUCTION: NIGERIA AND UK ENERGY SECTOR

The oil and gas industry is an important sector of the economy and contributes significantly to Gross Domestic Product (GDP). The industry generates employment and income for a significant percentage of the population, and covers an extensive variety of technologies and practices of scale (OGER, 2009). For instance, between 2005 and 2009, UK energy companies invested over £43bn in the UK (OGER, 2009). In 2009 and 2010, the oil and gas sector: invested more than £5bn in the UK economy; spent £13bn on exploration, developments and operations; and contributed £9.4bn to the Exchequer in corporate taxes, an increase of 45 per cent over the previous two years, thus adding to the £276bn invested since the 1960s. It has provided employment for approximately 450,000 employees, many highly skilled, throughout the country (OGER, 2010; 2012; and Ernst and Young, 2012). The oil and gas sector has also developed a world class supply chain in the UK, especially in Scotland, which has grown rapidly and now exports goods and services worth in excess of £5bn per year to more than 100 nations. Investment in the UK Continental Shelf (UKCS) increased from £8.4bn in 2011 to £11.4bn in 2013 and companies have just under £100bn of capital investment in their current business plans (OGER, 2013).

The UK will have to invest a total of £200bn by 2020 to decarbonise its power industry, thus doubling the rate of investment over the last 10 years. However, every credible scenario indicates further growth in demand for oil and gas over the next 20 years and providing around 70 per cent of UK energy in 2020 (OGER, 2012). There are no simple or inexpensive solutions. Although energy efficiency has an important role to play, unparalleled levels of reserves will be required over the next two decades and the energy sector will have to carefully balance and optimise its indigenous oil and gas resources. The challenge is to capitalise on existing strengths and deliver cost effective resource recovery. The UK government’s approval of the UK's first new nuclear power station in a generation is one step towards low-carbon power and lower generating costs in future.

Nigeria is the twelfth largest producer of petroleum in the world and the 8th largest exporter, and has the tenth largest proven reserves. Petroleum plays a large role in the Nigerian economy, accounting for 40 per cent of GDP and 80 per cent of Government earnings. However, agitation for better resource control in the Niger-Delta its main oil-producing region has led to disruptions in oil production and currently prevents the country from exporting at 100 per cent capacity (World Bank ,2011; World Bank ,2008). Shell-BP discovered oil in the Niger delta region of Nigeria in the 50s, since then the Nigerian economy has been dominated by oil. The majority of the reserves are located in the Niger-Delta, but there have been recent discoveries in deep waters. In 2004, Niger Delta activists demanding a greater share of oil income for locals began a campaign of violence against the oil infrastructure, threatening Nigeria's most important economic lifeline (World Bank, 2011). Nigeria is keen to attract foreign investment but is hindered in this quest by security concerns as well as by a shaky infrastructure troubled by power cuts.

The oil and gas industry in Nigeria has been under pressure to evolve into a sector that is constantly changing to fit the needs of the broader context in which the operations are executed. Attitudes towards working have changed dramatically in recent years and there is currently much more emphasis on the application of innovative knowledge based systems. As oil and gas organisations in Nigeria define more of their activities as projects, the demand for innovative solutions grows, and there is increasing interest in reforming the project delivery process (Ekemena, 2011; Nwafor and Salau, 2009; Rabiu 2009). Based on this demand, this research focussed on examining the extent to which knowledge management people approaches and technology approaches could contribute to adding value in the delivery of oil and gas projects. The growing difficulties associated with accessing and leveraging technical knowledge have roots in the several ongoing trends, including demographics (Oyejide and Adewuyi 2011; Rabiu 2009). For instance, about half of senior project management practitioners are expected to retire over the next 15 years (Nwafor and Salau, 2009). This exodus can be viewed as a recruiting and training challenge, but it is also a knowledge management challenge. The challenge for oil and gas companies operating in Niger-Delta is how to ensure that the remaining project management practitioners and the incoming generation of project management practitioners have access to the data they require, so they can avoid repeating lessons already learned. It is worth highlighting that, accessing that data is time-consuming and tedious because traditional knowledge management systems are

ill-suited. Local oil and gas organisations are finding it impossible to capture the value of information residing inside and outside their organisations (Okunoye and Karsten 2002; Oyejide and Adewuyi 2011). Ultimately, without a solution to the knowledge management challenge, senior project management practitioners will continue to waste valuable time and resources, to their companies' revenues and profits. It is worth mentioning that the findings of the study provides senior project management practitioners and local oil and gas organisations with an integrated framework for managing knowledge management based systems. The framework proposed in this study comprised of knowledge management technology approaches, people approaches, value added techniques, strategies and practices.

1.2 RESEARCH BACKGROUND

The discipline of knowledge management has emerged in both academic research and in practice over the years (Lang 2001; Leseure and Brookes, 2004). It deals with the management of knowledge as a business resource. Although there are a lot of different definitions of knowledge management, it can be said to improve organisational performance by allowing individuals to identify, take, share and apply their collective knowledge to make optimum decisions. An organisation must have "up-to-date" technology in order to develop globally, especially in the multinational business environment of today. However, to achieve bottom-line success, attention must be paid to the other issues. Experience in many organisations has shown that no more than one third of the knowledge management budget should be devoted to Knowledge Management technology (O'Dell *et al., 2000*). One of the main success factors for knowledge management is to develop an understanding of the existing connections and mechanisms of sharing and then develop ways to allow people to improve on the already existing process (Gilbert *et al.* ,2002). According to Bixler (2002), implementing a knowledge management framework can be complex and dynamic, no matter how well planned and developed the organisation is, as it involves people and other organisational factors.

A lot of interest has been placed on knowledge in organisations and the idea has been recognised as a source of competitive advantage, this has been acknowledged by many authors such as Eisenhardt and Santos (2002); Garavan and Carbery (2007). It was Nonaka (1991) who said that in an economy where the only certainty is uncertainty, the one sure source of lasting competitive advantage is knowledge. In turn, when discussing

knowledge management, it is necessary to make the following assumptions regarding knowledge: 'knowledge is worth managing, organisations benefits from managing knowledge, knowledge can be managed' (Stewart *et al.* 2000). Thus, Love, Fong and Irani (2005) claimed that effective knowledge management could be considered as an instrument in a project environment for reducing project time, increasing product quality and to avoid making the same blunder.

While all organisations may have a given knowledge repository within their organisation, they may be unaware of these resources as well as how to control them effectively to their advantage, therefore, project managers must come up with ways and ideas to sustain and leverage these resources. This type of ideas and activities is known as knowledge management. Hansen (1999) defined knowledge management as the conscious practice or process of systematically identifying, capturing and leveraging knowledge resources to help firms to compete more effectively. Knowledge management involves data mining and some method of operation to pass information to users. Some vendors are offering products to help an enterprise take inventory and access knowledge resources. IBM's Lotus Discovery Server and K-Station, for example, are products advertised as providing the ability to organise and locate relevant content and expertise required to address specific business tasks and projects. They are said to be able to analyse the relationships between content, people, topics, and activity, and produce a knowledge map report.

Ichijo and Nonaka (2007, p.27) noted that *"the success of a company in the twenty-first century will be determined by the extent to which its leaders can develop knowledgeable capital through knowledge creation and knowledge-sharing on a global basis".* The importance of knowledge in economics, business and management has been recognised for quite some time. However, significant attention to knowledge management as a source of organisational efficiency and competitive advantage is a recent phenomenon. Knowledge management can also be defined as *"deliberate and systematic coordination of the people in an organisation, technology, processes, and organisational structure in order to add value through recycle and innovation*" (Dalkir 2005). This coordination is achieved through creating, sharing, and applying knowledge as well as through feeding the valuable lessons learned and best practices into corporate memory in order to promote continued organisational learning.

The oil and gas industry has taken advantage of knowledge management (KM) developments (Leavitt, 2002; Grant, 2013). So far the industry has experienced swift transformations, throughout the rapid advance of technology, an extension of offshore drilling, numerous acquisitions, the growing reliance on foreign oil sources, and a focus on environmental issues, knowledge management initiatives have played a part in making operations more efficient and effective (Grant, 2013). Knowledge management (KM) is a key aspect of organisation capability that is critical in deploying best available resources (Rabiu, 2009). It is noteworthy, that every individual, society or organisation needs knowledge to be able to make real and sustained progress over time. KM teams provide support through technology and knowledge transfer, as well as asset management when an oil and gas organisation is faced with new technology, outsourcing, new partnerships, and government regulation. When business issues involved capacity management, cost reduction, and the environment, KM played a part through forecasting/scheduling and process and technique innovation.

According to Ichijo and Nonaka (2007) the success of a company in the twenty-first century will be determined by the extent to which its leaders can develop intellectual capital through knowledge creation and knowledge-sharing on a global basis. The importance of knowledge in economics, business and management has been recognised for quite some time. However, substantial attention to knowledge and its management as a source of organisational efficiency and competitive advantage is a recent phenomenon. Recently, a lot of research emphasis has been place don knowledge management in other parts of the world (Pawloski and Bick, 2012). Taking into consideration the existing state-of-the-art in knowledge management and organisational theory, there is evidence that a number of local oil and gas organisations in Niger Delta that have been involved in management of projects have placed little importance on knowledge management (Ekemena, 2011; Nwafor and Salau, 2009). In order to facilitate improvements in Niger Delta, this study reviewed existing strategies in knowledge management developments, examine future challenges and proposed actions required to address them.

1.3 ASPIRATION OF THE OIL AND GAS INDUSTRY

As established in this research, oil and gas operations are so complex and multidimensional that major heavy engineering projects in many developing countries are often performed as joint ventures with firms from developed nations. A good

understanding of knowledge management based systems was therefore particularly beneficial to developing and developed countries. According to Clark and Ip (1999), trans-global economic developments offer an opportunity to introduce products utilising up-to-date knowledge in a cost-effective manner. In any oil and gas project, it is essential for the senior project management practitioners to apply innovative knowledge management solutions. According to Leavitt (2002), the oil and gas industry has taken advantage of knowledge management developments for more than a decade. In that time the industry, has gone through rapid changes and so many mergers that a one worded petroleum company name now seems like an oddity. As established from the reviewed literature (Leavitt, 2002), throughout the rapid advance of technology, an extension of offshore drilling, numerous acquisitions, the growing reliance on foreign oil sources, and a focus on environmental issues, knowledge management initiatives have played a part in making operations more effective and efficient in developed and developing countries. It is worth highlighting that enhancing knowledge-based management systems remains an aspiration with the oil and gas industry.

As suggested by Leavitt (2002), when oil and gas companies have been faced with new technology, outsourcing, new partnerships, and government regulation, their knowledge management teams have provided support through technology and knowledge transfer, as well as asset management. When business issues involved capacity management, cost reduction, and the environment, knowledge management played a part through forecasting/scheduling and process and technique innovation. In addition, knowledge management initiatives have expanded to address point-of-sale technology adoption and procedure effectiveness. As established in this research, knowledge management is not a novel concept but an existing knowledge management infrastructure has been found to be a cost-effective means of addressing new and/or increasingly operational issues in the oil and gas sector, including: retaining valuable knowledge during a period of work force aging/diminishing and increasing efficiency through communities of practice (Leavitt, 2002; Mckenna and Wilczynski, 2006).

According to Rabiu (2009), the global oil and gas sector has been a catalyst to the economic advancement of many nations in the last four decades. Globally, a number of oil producing countries are grappling with key global energy challenges which include providing access to modern energy at optimum cost. As suggested by Rabiu (2009), the industry, particularly the upstream sector in Nigeria has been growing. There is a

therefore a need integrate optimally extant capability (i.e. people and technology) for business profitability and long-term sustainability of the society in Nigeria (Rabiu 2009). Recent evidence suggests that (Bridge and Wood 2005; Furner *et al.* 2009; Kasimu *et al.* 2012; Oyejide and Adewuyi 2011; Rabiu 2009), knowledge management is a key aspect of organisation capability that is critical in deploying best available resources. For instance Rabiu (2009) found that the globalisation of the knowledge-based economy will increase knowledge management requirements in strategic alignment with the organisation objectives. As noted by Rabiu (2009), oil and gas organisations in Nigeria have committed more time and resources to leverage the value of knowledge management practice for their organisations. There is, however, a lot more work to be done to make the right impact.

There is a need for increased research efforts in understanding influential factors that enhance knowledge management practices in the Nigerian oil and gas industry. There is mounting evidence and opinion indicating that knowledge management-based systems have a played a part in making oil and gas operations more efficient and effective. According to Mckenna and Wilczynski (2006), areas of concern in the oil and gas sector include knowledge management, supply chain, sourcing, project planning, commissioning and engineering. Given the uniqueness of knowledge management-based systems this study presents a balance between the experiences of senior project management practitioners from a developed and a developing country. The outcome is an integrated framework that should be of benefit to senior project management practitioners in Nigeria and to a broad range of professionals delivering oil and gas projects. Oyejide and Adewuyi (2011), showed that the dearth of linkages between the oil sector and other sectors of the Nigerian economy is a critical developmental problem. Oyejide and Adewuyi (2011) suggested that one reason why there are no linkages in the oil sector is the capital intensive nature of oil sector activities and scarcity of capital as well as local expertise. Thus, despite several government development initiatives including promotion of indigenous ownership, articulation of local content policy, local content remains insignificant (Kasimu *et al.* 2012; Oyejide and Adewuyi 2011; Rabiu 2009. This problem has led to crisis in the Niger-Delta region (Oil region) which remains undeveloped (Oyejide and Adewuyi 2011). As demonstrated by Rabiu (2009), the key challenges particularly in Nigeria are as follows:

- **Commitment and alignment**: securing commitment by top management to deploy knowledge management tools is a challenge.
- **Technology:** the level of internet penetration and impact are some challenges in managing knowledge management in many oil and gas organisations in Nigeria;
- **Return on investment**: measuring the value of knowledge management to the organization is not considered a priority but could significantly improve resource commitment and confidence level. Many organisations in Nigeria shy away from measuring impact and effectiveness because it is not an easy task and not exact science;
- **Development of KM professionals**: learning and development (and organisation design) professionals who manage the process must be provided skills building opportunities;
- **Engagement (Interaction) Culture**: the engagement culture, whether it is open or closed, friendly or hostile, willing or unwilling to learn (i.e. learning organization) will influence progress with knowledge management deployment.

It is worth mentioning that, books and academic journals related to oil and gas project delivery are invariably written based upon Western practices, and all too often assume that best practice is the Western Way. However, senior project management practitioners in developing countries need to be fully aware of the environment within which they operate to ensure the project way of working is efficient and effective. The need for senior project management practitioners in Niger Delta to successfully incorporate knowledge management based systems is a critical success. Research on knowledge management based systems in fraternity Nigeria is limited. Limited attention has been given by the oil and gas research community about the necessity to take account of enhancing knowledge management practices in Niger Delta. The research scope was thus expanded to include practitioners from the UK oil and gas sector.

1.4 RESEARCH QUESTIONS

In view of the perceived benefits of integrating knowledge-based management systems in the operations of the oil and gas industry in Nigeria, the main research questions were:

- What is the contribution of knowledge management systems to project success in Nigeria?

- What are the key success factors in implementing knowledge management systems in Nigeria?
- What are the challenges faced by senior project management practitioners in developing effective knowledge management strategies in Nigeria?
- What impact does knowledge management have on oil and gas projects in Nigeria?
- How does organisational culture affect knowledge management workflow?

1.5 RESEARCH AIM

The research aimed to propose an integrated framework for managing knowledge repository in oil and gas projects. The resulting framework comprises of strategies and practices that could be used to address operational issues in Nigeria, and also promote effectiveness in managing knowledge based management systems.

1.6 RESEARCH OBJECTIVES

The main objectives of this study were to:

1. Review current project management practices in Nigeria and compare to practices in the UK;

2. Determine the importance of knowledge management based systems in delivering successful projects in the oil and gas industry of Nigeria;

3. Examine the extent to which knowledge management strategies contribute to adding value in oil and gas projects being delivered in Nigeria;

4. Identify strategies and practices which contribute to improved performance, innovation and continuous improvement in the operations of the oil and gas industry in Nigeria;

5. Propose an integrated framework which best captures knowledge management strategies and practices at operational level; and

6. Validate that framework through focus groups and workshops.

1.7 NOVELTY OF THE RESEARCH

The novelty and significance of the research is underscored in the choice of the Niger delta region of Nigeria, which is the economic bed of the nation. There is a paucity of study relating to knowledge management strategies in the Niger Delta region. To date, there have been no studies that aim at comparing knowledge management practices and strategies in oil and gas industries in Nigeria and the UK. Due to the turbulent and volatile nature of the environment in which oil and gas projects have been executed, there was a need for a new knowledge management framework. The primary purpose of this framework is to guide executives on choices to initiate knowledge management practices according to goals, organisational character, technological, behavioural, or economic preferences. The research is primarily significant for the following reasons:

- There have been few studies aimed at integrating knowledge based management systems in oil and gas organisations in Nigeria, and this topic is of momentous interest both the researcher and organisations in Nigeria;

- The research findings would contribute to the body of knowledge and it will make recommendations that would support improved knowledge management based systems in the Nigerian oil and gas industry;

- The developed framework in this study is expected to contribute to and help improved already existing knowledge repositories within oil and gas organisations in Nigeria;

- The reviewed literature in the UK and Nigeria contributed to a better understanding of cultural differences between senior project management practitioners operating in developing and developed countries. This allowed the researcher to propose an integrated framework that could be used to enhance knowledge management-based systems in Nigeria.

1.8 RESEARCH PROCESS

An exploratory literature review of knowledge management within the oil and gas sector in Nigeria and the UK was conducted. The research questions were developed from the literature reviewed. The research aim and objectives were then confirmed and an

appropriate research methodology selected. A number of semi-structured interviews with senior project managers were conducted to identify strategies and practices which contribute to improved performance, innovation and continuous improvement in the oil and gas industry in Nigeria. There was also a complementary use of a questionnaire to investigate a wide range of knowledge management technology and people approaches. Figure 1.1 provides a flow diagram summarising the research process.

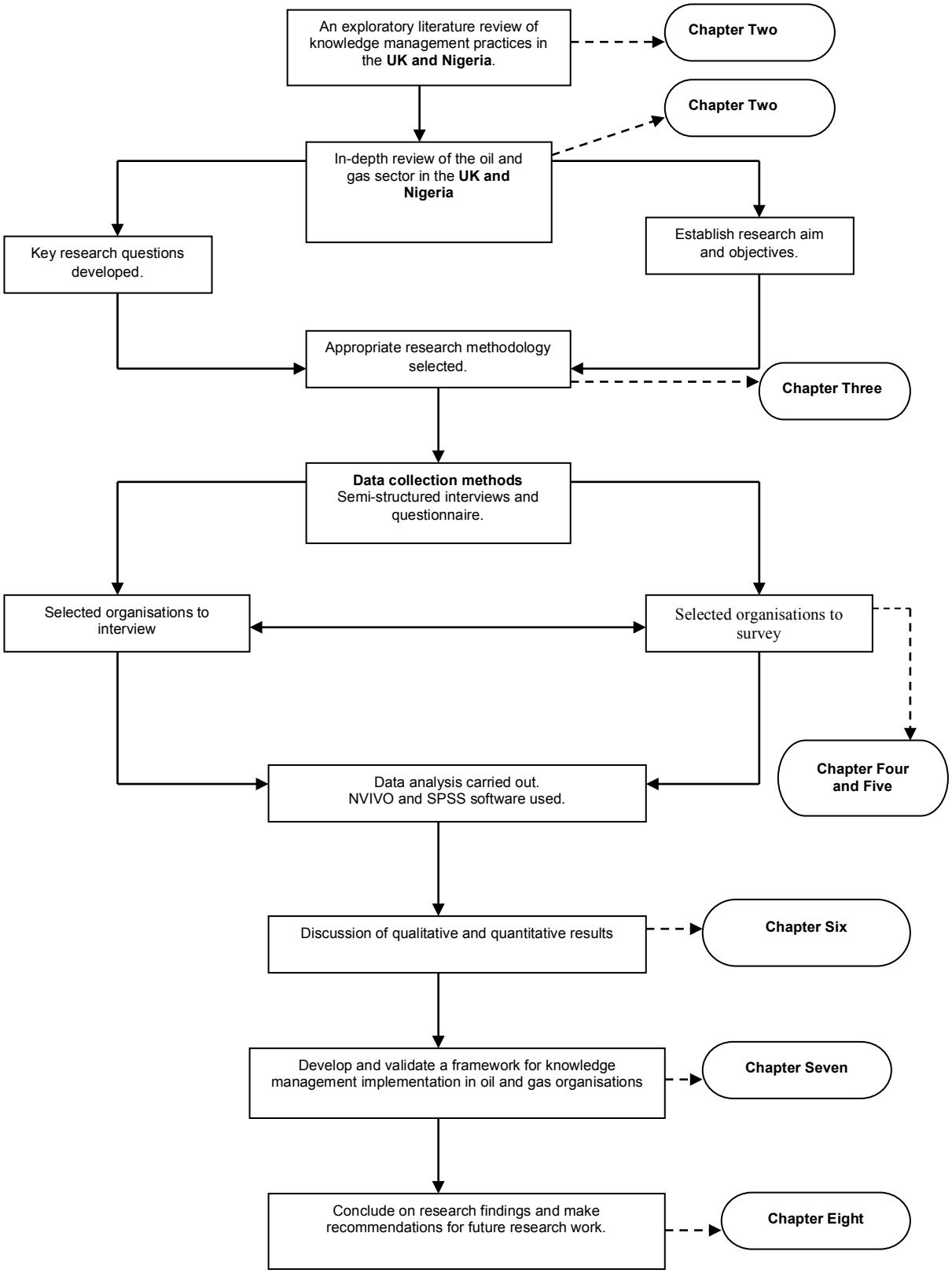


Figure 1.1: Research methodology flow chart

1.9 FRAMEWORK

A framework for knowledge management implementation in the oil and gas sector was developed and validated by two focus groups in Nigeria and the UK. Each group comprised senior managers who collectively agreed that the framework:

1. Sufficiently highlighted the key factors of knowledge management technologies, knowledge management people approaches, value added techniques, strategies and practices; and

2. Provides a generic applicability and established a basis for building an understanding and awareness of knowledge management tools and how they are to be managed.

1.10 THESIS STRUCTURE

- **Chapter One:** introduces the research. It comprises an introduction to the subject, the research background, and justification for the research, research questions, aim, and objectives. The chapter briefly delineates the research process and the key findings.

- **Chapter Two:** presents a review of knowledge management theory, practice, and research. It builds the theoretical foundation of the research. It reviews the oil and gas industry in Nigeria and the UK. It also discusses the nature of the product and the methods for delivering projects. In addition, it also compares oil and gas project delivery practices within Nigeria and the UK. Finally, the chapter summarises the current-state-of-the-art, which culminates in a discussion on key knowledge management issues for further research.

- **Chapter Three:** gives a detailed description of the research design and includes methodologies, research types, sampling strategies, and data collection techniques. Based on this assessment, the most suitable research strategy for this study emerged as one that involved combining both qualitative and quantitative methods. In addition, Chapter three also validates the chosen methodology in the light of the current field.

- **Chapter Four:** analyses the qualitative findings relating to the three research objectives. Findings from data collected through semi-structured interviews are presented in the chapter. The chapter discusses the participants' accounts of knowledge management strategies and practices in oil and gas organisations in Nigeria and the UK.

- **Chapter Five:** contains the survey findings relating to knowledge management technology approaches and knowledge management people approaches.

- **Chapter Six:** contains a discussion synthesising the interview, survey and validation results reported in chapter two, four and five. The chapter also shows how these results either confirm or contradict existing literature and, where appropriate, makes suggestions regarding the possible modifications to existing theory.

- **Chapter Seven:** is devoted to the development of knowledge management framework. The need for the framework and an overview of the variables of the framework are discussed. The chapter gives a detailed description of the proposed integrated framework. It also discusses the validation of this framework.

- **Chapter Eight:** presents the main conclusions of the research. These are drawn from the research findings as well as the recommendations for the industry. Suggestions for further work have been provided.

CHAPTER TWO: REVIEW OF KNOWLEDGE MANAGEMENT AND NIGERIAN OIL AND GAS SECTOR

2.1 INTRODUCTION

This chapter is broken down into broad headings and sub headings that include definitions of key concepts relating to knowledge management and organisational knowledge. A background of the Nigerian oil and gas industry in general, and the Niger-Delta in particular, is examined. Also discussed in this chapter are live oil and gas projects in Niger Delta, and the state of the UK oil and gas industry. A review of Nigerian economic performance, political, context and development challenges is explored in the following section.

2.2 NIGERIA

As shown in Figure 2.1, Nigeria is located in western Africa on the Gulf of Guinea and has a total area of 923,768 km^2 (356,669 sq mi) making it the world's 32nd-largest country (after Tanzania) (Rank Order 2011)... The main rivers are the Niger and the Benue River, which converge and empty into the Niger Delta, one of the world's largest river deltas and the location of a large area of Central African Mangroves (Rank Order 2011).

Figure 2.1: Map of Nigeria
Source: World Bank (2014)

Nigeria's most expansive topographical region is that of the valleys of the Niger and Benue River valleys (which merge into each other and form a "y" shape).

On 1st October 1960, Nigeria gained its independence from the United Kingdom. Nigeria's government was a coalition of conservative parties: the Nigerian People's Congress (NPC), a party dominated by Northerners and those of the Islamic faith; and the Igbo and Christian-dominated National (NCNC) led by Nnamdi Azikiwe, who became Nigeria's maiden Governor-General in 1960 (Udofia, 1981). Forming the opposition was the comparatively liberal Action Group (AG), which was largely dominated by the Yoruba and led by Obafemi Awolowo (Udofia 1981). The cultural and political differences among Nigeria's dominant ethnic groups: the Hausa ('Northerners'), Igbo ('Easterners') and Yoruba ('Westerners'), were sharp. An imbalance was created in the polity by the result of the 1961 plebiscite (Udofia, 1981). Southern Cameroon opted to join the Republic of Cameroon while northern Cameroon chose to remain in Nigeria. The northern part of the country was now far larger than the southern part. The nation parted with its British legacy in 1963 by declaring itself a Federal Republic, with Azikiwe as its first president. When elections were held in 1965, the Nigerian National Democratic Party came to power in Nigeria's Western Region (Udofia, 1981).

Nigeria is divided into thirty-six states and one Federal Capital Territory, which are further sub-divided into 774 Local Government Areas (LGAs) (Constitution Amendment, 2012). The plethora of states, of which there were only three at independence, reflect the country's tumultuous history and the difficulties of managing such a heterogeneous national entity at all levels of government. In some contexts, the states are aggregated into six geopolitical zones: North West, North East, North Central, South East, South South, and South West (Constitution Amendment, 2012; Constitution Review, 2012). Nigeria has six cities with a population of over 1 million people (from largest to smallest: Lagos, Kano, Ibadan, Kaduna, Port Harcourt, and Benin City). Lagos is the largest city in sub-Saharan Africa, with a population of over 8 million in its urban area alone. However, these figures are regularly disputed in Nigeria (Onuah, 2006).

Nigeria is the most populous country in Africa, the seventh most populous country in the world. Nigeria has a population of 158 million people (World Bank 2014). Recently, the thirty-six states of Nigeria have been divided into six geo-political zones, namely; South-South, South-West, South East, North-West, North-East and North – Central (Olaleye and Akanbi, 2009).

2.2.1 Nigerian economic overview and performance

Nigeria is classified as a mixed economy emerging market, and has already reached middle income status according to the world bank, with its abundant supply of natural resources, well-developed financial, legal, communications, transport sectors and stock exchange. Nigeria is ranked thirty-first in the world in terms of GDP as of 2011. Nigeria is the United States' largest trading partner in sub-Saharan Africa and supplies a fifth of its oil (11per cent of oil imports). Previously, economic development had been hindered by years of military rule, corruption, and mismanagement (World Bank, 2014). During the oil boom of the 1970s, Nigeria accumulated a significant foreign debt to finance major infrastructural investments. With the fall of oil prices during the 1980's oil glut, Nigeria struggled to keep up with its loan payments and eventually defaulted on its principal debt repayments, limiting repayment to the interest portion of the loans. Arrears and penalty interest accumulated on the unpaid principal, which increased the size of the debt.

As established from the reviewed literature (World Bank, 2014), Nigeria has been carrying an ambitious reform agenda. The most far reaching of those was to base the budget on a conservative reference price for oil, with excess saved in a special, Excess Crude Account (ECA). The economy responded with strong growth between 2003 and 2010-averaging 7.6 per cent. Nigeria was among the first countries to adopt and implement the Extractive Industries Transparency Initiative (EITI) (World Bank, 2014). The EITI Act was passed into law in 2007, and the country became EITI complaint in 2011. The power sector reform initiative was launched in 2005, recognising that improving power sector performance is critical to address development challenges. The challenging process of implementing reforms was revitalised in August 2010 through the 2010 Roadmap, which clearly outlined the government strategy and actions to undertake comprehensive power sector reform to expand supply, open the door to private investment and address some of the chronic sector issues hampering improvement or service delivery.

More recently, the declining oil revenues have placed increasing pressures on government budgets. As of the second half of 2013, total federation revenues available for sharing by the three tiers of government fell short of projections by 21 per cent (World Bank, 2014). The balance of the fiscal reserve of the country declined from $9 billion in early 2013 to $5 billion by mid-year. The implementation of the capital budget has been adversely hindered as only a little over half of the federal capital budget has been made available to line ministries. As found in the reviewed literature (World Bank, 2014), early indications from the 2014-2016 Medium Term Expenditure Framework (MTEF) point towards a significant fiscal contraction. If oil prices remain generally strong, this could relieve the short term pressures discussed in this section. Structural reforms in power and agriculture appear to be paying at least some dividends even if their main potential will be in the longer term. In addition, employment remains the major issue with an estimated 50 million underemployed youth (World Bank, 2014). The government has expressed determination to integrate job creation to its economic strategy and has specifically targeted information communication technology (ICT), entertainment, meat, leather, construction and tourism (World Bank, 2014).

2.2.2 Political and social context

It has been demonstrated that the fragmentation of Nigeria's geographical, ethnic and cultural identity lines is effectively balanced by the country's federal structure and the strong emphasis of the federal government on representing six geopolitical zones and different ethnic and cultural identities. World Bank (2014) found that though Nigeria's socio-political environment is fairly stable, there are a number of areas of instability in some parts of the country. Globally, Nigeria continues to be leading player in the:

- African Union (AU);
- New Partnership for Africa's Development (NEPAD); and
- Community of the West African States (ECOWAS).

2.2.3 Development challenges in Nigeria

As confirmed from the reviewed literature, poverty is still a major issue, and reducing it will require strong non-oil growth and a focus on human development (World Bank, 2014). To maximise growth, the current government has identified the following strategies:

- Infrastructure investment;
- Refining policies affecting agricultural productivity; and
- Quality and relevance of tertiary education.

It has been suggested that Nigeria may not be on track for meeting most of the Millennium Development Goals (MDGs). Underpinning these challenges is the core issue of governance, in particular at the state level (World Bank, 2014). As argued in the literature, fiscal decentralisation provides thirty-six states and seven hundred and seventy-four local governments considerable policy autonomy, control of 50 per cent of government revenues, and responsibility for delivery of public services. From the above, it is worth noting that economic growth in Nigeria will accelerate this year, driven by sectors outside its dominant energy industry, while inflation will continue its downward path. According to IMF (2014), Africa's second largest economy is set to grow 7.3 per cent this year, up from 6.4 per cent in 2013. In the next section, Nigerian oil and gas sector is explored.

2.2.4 Background of Nigeria oil and gas

Nigeria is the twelfth largest producer of petroleum in the world and the eighth largest exporter, and has the tenth largest proven reserves. It is also the biggest oil exporter in Africa, with the largest natural gas reserves in the continent (World Bank, 2014) Petroleum plays a large role in the Nigerian economy, accounting for 40 per cent of GDP and 80 per cent of Government earnings. With these large reserves of human and natural resources, the country is poised to build a prosperous economy, significantly reduce poverty and provide health, education and infrastructure services to meets population needs (World Bank, 2014). However, agitation for better resource control in the Niger-Delta its main oil-producing region has led to disruptions in oil production and currently prevents the country from exporting at 100 per cent capacity (World Bank, 2011).

Shell-BP discovered oil in the Niger delta region of Nigeria in the 50s, since then the Nigerian economy has been dominated by oil. The majority of the reserves are located in the Niger-Delta, but there have been recent discoveries in deep waters. In 2004, Niger Delta activists demanding a greater share of oil income for locals began a campaign of violence against the oil infrastructure, threatening Nigeria's most important economic

lifeline. Nigeria is keen to attract foreign investment but is hindered in this quest by security concerns as well as by a shaky infrastructure troubled by power cuts.

According to World Bank (2014), weaknesses in the oil and gas sector have increased macroeconomic risks. Oil accounts for close to 90 per cent of exports roughly 75 per cent of consolidated budgetary revenues. The decline in oil output, together with somewhat weaker oil prices, can be associated with a weakening of the balance of payments and shortfalls of budgetary revenues. The balance of payments surplus registered from October 2011 to April 2013 has disappeared: official foreign reserves declined slightly from almost $49 billion in end-April 2013 to $46 billion on September 2013 (World Bank, 2014). There is also the issue of short term portfolio capital inflows that reportedly reached more than $17 billion in 2012 (World Bank, 2014). These inflows have been targeting primarily the government bond market, with interest rates at 12-14 per cent and a rather stable exchange rate relative to the US dollar. These short term capital flows have added potential source volatility to the country's macroeconomic challenges.

2.2.5 Niger-Delta of Nigeria

The Niger Delta region is a densely populated region of Nigeria it consists of the following states (Bayelsa, Delta and Rivers state) however, six more states were added in the year 2000. There are about 40 ethnic groups and about 250 different dialects. The delta being an oil-rich region, has been the centre of international controversy over devastating pollution and ecocide. The choice of the Niger delta is because it is the economic bed of the nation. Nigeria's oil wealth is a source of continuing political tension, protest, and criminality in the Delta, where most of it presently originates (Aluko, 2000; Bamidele, 1998). The conflict has been linked to the vandalism of oil infrastructures; massive systemic production theft known as "oil bunkering," often abetted by state officials; protests over widespread environmental damage caused by oil operations; hostage taking; and public insecurity and communal violence. Several thousand people have been killed in pipeline explosions in the Niger-Delta since the late1990s; the largest single toll from an explosion was approximately 1,000 in October of 1998 (Bamidele, 1998). These explosions were triggered when people siphoned oil from holes punched in the above ground pipelines for personal use, resulting in a reported loss of up to 200,000 barrels of oil per day. The government established a

national task force on surveillance of petroleum pipelines in order to prevent a recurrence of the 1998 pipeline explosion tragedy.

Despite its wealth of resources, Niger Delta is a region suffering from administrative neglect, crumbling social infrastructure and services, high unemployment, social deprivation, abject poverty, filth and squalor and endemic conflict. It can be concluded therefore that since the commencement of oil and gas exploration activities in the region there has been social, economic, health and ecological destabilisation, and significant reduction in terrestrial and aquatic life. Since 1970, crude oil assumed a prime position in the Nigerian economy. Government dependence on oil revenues has also experienced phenomenal increases since 1970. According to the Statistical Bulletin of the Central Bank of Nigeria (CBN, 2004), the average contribution of oil to government export revenue and national earnings between 1970 and 2004 was 93 per cent. The irony is that the region that produces this large percentage of national wealth continues to experience abject poverty, psychosocial and environmental abuse and degradation resulting from the intensive exploration of the petroleum resource that is yielding the wealth. A review of knowledge management concepts is discussed in the following section.

2.3 KNOWLEDGE MANAGEMENT

Knowledge management means different things to different people (Bollinger *et al*., 2001). One central theme of knowledge management is the assertion that the knowledge found in an organisation has to be identified and accessible. The reason for this is that such knowledge needs to be transferred easily for reuse by others in solving problems within and outside the organisation. The main aim of knowledge management is to be able to convert and use the two types of knowledge (tacit and explicit) to the benefit of the project and the organisation as a whole. For an organisation to be rated as world class, there must be a good understanding of the role of knowledge management. Knowledge in an organisation is an essential asset for organisational development (Dixon, 1994; Pentland, 1995)

According to Saputelli *et al.* (1999), knowledge can be defined as *"information transformed into the capacity for effective action"*. In 2001, it was estimated that cumulative world-wide knowledge will double after every four years (Saputelli *et al*.

1999). The challenge of absorbing and productively exploiting this knowledge is colossal, but necessary if oil and gas organisations are to remain responsive and competitive in an expanding world of information. As found in the reviewed literature (Ekemena, 2011; Furner *et al.* 2009; Nwafor and Salau, 2009; Rabiu 2009; Saputelli *et al*. 1999), traditional strategies have become superseded, oil and gas organisations require proactive, structured framework not only for keeping up with the knowledge deluge, but keeping ahead of it. The foundation of a successful strategy in Nigeria is knowledge management. So, just what is knowledge management? No single definition is universally agreed-upon. For this thesis, the researcher adopted three definitions:

- *"Processes and technologies for capturing, sharing and applying collective knowledge to make optimal operational decisions" (Amin et al., 2001, p.20)*.

- *"Knowledge management can be defined as the process of identifying, capturing, organising and disseminating the intellectual assets that are critical to the organisations long term performance (Debowski, 2006, p. 33)"*.

- *"Improving organisation performance by enabling individuals to capture, share and apply their collective knowledge to make optimal decisions…..in real time (Smith and Farquhar, 2000, p.7)"*

In this context, real time means the time available to decide on an action that materially affects the outcome. In this new era, knowledge management happens in the background in real time. It is done by everyone as part of the day-to-day job, incorporated in the workflow. People are easily able to obtain the data and knowledge they need to carry out their tasks. Looking beyond the two definitions, what is the definitive goal? For instance, Schlumberger sets the target as: "apply everywhere what you learn anywhere" (Amin *et al.,* 2001). Achieving this objective depends on integrating technology, process and people's intellectual capacity and then transforming the result into prompt and well-defined action (Smith, 2001). The focus of knowledge management is about enhancing organisational capability. Positive outcome requires creating a new working environment where knowledge and experience can be shared easily. Processes and technologies to accomplish this goal must be put in place. Organisational behaviour from an operational, strategic and project level must be aligned so that data and knowledge merge and flow to the right practitioners at the right time so they can act more productively.

In the oil and gas sector, knowledge management must connect practitioners to information across a broad range of exploration and production disciplines. This connection should include the processes and encouragement needed for practitioners to not only trust and use the data available, but to then contribute to the global repository of data. Amin *et al.* (2001), demonstrated that intellectual capital is rapidly replacing physical capital as the driving competitive force. Investment in knowledge-management solutions brings the power of intellectual assets to the forefront and translates them into value. In their findings, Amin *et al.* (2001) suggested that roughly 80 per cent of the globe's largest corporations have some type of knowledge management effort under way, some basic, some highly refined. Oil and gas organisations have demonstrated substantial bottom-line savings by adopting and fostering knowledge capture and sharing. For instance, in 2000, Chevron reported $2 billion in reduced costs, whilst BP's initiatives saved the company $30 million in their first year (Odell *et al.,* 2000). Schafer *et al.* 2001, showed that in building successful knowledge-management programs, four issues must be examined:

- People;
- Technology;
- Process; and
- Content.

As illustrated in Figure 2.2, the initial knowledge management wave focused on infrastructure for capturing data, building data storehouses, providing access to these storehouses, integrating and managing them, and then using this capability as a basis for improved decision-making (Schafer *et al.,* 2001). The modern trend in knowledge management is cantered on empowering people to use data for creating value through aligned business objectives and user needs, the ability to extract, distil and customise knowledge and finally to successfully apply this knowledge efficiently and routinely.

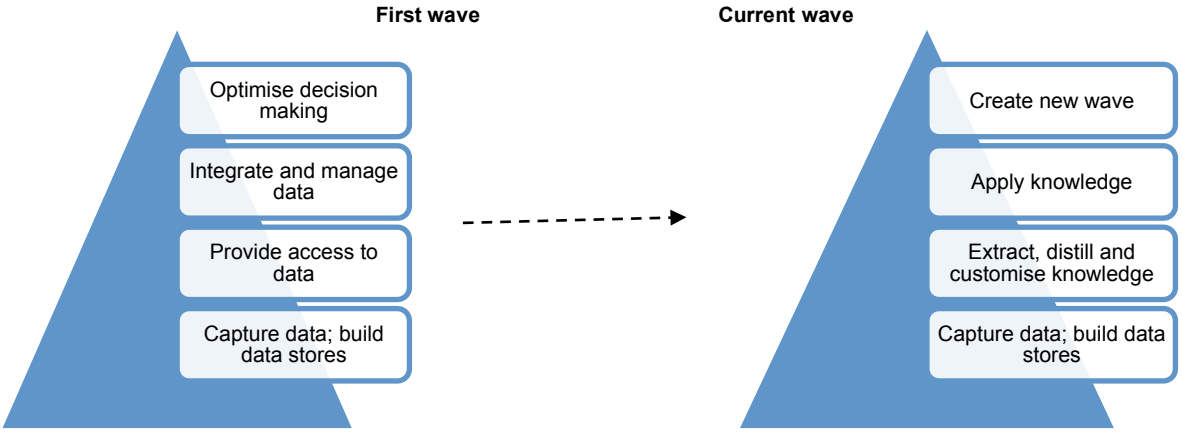


Figure 2.2: Knowledge management waves

Source: Amin *et al.* 2001

Recent evidence suggests that since the early 1990s, interest in knowledge management has been spurred by accelerating rates of technological and market change that have resulted in innovation and learning becoming increasingly important for business success and by rapid advances in information and communications technology (ICT) offering greater opportunities for exploiting the knowledge available to organizations (Grant, 2013). As noted from the reviewed literature, the oil and gas sector has been at the forefront of both the development and deployment of knowledge management techniques as a result of several factors (Grant, 2013):

- Rapid advances in information and communication technologies (ICT) have made it possible for organisations to gather and process unprecedented quantities of data while providing the means for globally dispersed employees to communicate and collaborate closely;

- Technological and market changes in the petroleum sector became increasing intense during the 1990s and first decade of the twenty-first century. The pressures resulting from the depletion of established fields, the need to explore in frontier locations (especially in deep waters), and pressures for greater environmental responsibility provided massive impetus for technological advance. Upstream technologies have moved rapidly especially in relation to seismology, drilling technologies, and offshore exploration and production (E&P);

- Individual projects (developing a new oilfield, constructing a deep-sea drilling rig, building a LNG plant) typically involve multi-billion dollar investments. Such huge investments require exceptionally careful analysis of the risks involved necessitating a marshalling of the full range of available information and knowhow relevant to the project;

- Globally, oil and gas organisations have undergone a major change in their *dominant logic*. Twenty years ago management in the oil and gas sector was viewed in engineering terms: tangible inputs—finance, equipment, and people—were deployed to acquire physical assets—oil and gas reserves—which were then transformed into marketable end products through a vertically-integrated system. Since the early 1990s, the oil and gas companies have recognised that they are operating in a knowledge-based business where superior performance is achieved through the early identification and appraisal of opportunities and their speedy exploitation. These factors were especially relevant to the international, shareholder-owned oil and gas companies. While the national oil companies could rely upon their ownership of low-cost reserves as the basis for their continued pre-eminence in oil and gas production, the majors had to rely upon their superior technology, management systems, innovation, and learning capabilities for their competitive advantage. By the early years of the twenty first century, Schlumberger, BP, Royal Dutch Shell, and Chevron had become recognised leaders in the field of knowledge management; and

- Conditions specific to the oil and gas industry further suggest the potential of knowledge management to provide solutions to some of the most critical problems faced by the industry. Between 2000 and 2010, the Society for Petroleum Engineers (SPE) estimated that 231,000 years of cumulative experience and knowledge would be lost to the industry in the next 10 years due to retirement of petroleum engineers and other technical staff. Knowledge management offers a means of limiting the potentially devastating effects of the continuous knowledge loss of due to retirement and downsizing (Drain, 2001).

For these reasons, the researcher undertook a detailed study of knowledge management practices among a sample of oil and gas organisations in a developed (UK) and a developing country (Nigeria). From the above review, it is clear that

knowledge is central to the strategy and operations of most clients in the energy sector, and comes in many different forms – whether it is scientific knowledge (petroleum chemistry), technological knowledge (how to run generator sets efficiently), or management knowledge (how to motivate your staff to introduce new operating practices). Even at the extraction end of the value chain, where competitive advantage might be based on simple availability of a resource, there is still a need for scientific and technological knowledge just to operate successfully (Grant, 2013; Rabiu 2009).

2.3.1 Knowledge management issues

Practitioners and clients in the oil and gas sector agree that issues of technology, process, people and content must be addressed to achieve success (McKenna *et al.,* 2006). According to Smith and Farquhar (2000), an organisation must have "good enough" technology to make progress, especially in the transitional business environment of today. Odell *et al.* (2000), noted that to achieve bottom-line success more attention must be paid to the other issues. Experience in a number of organisations has shown that no more than one third of the knowledge management budget should be devoted to technology. The basic organisational unit of knowledge management is the community practice, which is a group of personnel who share a common area of expertise and who search for solutions to common problems (Brown and Gray, 1995).

When the workforce is spread around the world, in remote areas as well as population centres, the challenges are huge. Therefore, significant attention must be paid to issues of process and people. It is essential for the workforce to have processes in place that enable them to capture, share and apply what they know in a coherent fashion across the organisation. In 1997, Ernst and Young investigated the perspectives of knowledge in organisations and found that biggest impediment to knowledge transfer is corporate culture (54 per cent), and the biggest difficulty in managing knowledge is changing people's behaviour (56 per cent). From this survey, senior managers indicated that the most important types of knowledge have to include (Amin *et al.,* 2001):

- Knowledge about customers (97 per cent);
- Knowledge of best practices and effective processes (87 per cent); and
- Knowledge about the competencies and capabilities of their company (86 per cent).

Business interest in knowledge management has picked up dramatically over the past few years because: it is now more virtual than physical. Organisations are increasingly distributed globally. As a result, it is more challenging to collaborate with one's peers. Second is intellectual capital. Knowledge is seen as displacing other physical assets as the most important competitive resource. Third is information technology. This is perhaps the main driver in the oil and gas sector. As a result of information technology, it is now possible to do something about knowledge management (Smith and Farquhar 2000). Today's internet, intranet and web technology allows practical capture, sharing and leveraging of information and knowledge throughout organisations.

Wiig (2000) classified the drivers of knowledge management in the table below (*see Table 2.1*).

Table 2.1: Knowledge management drivers

Classification	Driving force
External	• Globalised business competition • World-class customers • Competitors and suppliers
Internal	• Bottleneck in enterprise effectiveness • Technological capabilities • Understanding human cognitive functions
On-going developments	• Innovative ideas • Information management and technology • Cognitive science • Shift in bottleneck • Customisation requirement for customers and competitors

Becerra-Fernandez *et al.,* (2004) identified other drivers. According to Becerra-Fernandez *et al.,* an increase in knowledge domain complexity could be a driving force, this is because projects require complex knowledge to get to a successful completion, this complexity needs to be properly managed in order to eliminate future complications. This is closely in line with Wiig's (2000) categorisation above. Becerra- Fernandez also identified urgency of response as a driving force, therefore resounding the importance of a readily accessible knowledge repository.

2.3.2 Approaches to knowledge management

Knowledge management can be fundamentally approached in two ways: the practice and the process approach. The practice approach to knowledge management assumes that organisational knowledge is implicit in nature and those formal controls, processes and information technologies are not ideal for transmitting understanding. The focus of the practice approach is to build social environments or communities of practice necessary to facilitate the sharing of implicit understanding (Brown and Duguid, 2000; DeLong and Fahey, 2000; Gupta and Govindarajan, 2000; Wenger and Snyder, 2000). These communities are informal social groups that meet regularly to share ideas, insights, and best practices.

In contrast, according to (Hansen *et al.*, 1999), the process approach attempts to codify organisational knowledge through formal controls and processes and technology. The process approach frequently involves the use of information technologies, knowledge repository, decision support tools and groupware (Ruggles,1998). These tools enhance the quality and speed of knowledge creation and distribution in organisations. The process approach has been known to fail to capture much of the tacit knowledge embedded in firms and to force individuals into fixed patterns of thinking (Brown and Duguid, 2000; Delong and Fahey, 2000; Hargadon1998; Van Grogh, 2000).

It is important for knowledge management strategies to be in place in order for an organisation to utilise the full capabilities of knowledge. (Hansen *et al.*, 1999; Zack, 1999a; Beckman, 1999) Zack (1999b) stated that the organisation must first identify the knowledge that is unique and valuable to it. The contributions and impact of a knowledge strategy on an organisation must be made clear. Knowledge management strategy can be broken down into two classes (Hansen *et al*., 1999; Zack, 1999a):

- System strategy – this emphasizes the capability to create, store, allocate and use the explicit knowledge present in the organisation (Davenport *et al*., Lee and Kim, 2001)
- Human strategy - this highlights knowledge sharing by interpersonal interaction making use of dialogue through social networks (Choi and Lee 2002; Swan *et al.*, 2000).

In a business environment one of the main criteria in decision-making is financial performance (Zack *et al.,* 2009). Through applying different management approaches

and strategies, organisations seek to maximise profit, increase return on investment (ROI) and improve other financial indexes. The undertaking of knowledge management initiatives is no exception and is dependent on the same rules. In the case where there is no evidence of any improvement in processes or procedures during the period of application of knowledge management practices, those undertaking knowledge management approaches should be reviewed and changed. In order to achieve better results during integration of knowledge management practices it is crucial to understand the contextual dependences of knowledge nature applicable to the organisational and project context. Knowledge management should have a significant impact on every project; properly managed knowledge drives project improvements and organisational goals (Mertins *et al*., 2001).

2.4 KNOWLEDGE MANAGEMENT CONCEPT

Knowledge management is the name of a concept in which an organisation deliberately and comprehensively gathers, organises, shares, and analyses knowledge in terms of resources, documents, and people skills. In early 1998, it was believed that few enterprises actually had a comprehensive knowledge management practice in operation. Advances in technology and the way practitioners access and share information has changed that; a few organisations now have some kind of knowledge management framework in place. The different perspectives of knowledge have steered some authors (Carlson *et al.*, 1996; Luen and Al-Hawarden, 2001), to view knowledge management within three broad models. These are knowledge as an object, as a process, and as a capability. In some literature (Borghoff and Pareschi, 1998; Gold and Malhotra, 2001; Tiwana, 2001), these models are referred to as IT perspective, socialisation perspective and information system (IS) perspective respectively.

The object model views knowledge as creating access to information, this implies that knowledge management is concerned with building and managing knowledge repositories (Borghoff and Pareschi, 1998). Also, ensuring that, knowledge management focuses on making explicit the knowledge that is available in the form of knowledge items, widely accessible in the organisation (Rezgui, 2007). The process model holds that knowledge management is primarily about the flow and processes (practices) that go into the creation, transfer and distribution of knowledge (Gold and Malhotra, 2001;Becerra-Fernandez and Sabherwal, 2001). The capability model views the understanding and building of core competences and strategic advantages for the

emergence of intellectual capital as the main aim of knowledge management, this can be made possible by putting in place the right knowledge management strategy (Tiwana, 2001; Schultze and Leidner, 2002).

2.5 DEFINITION OF KEY CONCEPTS

Research studies show a growing concern about the misconceptions held on the use of the terms: data, information and knowledge, which makes the understanding of knowledge management difficult to comprehend (Corner *et al*., 1997). This confusion arises from the mistaking of data either to mean information or knowledge (Harmaakorpi and Melkas, 2008). Hence, in order to categorise knowledge management, it is imperative to gain an understanding of the main approaches to its definitions:

2.5.1 Data

The terms data, information and knowledge are used interchangeably in the literature (Harmaakorpi and Melkas, 2008). This interchange of one concept can be the line that separates them, owing to the fact that, data dictates knowledge. Information and knowledge form a field that originates from data through information and then to knowledge (Baumard, 1999; Boisot, 1998; Davenport and Prusak, 1998b). Data on its own is meaningless; it only becomes meaningful when an agent interprets its component. Johannesen *et al*., (2002, p.1105) stated that, "*data can be regarded as bites of potential information, which on its own does not provide any meaning…*" This suggests that data cannot produce any tangible meaning until an interpretation is given to the message that is being transferred.

For data to become useful and relevant, the prior knowledge of an agent is a very important factor. This is because data is eventually transformed to information as soon as its message is understood. This transformation is only made possible after the data has been interpreted by the receiver (Corner *et al.,* 1997). In this same regard, Davenport and Prusak (1998, p.2a) sees data as *"a set of discrete objective facts about events".* Data is discrete because its usefulness solely depends on what other spheres makes of it. This is supported by Miller *et al.*, (2001, p.355) who states that, data is "*a representation of an object",* this object on its own cannot be attributed with any concrete meaning until an interpretation is given through a human or an automated process which culminates in information. Information is very important as far as the interpretation of received data is concerned; this is because an understanding of data enables its

conversion so that it can easily be put into proper use. Hislop (2005, p.16) notes that data are "*Raw images, numbers, words, sounds etc.*, which result from observation or *measurement".*

An important point to note when considering data is that its presence is vital for the evolving of other concepts like information and knowledge. It serves as a base on which information rests. Data contains attributes that are in information (Frické, 2008) that eventually leads to knowledge. Corner *et al.*, (1997, p.71) corroborates this by stating that "*data are carriers of knowledge and information;* a means through which *knowledge and information can be stored and transferred*". Data is that raw constituent that is necessary for the other concepts to be studied, observed and inferred from. It is that raw fact that is acted upon to derive information.

2.5.2 Information

Information is regarded as being similar to data (Lueg, 2001). It is a necessary component in the structure of knowledge. When data is received and interpreted, it is transformed from data to information, eventually resulting in knowledge. The similarity between data and information therefore, makes a distinction between them difficult. Data is a necessary antecedent for information, as information is to knowledge, what makes the transformation possible, is the interpretation that the receiver gives to it (Corner, *et al.*, 1997). Boist (1998, p.12) sees information as, *"that subset of data residing in things that activates an agent - it is filtered from the data by the agent's perceptual or conceptual apparatus. Information, in effect, establishes a relationship between things and agents".*

Just like data that cannot be said to be meaningful on its own unless interpreted (Olsen *et al.*, 2002). Information also needs some level of understanding to be able to comprehend the message that is being conveyed. Waters (2000, p.428) found that, *"data becomes information when its creator adds meaning".* It is one thing for information to be meaningful after being interpreted, but quite another to convey the required meaning for the understanding of others who were not involved in the process of organising and interpreting the data to become information in the first place.

2.5.3 Knowledge

Knowledge is a multidimensional concept with various definitions and meanings (Nonaka, 1994; Starbuck, 1992). Knowledge can be either tacit or explicit in dimension, knowledge being a very vital resource in an organisation, is formed by the constant dialog between both tacit and explicit. Knowledge is as important as every other asset in an organisation and the ability to manage knowledge is essential for staying competitive in the market (Andersen and Vaagaasar, 2009; Blessing *et al*., 2001; Hong *et al,.* 2008). Davenport and Prusak (1998, p.5) defined knowledge as,

> *"A fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of the knower. In organisations, it often becomes embedded not only in documents or repositories but also in organisational routines, processes, practices and norms".*

No single document can be said to contain or capture all the issues explained in the above definition, rather they can be located also in the daily routines of the work place and held by the workers in the form of tacit knowledge. These are great knowledge asserts that interpretation alone may not convey, thereby making them distinct from information. According to Boisot (1998) *"knowledge builds on information that is extracted from data. Whereas data can be characterised as a property of things, knowledge is a property of agents pre-disposing them to act in particular circumstances…Knowledge can be conceptualised as a set of probability distributions held by an agent and orienting his or her actions. These either consolidate, or undergo modification with the arrival of new information".*

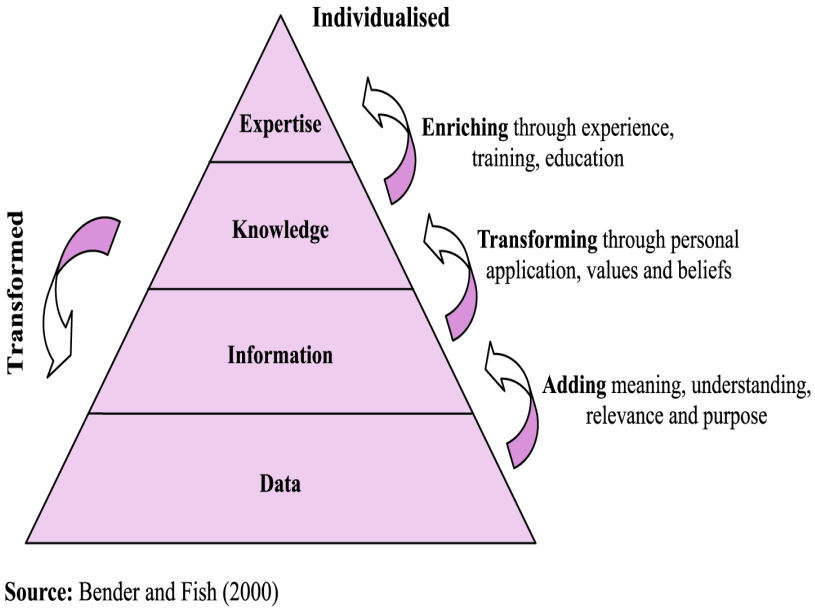
There is knowledge when information received is comprehended by the person or agent using it. These account for behavioural patterns that may change as a result of more information that can further modify the existing behaviour. The point is that there cannot be knowledge without the one who holds the knowledge. This same stand is held by Alavi and Leidner (2001, p.1009) who maintained that, *"…knowledge does not exist outside of an agent …"* .

The individual nature of knowledge, which is in the form of the acquisition of information in order to make informed decisions or actions, is better appreciated if there is a link

between the three concepts mentioned above. This link will then represent a form of sequence of transition from one stage to the other.

2.5.4 Relationship between data, information and knowledge

There is very little difference between data, information and knowledge. This difference can be translated by interpretation and understanding of these concepts. As Bhatt (2001a, p.70) states, *"without meaning, knowledge is information or data. It is only through meaning that information finds life and becomes knowledge".* Therefore these three concepts are fundamentally linked. Data translates to information and then ends in knowledge. As represented in the knowledge hierarchy. This hierarchy starts with data at the base and ends in expertise at the apex. A representation of this is depicted in Figure 2.3.



Source: Bender and Fish (2000)

Figure 2.3: Knowledge hierarchy

The knowledge hierarchy shows the various stages of each concept, with expertise occupying the highpoint of the hierarchy, but there is no expertise without knowledge. Some literatures refer to it as the knowledge pyramid (Frické, 2009) or wisdom hierarchy (Rowley 2007). For this research, the term knowledge hierarchy will be used. "Knowledge hierarchy depicts the conventional concept of knowledge transformations, where data is transformed into information, and information is transformed into knowledge" (Galup and Hicks, 2007). In linking these three concepts therefore, it is

important to state that information is a state away from data, and knowledge the human application of information. For the purpose of this research, there is a need to clarify these concepts from the onset so that information is not taken totally to mean knowledge, but seen as a very fundamental component of knowledge. The clarification of these three concepts (data, information and knowledge) commenced early in this research in order that, knowledge management which is the core of this study can have the necessary drive when being reviewed.

2.5.5 Knowledge management systems

Previous studies have reported that knowledge management systems are commonly defined solely in IT terms, for example as *"information systems applied to managing organisational knowledge"* (Alavi and Leidner, 2001; Carlsson, 2003). Throughout this thesis the researcher regarded a KM system as including people, processes, technology and (potentially) structure, in a similar manner to Leavitt's socio-technical systems "diamond" (Leavitt, 1964). The interactions between the three knowledge management system elements of people, processes and technology are illustrated in Figure 2.4**.**

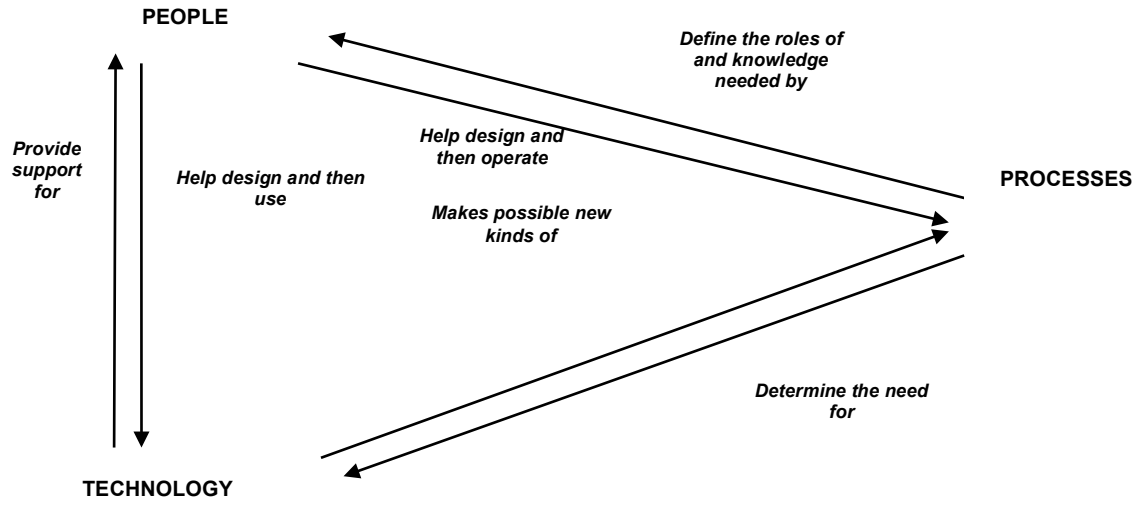


Figure 2.4: People, processes and technology in a KM system

Source: Edwards (2005)

A fundamental distinction found is that between tacit and explicit knowledge, which in the KM field usually takes as its foundation the work of Polanyi, (1966). One point that needs to be made very clear is that tacit and explicit knowledge are not alternatives. Rather, all knowledge has both tacit and explicit elements, as shown in **Figure 2.5** the

size of the circles is arbitrary, for illustration). The balance between tacit and explicit knowledge changes for different items of knowledge: knowledge of how to ride a bicycle is almost entirely tacit, whereas knowledge of how to connect two pieces of equipment together is usually mainly explicit. Knowing how to release a stuck drill bit is probably somewhere in-between. There is a growing tendency to refer to the "middle" circle – tacit knowledge that could be made explicit – as implicit knowledge, whereas older KM work tends to treat the phrase implicit knowledge as a synonym for tacit knowledge (Edwards 2005).

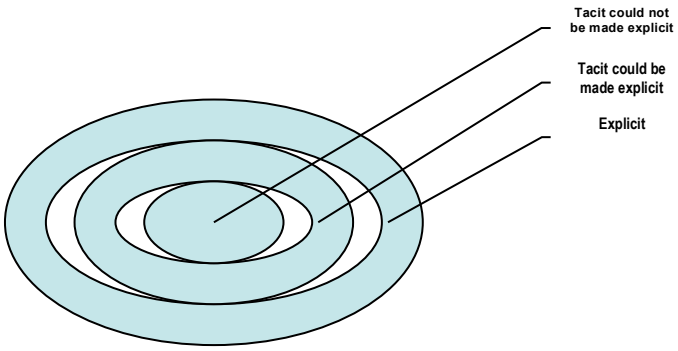


Figure 2.5: The relationship between tacit and explicit knowledge

Source: Edwards (2004)

2.5.6 Personalisation and codification

Related to both the people-technology distinction and the concepts of tacit and explicit knowledge is the broad acceptance within the literature that there are two fundamental approaches to KM strategy: those of personalisation and codification (Hansen *et al.* 1999). Personalisation takes the viewpoint that an organisation's knowledge resides mainly in the heads of its people, and is mainly tacit. The main purpose of KM systems is therefore to help people locate and communicate with each other. Codification takes the viewpoint that the most relevant knowledge for the organisation can be codified and stored in computer format (i.e. made explicit), so that it may be widely shared, and that this would be the core of a KM system. These two approaches were originally identified and proposed as fundamental by Hansen *et al.* (1999), on the basis of research conducted initially with management consulting companies.

2.5.7 Communities of practice

It has been conclusively shown that the concept of communities of practice (CoPs) was first identified by Lave and Wenger (1991) and Brown and Duguid (1991). A useful definition of CoPs is *"groups of people informally bound together by shared expertise and passion for a joint enterprise"* (Wenger and Snyder, 2000, p.29). They might form within an organisation, or across organisational boundaries. Naturally, CoPs are likely to form a key element of any personalisation strategy towards KM. There is still debate in the literature as to whether CoPs can be "constructed", or encouraged, or merely have to be left to emerge (or not) by themselves (Edwards *et al.,* 2005a.) For instance, Edwards *et al.* (2005a) found an example where a CoP had arisen naturally to connect new staff with experienced staff in a research and development organisation, but even relatively limited attempts to provide more formal support for it only succeeded in killing it off.

CoPs are one example of the relevance of the concept of *ba* to knowledge management, as expounded by Nonaka and Konno (Nonaka and Konno, 1998). The Japanese term *ba* has no direct translation into English, although Snowden (Snowden, 2000; Snowden and Boone, 2007) claimed that the Welsh word *cynefin* has a similar meaning. The closest single word equivalent in English is something approximating a "place" or a "space", where people meet, but the word also has a strong cultural resonance – the slang terms "turf" and (for Londoners) "manor" capture a little of the essence of *ba*. For KM, however, there is much more to *ba* than a physical place – it may also be virtual, spiritual, metaphorical or all of these at once. Nonaka and his co-workers emphasised that it is vital to provide suitable *ba* to offer a shared context in which knowledge-related activities, especially knowledge creation and organisational learning, may take place (Edwards *et al.* 2005a). Research on this continues (Nonaka and Toyama, 2003). Indeed, one view of KM is that this is all that needs to be done, rather than for example the provision of extensive IT-based KM systems. This remains an active debate in the KM field, sometimes over-simplified to a contrast between "Eastern" and "Western" approaches. Zhu (2004) provides a more detailed discussion of cultural aspects of KM.

2.6 TYPES OF KNOWLEDGE

As shown above, knowledge can be classified into two types, tacit and explicit knowledge. Tacit knowledge is subjective and difficult to transmit while the explicit knowledge is objective and easy to communicate. The reason why explicit knowledge is easy to communicate is that; it is easily retrievable while tacit knowledge is locked in the head of an individual and becomes complex to obtain. Knowledge can be transformed between these two forms (i.e. tacit and explicit), because they are complementary. Mooradian (2005, p.107) substantiates this by stating that, *"hence, if there is a value in identifying tacit knowledge, it is in relation to making explicit knowledge understandable".*

2.6.1 Tacit knowledge

This form of knowledge is protected in the head and mind of an individual. It is knowledge that takes a personal interaction to be able to extract. Explaining and communicating it, is usually a difficult task (Dawley *et al.*, 2008). Tacit knowledge is articulated more through personal contacts but not in documentations like manuals and on –the- job training tutorials. It is in most cases an exclusive reserve of the individual that holds such knowledge. Davenport and Prusak (1998, p.95) notes that, "*tacit knowledge transfer generally requires extensive personal contact. The transfer relationship may be a partnership, mentoring or apprenticeship but some kind of working relationship is usually essential. Such relationship is likely to involve transferring various kinds of knowledge, from explicit to tacit".*

The collation of various knowledge assets in an organisation is so important that executives have to pull together these assets in such a way that will be beneficial to the organisation (Smith,2001). Smith (2001) further notes that, valuable human and knowledge resources will be wasted unless management openly accepts and supports efforts to gather, sort, transform, record and share knowledge. Priceless knowledge will continue to be lost unless organisations make better use of their prime resource – relatively unchallenged, creative people who are eager to apply their knowledge.

The fact that tacit knowledge is in the heads of individuals, poses a cogent reason for employers of labour to find out ways of putting these heads together in order for them to interact and in the process unlock this huge repository of knowledge. This is done through forums like seminars and workshops sessions, where the outcomes of such

meetings are communicated and documented for reuse. These meetings when held in informal settings communicate better passion, emotions, care and commitment; these are all elements of tacit knowledge. Leonard-Barton and Swap (1999) showed that informal settings that entail face-to-face meetings are preferred in unlocking tacit knowledge. This is not to mean that formal meetings cannot achieve some meaningful purpose, since face to face is also possible in a formal setting but for tacit knowledge, the informal is best suited for its unlocking. Story-telling is yet another means for achieving this same purpose of tapping into tacit knowledge (Mládková, 2007).

In the oil and gas industry, one vital form of training that takes place can be a tool that aids the unlocking of tacit knowledge. This specific training that is referred to as induction (mentoring), where new staff are made to understudy older staff and these older staff serve as mentors to the mentees (O'Gorman and Fowler, 2006). In the course of this training, the tacit knowledge of the mentor is being transferred in the process, while the mentee is also expected to transfer his or her knowledge to the mentor in the form of feedback during this induction and subsequent formal and informal training (Thompson *et al.*, 2000 ; Szarka *et al.*, 2004).

Hansen (1999) emphasised the need for the one – to - one approach for unlocking tacit knowledge, in his affirmation of the strategies that organisations should employ in managing knowledge. Five sub-strategies were put forward; the five sub-strategies are offshoots of two main strategies (personalisation and codification). From the five sub-strategies, two of these (knowledge management and human resource strategy) are of importance to this research. This is because whereas the knowledge management strategy emphasise the need for person-to-person interaction to develop networks for linking people so that tacit knowledge can be unlocked and subsequently shared, the human resource strategy stresses among other things the need to train people through one-on-one mentoring. It is important to note that these two strategies both emanate from the personalisation strategy.

The implications that the issues raised (e.g. mentoring, feedback, induction, collaboration, in-service training and informal settings for transferring tacit knowledge) have for this study are enormous. In the sense that, most of the measurable indicators used in asking questions about knowledge transfer revolves around the issue of training which incorporates mentoring, induction and feedback. While for the interviews

conducted, the question of collaborating in an informal setting outside the normal office setting featured prominently as a yardstick for measuring transfer of knowledge and also organisational culture. This goes a long way in answering the research questions of this study. For the fact is that tacit knowledge is not the only knowledge that makes up the entirety of knowledge per se, there is the need to look at the other types of knowledge. This is viewed from the background that, within every single oil and gas project, there exists also explicit knowledge found mostly in documents and other tangible forms. The next subsection looks at this type of knowledge.

2.6.2 Explicit knowledge

Explicit knowledge is knowledge that can be verbalised and readily codified, that is, put in a state that makes understanding and reuse possible (Johannessen *et al.*, 2002). This kind of knowledge is contained in writings or recorded in manuals, official documents, reports, assessments and databases (William, 2006). It can be articulated and captured with ease. The explanation of this type of knowledge within an organisation or to a person takes little effort. Its transfer is simplified in the sense that, it is documented and readily available to access and with no distortions to the knowledge. Davenport and Prusak (1998, p.95) supports that, *"knowledge that is more or less explicit can be embedded in procedures or represented in documents and databases and transferred with reasonable accuracy".* This type of knowledge is said to be reasonably accurate because it can always be crosschecked and referenced due to its tangible nature.

Explicit knowledge that is captured is easily disseminated, and as such expedites knowledge sharing and reuse, which are two fundamental aspects of knowledge management. The form in which explicit knowledge is stored makes it easily deducible to users, thereby cutting out difficult personal contacts that could have delayed its access and subsequent use. Unlike tacit knowledge that, in most cases, is the product of just one person that involves one to one contact to be able to unlock, explicit knowledge is accessed by a good number of users at once without necessarily contacting anybody else in some cases.

In an organisation when new staff comes on board, there is usually a time of induction and the need to get to know the workings of the organisation. A ready tool for such employees is documents to read and refer to on the everyday job to be performed. There may, however, be training given on the job in the form of courses both within and outside the organisation. To the new employee, a quick reference in the form of

documentation can be very helpful; Jasimuddin *et al.*, (2005, p.106) note in this regard that, *"explicit knowledge, on the other hand, is easily communicable and easy to store because such knowledge is codified".* The ease of its communication apart from being attributable to the way it is packaged is also as a result of the clarity and direction that it affords the users. Bollinger and Smith (2001, p.9) substantiate this by asserting that, *"explicit knowledge is clearly expressed without ambiguity or vagueness, and codified and stored in a database".*

Alavi and Leidner (2001) and Sambamurthy and Subramani (2005), sum up explicit knowledge as being codified for specific purposes when they asserted that, it is the know-what knowledge. Smith (2001), holds same position while Freeze and Kulkarni (2007) made mention of five knowledge capabilities (expertise, knowledge documents, lessons learned, policies and procedures, and data). These, they note, a firm can build internally and refer to them as knowledge assets. However amongst these assets, knowledge documents are regarded as codified knowledge that is highly explicit. They affirm that explicit knowledge can be in a traditional structured form, which includes research reports, project reports, technical reports and publications. All these elements of explicit knowledge are in text based forms. Explicit knowledge to them can also be in an unstructured form, which includes; pictures, videos, drawings, diagrams, tutorials, audiotapes and presentations. When viewed from the above perspective, explicit knowledge is a very important type of knowledge as far as this study is concerned. This is because this type of knowledge exists in Nigerian oil and gas organisations, mainly in the form of documents.

These types of knowledge help in determining the specific source of knowledge consulted by the oil and gas industry, as well as being aware of the exact type of knowledge required to manage an oil and gas project. This is whether it is tacit or explicit in nature. An understanding of the typologies also aids in determining the appropriate mechanism that is employed in knowledge transfer (Hick *et al.*, 2007). Specifically, if the knowledge type is explicit in nature, the mechanism for transferring it will be one that does not involve too much personal contact between the sender and the receiver. This is due to its tangible nature (Duffy, 2000; Martensson, 2000; Haldin-Herrgard, 2000; Jakubik, 2007), unlike that of tacit knowledge.

2.7 ORGANISATIONAL KNOWLEDGE

Having gone through the various dimensions of knowledge, one other important aspect of knowledge that needs to be considered is organisational knowledge. This is because for any type of knowledge to be beneficial at all, it has to interact in a social setting, and this setting is within or outside the organisation. Organisational knowledge can be tacit, explicit or both; it is internally generated within personal domains of intuition and understanding involving relationships between technologies, techniques and people (Yahya and Goh, 2002). Knowledge pool in organisation should be easily identified and accessed. In identifying knowledge pool, Bacerra-Fernandez *et al.* (2004) suggest the following three categories must be looked into: People, Artifacts and organisational entities, these three categories are detailed in Figure 2.6.

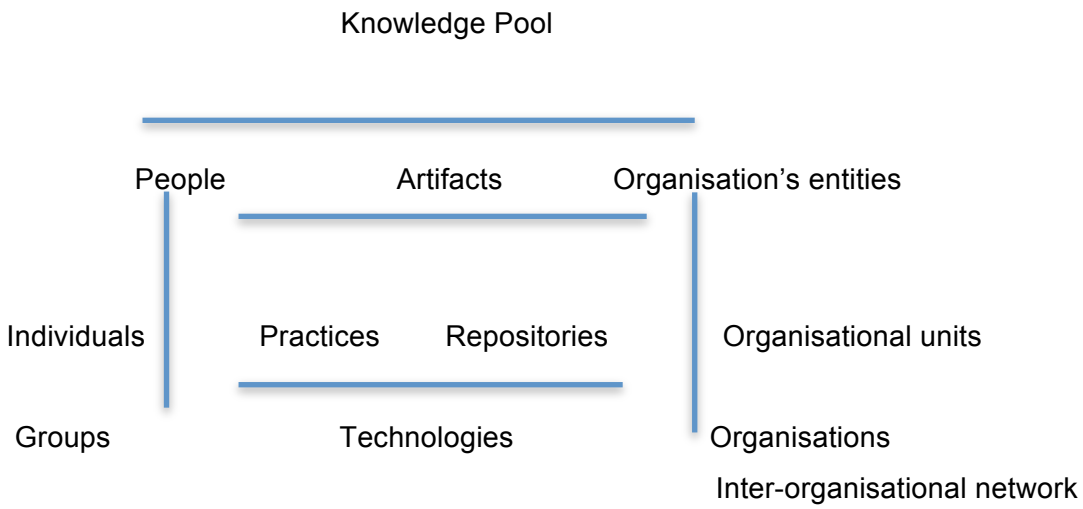


Figure 2.6: Knowledge location in an organisation

Source: Becerra-Fernandez *et al.* (2004)

Both individual and collective knowledge extensively reside in people (Chua 2002). Collective knowledge can be in the form of social groups formed within members of the organisation. A good example of collective knowledge is the community of practice (COP), which is a group of people involved in carrying out a particular activity therefore having and needing common knowledge (Hislop, 2005). Knowledge stored in the organisational artifacts can include a list of practices, and guidelines that is continuously

updated. Knowledge repository is a good example of an organisational artifact; this can either be manually or electronically based. Finally, knowledge can exist in the different entities within an organisation, these entities can range from departments to the entire organisation and even inter-organisationally. The following section looks into knowledge life cycle.

2.8 KNOWLEDGE LIFE CYCLE AND KEY CONCEPTS

Just like in project management, it is important that an organisation develops a life cycle for knowledge management within any given project. This life cycle will help identify the exact knowledge required, the knowledge that needs to be acquired, created, applied, transferred and shared.

2.8.1 Identifying precise knowledge

This process targets the exact specification of knowledge required (Dickinson, 2000). For example, the ability for an engineer to carry out a deep sea drilling operation requires him to have the exact knowledge about deep sea drilling and the technology required for such activity. The specification of knowledge required to perform a given task determine the result of this process.

2.8.2 Acquiring knowledge

The term knowledge acquisition simply means getting the knowledge from outside the team performing the task. Such knowledge may be acquired from the organisations own repository or it may be acquired according to the requirements of the specific task from outside the organisation (Dickinson, 2000; King, Chung and Haney, 2008; Rus and Lindvall, 2002; Tiwana, 2000).

2.8.3 Creating Knowledge

Knowledge creation is the process of developing new knowledge or altering the current content of knowledge with new content. This is important because knowledge acquired from outside the project team is often not sufficient to carry out a planned task or solve a problem, such knowledge is either too general or too detailed. In a situation like this, new knowledge has to be created (Alvin and Leidner, 2001; Davenport and Prusak, 1998; King *et al.,* 2008; Rus and Lindvall, 2002; Snider and Nissen, 2003; Ward and Aurum, 2004).

2.8.4 Applying knowledge

This is the heart of a knowledge life cycle. It is the process by which knowledge is directly applied to a task or to problem solving. Knowledge may be applied individually or by the whole team for the benefit of the project (Ajmal and Koskinen, 2008; Chen, 2005). Organisations benefit more from the proper application of knowledge than just the existence of knowledge (Alavi and Leidner, 2001).

2.8.5 Knowledge transfer

The act of communicating between specific subjects can be referred to as knowledge transfer. This process can be carried out either by an individual or a team of people (Alvavi and Leidner, 2001). A common form of knowledge transfer is by socialisation through observing the character or behaviour of the people possessing the desired knowledge.

2.8.6 Knowledge sharing

Knowledge sharing is another form of passing knowledge (Alavi and Leidner, 2001). Sharing knowledge from the creator of the knowledge is not necessarily directed to one recipient. Knowledge that is shared is commonly placed in the knowledge repository of an organisation. Placing acquired and documented experience into an organisational repository is an example of knowledge sharing. (King *et al.,* 2008)

2.8.7 Building a knowledge sharing culture

In this section of the thesis, the researcher explored some of the knowledge-management initiatives that are elevating the oil and gas sector's ability to find, develop and produce oil and gas reserves cost effectively. There is no alternative for knowledge. Albert Einstein once noted "*knowledge is experience; everything else is just information*" (Amin *et al.,* 2001, p.3). It is becoming increasingly essential to shorten the learning curve, or the time to achieve full competence, to rapidly integrate sophisticated advance technologies; and to efficiently fill the gaps in an organisation knowledge base particularly as field developments become more complex and operating environments, like the deep offshore, pose increasing demands on practitioners and equipment (Amin *et al.,* 2001; Edwards, 2008). Knowledge-management solutions are important elements in achieving higher production rates, increased reserve recovery and maximum asset value. Success will depend on leveraging intellectual capital, sharing knowledge across borders, preventing the same mistake from happening twice and taking advantage of

opportunities because the right information is available at the right place, at the right time (Edwards, 2005).

Perdue (2001) claimed that the biggest barrier to transferring and applying knowledge is corporate culture and the largest difficulty in managing knowledge is changing people's behaviour. A number of oil organisations are rigorously adopting knowledge-based philosophy, vowing to be the best-in-class by having the best people produce and apply the best technology using the best process to provide the best products and services - in essence creating a knowledge-powered enterprise (Edwards, 2008). For most, this will require a basic cultural shift. Organisations must be equipped with the right tools, including a new generation of business and technical applications that contain integrated decision-support and simulation capabilities, and be motivated to evolve from individual contributors to fully participating members of export communities. Changing the culture in oil and gas organisations rapidly and efficiently requires an intellectual atmosphere that embraces and rewards knowledge-sharing (Amin *et al.,* 2001; Edwards, 2008; Hansen *et al.,* 1999). The benefits are enormous organisationally, operationally and financially.

Amin *et al.* (2001) found that, despite advances in high-speed, high-power computing and communications technologies, the nearly exponential growth in the volume of the modern oilfield data has, at times, overwhelmed those involved with data manipulation, management and interpretation. Without data management, knowledge management is impossible. Interestingly, until the mid to late 1990s, few oilfield organisations had defined and incorporated a data-management methodology that encompassed full verification and categorisation, construction of comprehensive, easy-to-use databases; and utilisation of the databases as a foundation for capturing knowledge. This deficiency forced several organisations to initiate comprehensive data-management programs that form the basis for a knowledge-driven infrastructure (Beham *et al.* 1997; Gould 1999).

There is, however a profound difference between data management - principally devoted to technology and process - and knowledge management focused primarily on people and their interaction and collaboration. According to Gould (1999), the abyss between the two can be bridged only if oil organisations invest in and commit to building a comprehensive knowledge-sharing culture. To date, significant progress has been made toward building such cultures, but much remains to be done. Knowledge

repositories, corporate memory banks and communities of practice are becoming common in the oil and gas sector. It could be argued that the industry is finally beginning to yield the tremendous value inherent in fully exploiting the data and information at its disposal (Amin *et al.,* 2001).

2.8.8 A new landscape for learning

As observed from the reviewed literature, the information age has steered in an era of unsurpassed efficiency and flexibility in transferring, cataloguing and retrieving data about people, process and technology (Egbu *et al.,* 2001a; Gartner, 2013). This ability has led to an atmosphere conducive to higher productivity, greater cost-effectiveness and total quality awareness. Today, fuelled by this new-found ease of accessing information, oilfield practitioners are increasingly willing to broaden, learn and deepen their basic repertoire of skills, and to mould and adapt new information to help achieve both personal and business objectives (Egbu *et al.,* 2001b; Gartner, 2013). The need for learning and understanding has led to a revolution in structured knowledge sharing in which the collective experience of multiple experts can be pooled and then disseminated quickly to anyone located anywhere in the globe. Amin *et al.,* (2001) noted that the desire for increased speed can often conflict with getting the right data of the utmost quality to the right individual at the right time - a prerequisite for accurate, real-time decision making. It is worth mentioning that efficient data movement can be achieved with no trade-off in quality, content and delivery flexibility (Carrillo *et al.,* 2000).

2.8.9 Connectivity and the knowledge hub

Connectivity is fundamental to empower and sustain a knowledge culture and its resulting initiatives (Harman and Brelade, 2000). For instance, more than 20 years ago, Schlumberger recognised that the future of the upstream oil and gas industry would hinge on providing an infrastructure for diverse, globally distributed teams to interact electronically. In response, the organisation implemented a world class intranet for rapid and effective communication among all worldwide locations (Amin *et al.,* 2001). Today, it has one of the largest private communications networks in the world, connecting over 40,000 users. It is worth highlighting that the Schlumberger intranet and knowledge-management portal support a full spectrum of communities of practice, composed of people in the fields of operations, research and development, marketing, personnel, finance and other key disciplines. As illustrated in Figure 2.7, the human foundations for

knowledge management are communities of practice, collections of practice equipped with the tools necessary to interact effectively.

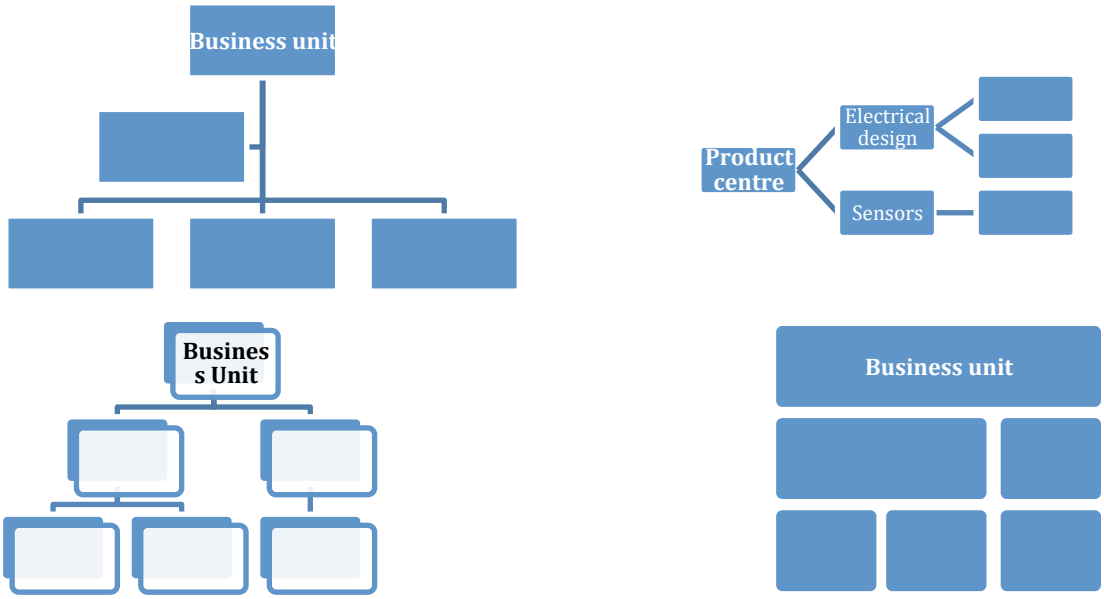


Figure 2.7: Communities of practice

Source: Amin *et al.* 2001

Shared community experience adds vivacity and aids in the definition, capture, preservation and dissemination of company and industry best practices that, in turn, accelerate the adoption of new technologies and help maintain and further develop core competencies. The following observations have been made (Bargach *et al.,* 2001; Gartnre, 2013; KPMG, 1998; McConalogue, 1999):

- Electronic collaboration has replaced face-to-face interaction as oil and gas organisations diversify geographically;
- Optimal use of intellectual capital implies learning quickly and continuously to reap major benefits from the company's most competitive resource;
- Today's routine use of data technology and web-based collaboration tools fully facilitates capture, sharing and leveraging of expertise and knowledge so that it can be applied more efficiently.

2.8.10 Making knowledge management happen

It has been demonstrated that there is general consensus in the KM literature that there is no "one right way" to make KM happen in an organisation (Edwards, 2008). Naturally,

this can make it seem more difficult, because of the need to tailor the approach taken to the needs of the organisation in question. In this section, the researcher examined some of the key strategic elements that need to be taken into account. What does KM encompass? How do you know where you are starting from? What are you trying to achieve? Will you know it when you see it?

To address the first question, Edwards (2008) suggested that one appealing way to conceive of knowledge management activities in an organisation is in the form of a life cycle of knowledge. Unfortunately, as confirmed in the literature there is no general agreement in the KM literature on what that life cycle should be (Edwards, 2001; 2008). **Figure 2.8** shows (Edwards, 2001), activities of knowledge creation, refinement, storage, transfer and use (Edwards, 2001). In some contexts, it may be important to include knowledge acquisition (from outside the organisation) explicitly in the model, as an alternative to an internal process of knowledge creation. Most alternative views of the life cycle have broadly similar activities, with variations in the level of detail.

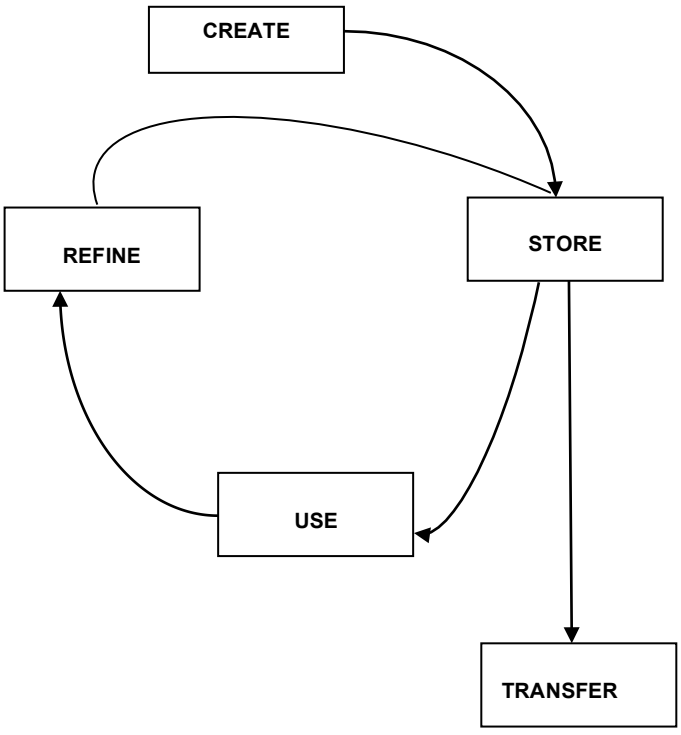


Figure 2.8: A knowledge management life cycle
Source: Edwards 2001

Moving on to the second question, any oil and gas organisation that is completely new to KM, at least as an explicit activity, would be well advised to begin with a knowledge

audit. A number of tools and techniques are available for this (De Lusignan *et al.*, 2005; Hylton, 2003; Liebowitz, 2005; Schwikkard and du Toit, 2004) and the results are often produced in the form of knowledge maps. What a KM initiative is trying to achieve is a question that can only be answered for a particular organisation at a particular time, but it is worth stressing that senior oil practitioners need to make this absolutely clear, and to ensure that a consistent message is passed down to everyone involved in the project . According to Edwards (2008), some KM initiatives are still introduced on a "me too" basis, which is unlikely to bring success. So, how will managers know it when (or if) they see it? Again, it is important to set objectives and to recognise that a major KM initiative may take several years to come to fruition. Daven *et al.,* (1998), pointed out that "even the most developed, mature projects were unfinished" and there is no evidence that the situation has changed substantially since then. One important determinant in any KM initiative or project is to ensure that the top-down strategic direction of knowledge management in the organisation is aligned with the bottom-up organisational learning that is essential in order to make any concrete difference in the way that the organisation actually operates (Edwards and Kidd, 2003). This brings together all the aspects set out in this section do the strategy and culture of the organisation better support personalisation or codification approaches? How standard are the organisation's processes? What are the key knowledge-related activities to be managed in *this* organisation *now*? Much can be learned from the experiences of others in KM, as the following sections will show, but in the end the one thing that all authors on KM agree about is that there is no "one size fits all" solution to KM problems. The following section explores knowledge management in the oil and gas sector.

2.9 KNOWLEDGE MANAGEMENT IN THE OIL AND GAS SECTOR

Oil and gas organisations have always managed their knowledge in some form. They have always relied on the expertise of key members of staff. Thus, knowledge management is not entirely new to the industry. What is new is the application of the terminology and the increased awareness that knowledge should be management in a more structured manner. This has been largely brought about by a number of factors such as the:

- Increased global competition;
- Company size;
- Geographical spread; and

- Employee turnover (Carrillo, 2004).

Mertins *et al*. (2001) highlighted KM's ability to improve organisational goals and therefore its close connection to business processes. They considered KM:

- Provides an understanding of markets;
- Customers;
- Develops visions and strategies;
- Develops products and services;
- Improves marketing and sales;
- Improves the production and distribution of; and
- Products and/or services.

In addition, as illustrated in Table 2.2, they identified the top ten improvements achieved through KM.

Table 2.2: Improvements through knowledge management

Rank	Improvement
1	Cost/time reduction, increase in productivity
2	Process improvement
3	Improvement in the exchange of information
4	Customer orientation and satisfaction
5	Transparency of structures and processes
6	Facilitation of decisions and predictions
7	Quality improvement
8	Staff quality and satisfaction
9	Success, market leadership

Source: Carrillo 2004

The increasing size and the geographical spread of oil and gas organisations have led to large, international organisations that make it difficult to source expertise quickly or indeed know what expertise is available within the organisation (Ochieng *et al.* 2013). The high turnover of employees means that there is a need to provide clients with confidence that the organisation is competent in specific areas of work. To facilitate knowledge sharing in an organisation, it has to focus towards human resource policies, information policies, group dynamics, departmental cooperation and organisational

incentive structure and any other relevant activities according to the nature of the process involved (Ramanigopal, 2012).

In the oil and gas industry, knowledge management can be thought of as either a framework or an approach, which will enable the development of a set of practices to collect and share knowledge. In balancing information culture and technological culture, there are three major resources named people, process culture and technology which can enable the organisation to utilise and share the information effectively and efficiently towards the betterment of the organisation, where the oil and gas industry cannot be an exception. McKenna *et al.* (2006) noted that the oil and gas upstream industries operate based on the strength of their natural resources, infrastructure, processing facility and technology, human resources and the most important, energy products that the market demands. If one of the factors fluctuates, it affects the industry operations, planning and production. By nature everything is not exceptional, there are strengths and weakness, resources without capital, knowledge without management, skilled people without organisation, willingness to do but lack of technology, strength in execution but with no quality, no core know how, success with no sustainability, vision with no decision making, and so on and so forth (Ramanigopal, 2012). To be successful, it is important to make use of the best available resources. Everyone could be a master in their own domain but to be a master of all in a particular capital venture, one needs to understand all available data collectively as teams and groups by analysing, sharing experience, knowhow and knowledge.

In the current global context, oil and gas organisations in Nigeria are in need of knowledge management implementation as a key strategy to handle the global competition and to improve their competence to meet the challenges in their business irrespective of the size of the organization (Kasimu *et al.* 2012; Oyejide and Adewuyi 2009; Rabiu 2009). Knowledge and information management has become the most essential key strategy for the upstream oil and gas sector. From the reviewed literature, it has been established that organisations in the oil and gas sector were early users of knowledge management, and have provided the way in terms of knowledge management implementation.

The energy sector incorporates a huge variety of organisations, from oil and gas majors, to conventional, renewable and nuclear power companies, to specialist drilling, mining

firms and all allied industries (McKenna *et al.,* 2006). It is an industry dominated by a number of huge multinational organisations, each of which must contend with the difficulties and challenges of maintaining a geographically dispersed workforce, operations, and functioning according to clearly defined operational procedures (OGER 2012; 2013). At the same time, they must cope with external pressures relating to deregulation, growing environmental concerns and strict health and safety guidelines. It is therefore not surprising that some of the world's biggest energy organisations were early pioneers of the principles and working practices of knowledge management and, indeed, still lead the way on a global scale. That said, most energy companies are still to realise the full potential of the resources at their disposal and have not understood the importance of knowledge management and its fruitfulness, and knowledge management represents a powerful means for these firms to deal with the challenges that lie ahead and growing endlessly according to the techno and social changes (McKenna *et al.,* 2006; Ramanigopal, 2012).

A centralised knowledge management system helps companies hasten their effort to backfill their technical capability gap. This also helps to recognise and anticipate problems and avoid these problems across multiple projects. Knowledge management includes on the job mentoring, structured training, and the establishment of institutional mechanisms to capture and disseminate information relevant to project teams. Oil and gas organisations in Nigeria have always managed knowledge in one form or another, usually by relying on the expertise of one key member or another. This shows that knowledge management is not an entirely new concept in the Nigerian oil and gas industry, but there is the need to create an awareness of the terminology and to develop a structure that enables proper knowledge management.

2.9.1 Industry structure and eLearning needs

According to Edmonds (2002), two overall features of the oil and gas sector drive demand for eLearning:

- *Oil and gas is a truly global sector*. Not only is the oil and gas business truly global, but unlike some other global companies, the sector looks much the same worldwide. Drilling rigs, oil refineries and gas stations are similar in Nigeria, the United Kingdom and the Middle East. Project teams in the oil and gas sector face similar issues, which mean they could benefit from global learning systems and

communities. The global nature of the oil and gas sector also creates demand for network-based tools such as eLearning that can deal with highly multicultural teams.

- *Oil and gas is a highly competitive, commodity business*. Oil and gas themselves offer limited opportunity to differentiate products in terms of quality. Retail end of the business competes on factors such as location, price, brand, reward schemes and in-store shopping and services. The upstream oil industry essentially competes on cost, which is possible through the application of technology and the use of knowledge.

Previous studies have reported that the oil industry has three main components: exploration and production (E&P), refining and marketing. Various linking components such as pipelines, shipping and road tankers also play a role (Amin *et al.,* 2001; Carrillo, 2004; Edmonds, 2002).

- **Exploration and production:** is the area in which oil organisations have the longest history in eLearning and particularly, knowledge management. In E&P, oil organisations compete in applying technology and knowledge to achieve low costs and they also undertake huge speculative investments. Making the right decisions is therefore crucial in E&P, because mistakes incur huge costs.

- **Refining:** the business requirements of oil refining are quite different from those of E&P. Capital expenditure is less variable because fewer opportunities for innovation exist in building refineries than in building upstream facilities. Refineries benefit by sharing knowledge with one another and being able to call on the expertise of local and remote staff to resolve problems and avoid problems that other refineries have faced.

- **Marketing:** the final part of the oil and gas business includes the retail fuel. It is worth highlighting that the margins for retail fuel are very low in most nations, and gasoline stations supplement their incomes with a variety of value-added services.

The above three components of the oil and gas sector have different but overlapping learning needs (see Table 2.3). Exploration and production remains the part of the oil and gas industry in which demand for eLearning is the strongest.

Table 2.3: Learning needs of the oil and gas industry

	Exploration and Production	**Refinery**	**Retail**
Business drivers and levers	• Need to minimise capital costs • Efficiency • Risk reduction	• Optimal use • Efficiency	• Need to control operating costs • Brand management • Market positioning
Characteristics	• Complexity • Knowledge intensiveness • Global scope • High cost of mistakes • Aging workforce	• Constant process • Global scope • Aging workforce	• Low-margin business • Drive for added-value services • Temporary and part-time workforce
Examples of learning needs	• Knowledge sharing with other exploration teams • Reduced time to competence • Sharing of transitory project knowledge • Health, safety and environmental training	• Knowledge sharing with other refineries • Reduced time to competence • Health, safety and environmental training	• Customer service • Brand values • Capture of ideas for added-value services

Source: Edmonds (2002)

From the above, it is worth highlighting that in E&P and refining, the aging workforce is a key determinant for the adoption of eLearning. From the reviewed literature, it was found that the average age of an oil and gas employee in the USA is 48 years (Edmonds, 2002). Oil and gas clients realise that the key knowledge that enables them to run their businesses is retiring in the next 10 to 15 years (Edmonds, 2002). New workers are not coming through fast enough to make up for this mass departure, and in any case take a long time to train. Given the demographics of its personnel, the global oil and gas sector needs to address the following two key learning priorities:

- Reduce the time to competence for new recruits; and

- Increase the effectiveness and knowledge of all workers so that organisations can do more with fewer people.

The challenges are in such a way that the oil and gas businesses are having some common challenges, and solutions need to be shared and applied all around the globe. Knowledge management can be a real solution for this challenge in the energy sector, particularly the oil and gas sector in Nigeria. There are major challenges in finding effective ways in the exploration of oil business, in knowledge-intensive areas such as drilling, geology and geophysics, to access the most valuable knowledge reservoir as one million man-years of experience (Kasimu *et al.* 2012; Oyejide and Adewuyi 2009; Rabiu 2009; Ramanigopal, 2012). Also other challenges are delivering performance improvement in the risky and expensive offshore megaprojects. Organisations in Nigeria should learn and update new culture to handle major challenges.

Oil and gas organisations in Nigeria, are facing a lot of issues and challenges, in handling information required to operate as well as to execute in their business activities (Oyejide and Adewuyi 2009; Rabiu 2009; Shell, 2014). Lessons learned systems are crucial for delivering performance improvement in the risky and expensive world of the international and offshore megaprojects. Discussion forums, have become more and more vital for connecting people in communities of practice, and these can usefully be supplemented by real-time collaboration technologies. The major benefit that knowledge management has given oil organisations so far is protecting the base. The objective is on reducing capital and operating costs, increasing utilisation and up time, and improving market positioning to compete in the global market. Knowledge is captured and shared about topics such as increasing success in finding oil fields, reducing maintenance down-time in oil refineries, and increasing the speed of build of gas stations.

Culture related knowledge management has become more and more popular. Economic conditions remain tough due to cut throat competition, globalisation, strategic operations against competition both local and global level. Web Portal has become the most essential tool in the energy sector. Organisations in energy sectors operating at international level started developing and applying required portals to keep a transferable database of reservoir engineering techniques.

2.9.2 Knowledge management examples in the energy sector

This section gives examples of KM in the energy sector. It is worth noting that all of the projects discussed were called KM at the time.

Some parts of the oil sector have an extremely good reputation for KM, the best known example surely being that of BP. Amongst the novel elements in the BP approach was their cycle of "learning before, learning during and learning after" (Collison and Parcell, 2004; Davenport *et al.*, 1998; Edwards 2008). They also introduced many communities of practice and a corporate Yellow Pages system intended to help communities of practice to form and operate. Above all, however, the BP approach to KM relied upon building up a culture within which people were willing to share knowledge (Collison and Parcell, 2004; Davenport *et al.*, 1998).

This culture stood them in extremely good stead when it came to the mergers which were common in the industry at this time. Barrow (2001) concentrated on the merger between BP and Amoco. Barrow (2001) further examined how the principles that had already been established at BP were used when the merger took place. Sharing know-how was one of the key principles. Barrow (2001) described the:

- Operation of various CoPs, giving examples of five different "networks" (as BP call CoPs) ranging from Refinery Operations Managers to Challengers (workers new to the company).
- 3D visualisation technology HIVE (Highly Immersive Visualisation Environment) and how it was used to help specialists with different skills (such as geologists and drilling engineers) to work together.

A key point specific to mergers is that BP believed that common core processes were vital in enabling the sharing of knowledge: examples are the complementary pair of the capital value process and the operations value process. BP also stressed a holistic approach to KM (Coffman and Greenes, 2000). Coffman and Greenes (2000) emphasised two aspects:

- How useful the KM work was in mergers and acquisitions, the value of the networks (CoPs) and the need for people who can take ownership of the KM initiatives;
- Makes the point that simple tools (like a good search engine) can often provide better support for KM than complex special-purpose ones.

According to Bahra (2001), Halliburton and Schlumberger acquired a reputation for KM. Shell's main approach to KM had been to relocate people from one site to another. This could perhaps be seen as one way to attempt to form CoPs. Bahra (2001), examined two KM frameworks that had been used in Shell, one being a lifecycle type model of the processes involved in KM (capturing, sharing, using, learning) and the other a content-based framework divided into three parts (collaboration, content and best practices).

Reinmoeller and van Baardwijk (2005) also include Shell Petroleum as an example of good practice not specific to the energy sector, in this case as one example of sustained successful innovation amongst Dutch companies. They suggest that Shell's success as resulting from a combination of diversity and resilience. Leavitt (2002) explored KM projects in Schlumberger, Chevron, Halliburton and BP Amoco. Turning to other more specific examples of KM in the oil industry, Nelson (1997) described the pioneering use of virtual seminars in the petroleum industry. According to Nelson (1997) the very first example of a web-based virtual seminar was given by him to groups of geoscientists involved in interpreting seismic results in the mid-1990s, building on earlier work using teleconferencing and video conferencing. As early as the end of 1996, several virtual seminars were available over the web to those in the petroleum exploration and production industries.

An alternative approach to forming relatively informal CoPs (or letting them form) is to set up specific departments or units to achieve similar results. Morales *et al.* (1999) showed the importance of a Technical Information Centre as a centre of provision of knowledge in the oil industry, using the example of PDVSA, the Venezuelan state owned oil company. This is not to imply that all KM initiatives are immediately successful Oliveira *et al.* (2005) described how, in a Brazilian Oil Company, equipment knowledge was not transferred along the manufacturing chain (as they label it) to the point where strategic decisions about extraction were actually being made. A design re-engineering project was needed to solve this problem. In the next section, the researcher explored more examples concerned specifically with exploration and development in the oil (and gas) industry.

2.9.3 Oil/gas exploration and development

As mentioned above, KM in the energy sector goes back a very long way – and if we go beyond KM into the heyday of expert/knowledge-based systems (KBS), one of the

earliest practical examples was Dipmeter Advisor, used by Schlumberger in oil exploration (Edwards 2008). Smith and Farquhar (2000) explained how this artificial intelligence-driven work led Schlumberger into KM. Etkind *et al.* (2003) explored the use of project KM portals in oilfield projects using Schlumberger's *Integrated Project Management Group* as the example. Their approach covers both exploration and production, and stresses the difficulties caused by having to deal with geographical dispersion and multiple specialists, the latter often working for different companies or sub-contractors (Etkind *et al.,* 2003). They point out that mergers often lead to the loss of experienced people. The literature examined, refers to as many as one-third leaving within two years (Cartwright and Cooper, 1993; Unger, 1988). This contrasts with the approach that BP claimed to take. Interestingly, Etkind *et al.* (2003) state "*the average age of petroleum engineers is almost 50 years*" (p.191). They claim that Schlumberger's KM is based on a knowledge sharing culture and give many examples. These use all of the three elements in Figure 2.8 to make connections, as shown in Table 2.4.

Table 2.4: Knowledge management systems in Schlumberger

Connecting….	Knowledge Management System	Elements
People to people	Online CVs system	People, technology
People to information	Project data repositories	Technology
People to CoPs	A specific initiative intended to create CoPs	Process
People to knowledge	InTouch, a corporate validated knowledge repository	People, process, technology
People to learning	HR department	People
People to everything	Project knowledge portal	People, technology

Source: Etkind *et al.*, 2003

Between them, the systems in Table 2.4 address all of the stages in the life cycle shown in Figure 2.8. For example, the project knowledge portal was used in a project in South America, both to improve the performance of the team working on the project ("use" and "refine" in *Figure 2.8*), and to enable a completely new team to take over after the project had been stopped for several months ("store" and "transfer"). Schlumberger have built so many project portals (326 in three years) that they developed their own software tool, Schlumberger DecisionPoint, to do it (Edwards, 2008).

Also pre-dating the invention of the term KM is a book that looks at the organisation of the Norwegian oil industry (Stinchcombe and Heimer 1985). Indeed, neither "knowledge" nor "learning" appears in the book's index, but it does raise some of the issues that are

still relevant to KM today (Stinchcombe and Heimer 1985). These include the coordination of different professional specialists (Davison and Blackman, 2005), often working for different organisations (van den Berg and Popescu, 2005), and coping with the uncertainty of an environment which no-one has ever experienced before (Koulopoulos and Frappaolo, 1999; Pauleen *et al.*, 2007). It also mentions one or two specialised aspects of knowledge, such as that relating to insurance for the energy sector, that no longer seem to be covered in the energy sector literature. Norwegian sea oilfield organisational learning has continued to be an important area of KM focus. Hustad (1999) writes about Statoil and the Norne oil field deployment project.

Hustad (1999) examined organisational learning and the knowledge creation process, using Nonaka's ideas (Nonaka, 1994) which developed into the concept of *ba*. Integration of specialists from different companies was an important issue, and Hustad makes a key finding that "both redundancy and variation must be present in a knowledge development team". The team has to have enough similarity of background and language to understand each other but also needs to bring enough dissimilarity of perspective to produce new ideas. This is consistent with the results of work on team performance more generally, that teams with moderate diversity are most effective (Brodbeck *et al.*, 2007; Ochieng *et al.,* 2013). This theme of "medium diversity" or "sufficient variation" is also the explanation given by Reinmoeller and van Baardwijk (2005) for Shell's success. Their claim is that enough diversity is needed to be able to continue to innovate successfully in an unknown future, but not so much that no progress can be made.

Hustad also finds that Nonaka's work is well justified in the Norwegian oilfield case, as is that of George Huber on organisational learning (Huber, 1991). Hustad also speculates on whether the formal organisation will maintain its role as the home of learning for the knowledge worker in the future. Two papers describe KM at Halliburton (Behounek and Martinez, 2002; Ash, 2005). Behounek and Martinez (2002), had a rolling project based KM strategy, which is a good example of the staged approach advocated elsewhere (Edwards and Kidd, 2003) and moved from an initial technology focus to one that emphasised human issues such as CoPs. Ash (2005) examined a community of electronic technicians at well sites. They designed their own portal so that they could function as a CoP at all times. Interestingly, organisationally KM was (in 2005) under Supply Chain and Management Systems. Behounek stressed the need for the

sustainability of KM – key elements in this are trust, rewards, adaptation, value generation driven, collaboration, and ensuring that KM is not an isolated initiative but tied into others. Another discussion of the benefits of CoPs in oil exploration and development is that by Amin *et al.* (2001). It regards them as crucial in developing and sustaining a knowledge sharing culture, with examples from Schlumberger, BP and briefly Chevron.

Anderson and Boulanger (2004) considered drilling as one of many aspects within lean energy management. Their main interest was in “lean” as applied to process control, and they list a whole host of actual and potential applications relevant to the energy sector, including power plants of all kinds, and electricity transmission systems and distribution networks. They considered KM based on a three-dimensional model, with dimensions of static-dynamic, context-dependent or independent and abstraction understanding. Onto this they super-imposed other dimensions, based on the two dimensional planes at the sides of the cube formed by these three dimensions, such as the knowledge ladder hierarchy that runs data-information-knowledge and more contentiously wisdom. Their approach also emphasised the feedback loop in modelling (adaptive models) and machine learning. Their claim was that lean approaches to exploration and development require extensive modelling and simulation before implementation, with this computer-based work taking five times as much effort as the physical work in the field. They give a proof of concept example of lean exploration drilling, which uses machine learning adaptive models.

Corben *et al* (1999) described a system dynamics model for oil field value management. They used system dynamics as the basis of an approach to capturing knowledge about all aspects of the oil field management value chain. This uses typical system dynamics causal loop diagrams as a means of knowledge representation. Hesthammer and Fossen (2000) used a simulation model to assess oil and gas recovery from drilling fields. Prassl *et al.* (2005) outlined a fuzzy logic expert system for assessment of gas drilling risks.

2.10 OIL AND GAS PROJECTS IN NIGERIA

2.10.1 Bonga deep-water project

The bonga project was the first deep-water oil discovery project in Nigeria. The Shell Nigeria Exploration and Production Company (SNEPCo) began producing oil and gas from Bonga in 2005. Lying 120km offshore, the Bonga floating production vessel has the capacity to produce more than 250,000 barrels of oil a day and 150 million cubic feet of gas a day. By the end of 2012, Bonga had produced about 450 million barrels of oil. When it came into production, the project increased Nigeria's oil production capacity by around 10 per cent, and it will allow Nigeria to remain a leading energy producer for decades to come (Shell 2014).

The project has created the country's first generation of deep-water specialist engineers. By the end of 2010, some 90 per cent of Bonga's core offshore staff were Nigerians. Bonga also stimulated the growth of support industries vital to offshore deep-water projects. Nigerian companies contributed significantly to the success of the bonga project. They designed and built three of the Bonga modules, as well as the foundation piles for the vessel and the pipes transporting the gas to it. The giant single point-mooring buoy was also built in Nigeria: weighing around 870 tonnes, it was the largest of its kind at the time. Following an oil leak in December 2011, SNEPCo carried out a full review of the Bonga crude oil offloading procedure and has since introduced additional controls to enhance early detection and management of any potential oil leak (Shell 2014).

2.10.2 Bonny terminal upgrade

Exports of oil and gas generate billions of dollars each year for the Nigerian government. Shell Petroleum Development Company has completed work to increase the capacity of the Bonny crude oil export terminal and has also upgraded and expanded the Bonny crude oil terminal - the largest of its kind in Africa. The new facilities have more than doubled the amount of oil it can process and export to 1.25 million barrels a day. The system is fully automated, which also improves safety and reduces operating costs per barrel (Shell 2014).

The Bonny facility is now one of the most technologically advanced terminals in Africa and gives Nigeria the potential to deliver uninterrupted crude oil exports for the next

twenty-five years and as part of the project, SPDC installed a new generator at the terminal that will provide local residents with enough reliable power to meet the power needs of Bonny Town for years to come (Shell ,2014).

2.10.3 Nigeria Liquefied Natural Gas (NLNG) project

The Nigeria Liquefied Natural Gas (NLNG) supplies project, comprising of the Gbaran-Ubie and Soku fields, is designed to supply the natural gas needed by the NLNG Plant at Bonny Island in the Niger Delta. Operated by the Shell Petroleum Development Company of Nigeria Limited (SPDC), it also aims to provide gas to local power stations in the Niger Delta and help reduce flaring. Phase 1 of the Gbaran-Ubie project began producing oil and gas in June 2010. It achieved peak gas production of up to one billion standard cubic feet of gas a day (1 Bscf/d) in early 2011, equivalent to about a quarter of the gas currently produced for export and domestic use in Nigeria. It also produces more than 50,000 barrels of oil a day (Shell, 2014). The next phases include developments to maintain the gas supply, which include compressing the gas at the Soku field to raise pressure and keep it flowing. Over two-thirds of the contract value for these developments will be awarded to local suppliers and contractors. The developments will cut across the Niger Delta states. The project team has started community engagement around the planned activities, and will continue throughout the project.

2.10.4 Afam gas and power supply

The Afam power plant has increased Nigeria's electricity generating capacity and gas supply by around 14-24 per cent. During a combined-cycle commercial operation, the plant is generating at peak 650MV net dependable capacity. Currently it is delivering power to the national grid and helping supply homes and businesses. It requires only two thirds of the gas needed by many of Nigeria's existing power plants to generate each unit of electricity. Afam VI's gas turbines generate up to 450MW of power. Waste heat from the plant is then used to generate a further 200 MW of very low emission electricity. The gas comes from the newly built Okoloma plant, capable of processing 240 million cubic feet of gas each day from the Okoloma field. The combined cycle power plant (Afam V1) is the second combined-cycle power plant in the country, where many people lack access to power and electricity shortages are common (Shell, 2014).

The plant contributes substantially to Nigeria's electricity generation, making it critical to the federal government's aspiration to increase power supply in the country. The World Bank (2014) has recently registered Afam as a clean development mechanism project, which allows it to earn certified emission reduction credits, each equivalent to one tonne of CO_2. At its peak the project employed 3,000 local construction workers and Nigerians made up 95 per cent of the labour force. The project also funds a number of community development initiatives in the project area including power supplies to local communities. SPDC is currently providing training for fifteen young community graduates in the operation and maintenance of a combined cycle power plant (Shell, 2014).

Having such projects in the region, the need for a world-class knowledge management framework cannot be over emphasised. Even though these projects are executed locally, they are of international magnitude in size and interests. They all also have the driving forces for knowledge management as categorised by Wigg (2000). Knowledge in the business world today is of increasing importance and continues to be vital for any developmental project; knowledge drives towards planned growth and profitable potentials. On the other hand, adequate knowledge will help position an organisation for the global competition for both customers and clients. It is important for organisations in the Niger – Delta to understand that knowledge management is as important as every other mechanical and IT tool needed for a project. Knowledge sharing should be a part of the culture of the organisation; this will avoid the loss of knowledge with the migration of project team members.

In addition, it is worth noting that the oil and gas industry is currently perceived as not very *environmentally attractive* even though it employs a number of environmentally friendly technologies. There are also ongoing initiatives, such as the utilisation of microorganisms, to produce win-win solutions. Furthermore, the Nigerian oil and gas industry's environmental standards make it an unattractive oil and gas hub in which to do business. This aspect needs to be emphasised further. However, the development of higher environmental standards is called for. Nigeria must be at the forefront of the global industry in terms of developing environmentally friendly solutions.

2.11 UK OIL AND GAS INDUSTRIES

The Oil and Gas UK Economic Report (2010) reveals that leading global producers of oil and gas may include US, Canada, Norway, United Kingdom, Venezuela, Qatar, Nigeria, Kuwait and Saudi Arabia etc. For the purpose of this research and given their uniqueness in the global oil and gas industry, the activities of the Nigerian and United Kingdom oil and gas industry shall be highlighted. These two nations present a balance between an African (Nigeria) and a European (United Kingdom) perspective of an oil and gas producing nation. From the late 70's to the early 21st century, the United Kingdom has been a major exporter of oil and gas, but at present, the UK is a net importer of the product (OGER, 2012). Almost all the oil and gas production in this nation comes from offshore drilling, where there is a network of 14,000kilometers of pipeline linking 107 oil platforms and a large number of other seabed installations.

The UK world-class oil and gas industry comprises of both production and the very important support services and this is vital to the economy. According to the (OGER, 2012) the industry provides a source of employment for over 400,000 people across the country, and has attracted interest from the largest investors in such industry, more than ever before. Due to the strong domestic supply chain network, the revenue has grown dramatically since 2008. Strategies and actions are in place to ensure the continuous growth. Such strategy includes but is not limited to regular meetings of the industry council to monitor the progress of every mega heavy engineering project, annual review and where necessary revision of strategy to eliminate loop holes. Despite the assumption that the oil and gas industry in the UK is taking a downturn, the Oil and Gas UK's activity survey, found that the UK will continue to supply oil and gas well beyond 2055, it forecast that there will be a 28 per cent increase in the global demand for oil and gas between now and 2035 (IES World Energy Outlook, 2012)

2.11.1 Effect of demand and supply on oil and gas

There has been a surge in demand in the oil and gas industry since the turn of the 21st century. There has been a significant and continued rise in consumption in the developed countries, and indications are that this demand will continue to increase. This industry has been known to boom and bust in the past a good example is the 1973 rise in the price of oil due to the OPEC embargo, and the fall in 1979 during the Iranian revolution. Mckenna *et al.* (2006) noted that this current boom is more demand driven

rather than political. This boom has put a strain on the infrastructure available to this industry, there is need for new drilling rigs and improved refining capacity in order to keep up with the demand.

2.12 ISSUES AND THEMES EMERGING

From the literature reviewed a number of broad conclusions can be drawn. These conclusions give a suitable context to the research aim and objectives discussed in Chapter One. Enabling oil organisations in Niger Delta to capture, share and apply the collective experience and know-how of their project teams is seen as fundamental in this study. Consequently, there has been a wave of enthusiasm and activity centered on knowledge management. To make progress, issues of technology, processes, people and content must be explored. Growing global operations in oil and gas organisations is leading knowledge and content management challenges. Organisations are being forced to rethink and redesign their knowledge management strategies so as to be responsive to evolving market dynamics, such as technological innovations, (mobility, wireless communication and geographic information systems). There is little doubt that KM has contributed substantially to the companies' success in dealing with challenges of the past decade.

It can be observed that oil companies are increasingly relying on big data to engage practitioners, improve business processes and drive innovation. However, with the volume, velocity and variety of information that threatens to inundate organisations and their employees, big data brings with it its own set of problems. Oil companies of all sizes in Nigeria are finding themselves with overwhelming amounts of information, often locked away in silos different systems, different departments, different geographies and different data types, making it impossible to connect the dots and make sense of critical business information (Kasimu *et al.* 2012; Oyejide and Adewuyi 2009; Rabiu 2009). For instance, the average organisation today has three times the number of information sources it had only 10 years ago. Variety is, for many, a significantly greater challenge than even volume of data (Gartner, 2013).

As this data grows at a rate of 800 per cent over the next five years 3 and continues to diversify and fragment, so does the challenge of knowledge access and of relevance to end-users and clients (Gartner, 2013). The inability to access relevant knowledge has resulted in poor knowledge re-utilisation, leaving oil companies' vast knowledge capital

untapped. The increasing amount of unstructured data (emails, forums, social media etc.) and tacit knowledge generated from higher levels of employee collaboration also add to the challenge of curating these assets and facilitating knowledge access and re-utilisation. As shown from the reviewed literature, knowledge will only generate returns to the extent that it is re-utilised. When effectively accessed and re-used, it provides an infinite reservoir of resources to support the key business issues clients care about teams relationships, innovation and human capital. Despite the immense value that resides with collective enterprise knowledge and the value it can create, many oil organisations are unable to harness their knowledge assets effectively due to the limitations posed by traditional knowledge management initiatives.

As shown in the reviewed literature, oil companies in the UK have already taken steps to curate knowledge and facilitate collaboration. Customer relationship management systems, enterprise resource planning systems, websites, enterprise communication tools, intranets, databases—these are some of the enterprise content management systems and collaboration tools that comprise many companies' knowledge management initiatives (Edwards, 2002; 2008). However, despite the amount of resources invested in these systems and the inherent value of knowledge capital, traditional knowledge management initiatives have failed to facilitate access to this reservoir of knowledge assets. Traditional knowledge management initiatives have failed primarily because of (Gartner, 2013; Hart *et al.,* 2013):

1. *Current emphasis on mining instead of using knowledge* - there is limited discussion on facilitating the sharing and re-using of knowledge output that ensues which resides in different systems, locations and disparate formats to generate the radically better outcomes ROK can achieve, which paradoxically reaches far more

2. *Knowledge management systems currently function as operational tools* - as a result of being used primarily to store, retrieve and extract data and information, knowledge management has been relegated to an operational rather than asset management function. Consequently, search is viewed merely as a commoditised retrieval tool—often for non-structured data—although it has the ability to generate radically greater returns when used as a knowledge-sharing and re-utilisation tool.

3. *Current focus on accessing explicit knowledge but not tacit knowledge* - while knowledge management systems provide avenues for employees to access explicit knowledge, it has limited success in helping employees find and access tacit knowledge. This is mainly because the link between talent management and knowledge management has yet to be established.

2.13 CHAPTER SUMMARY

As shown in this chapter, knowledge management in the oil and gas industry is striving but there is need for a structured knowledge management process, some organisations in the developed countries, such as the United Kingdom, have tackled this issue by having frame-works and functioning knowledge repositories, but some others have not addressed it at all which is the case of the oil and gas industry in the Niger Delta of Nigeria. There is much to be gained from inter-organisational learning - even learning from other sectors apart from the oil and gas. From the literature reviewed, there is the need for researchers to make an effort to merge the still disjointed theoretical base of knowledge management, every author seem to have an individual idea and understanding of the definitions of knowledge management. As evidenced in this chapter, the cluster dynamics or the innovation system in the oil and gas sector is based on a high degree of collaboration between suppliers of technology solutions and their clients, the operators. Chapter three focuses on the research method employed.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 INTRODUCTION

At its conception, the scope of the study was almost boundless, partly due to the limited and fragmented nature of the existing literature on knowledge management. The introductory chapter introduced the research and provided an overview of the justification for the research, aim and objectives, research process and the basic structure of the thesis. This chapter presents the philosophical assumptions underpinning this research and thereafter introduces and establishes the research design and methodology. The chapter discusses the different research strategies and the broad issues of quantitative and qualitative methods. The chapter deals with the whole issue of research design, research approach, research types, research methods, sampling strategies, and data collection techniques. The data collection methods adopted, namely, a postal questionnaire and interviews are discussed at length. Then, the chapter goes on to discuss the issues of sampling, gaining access strategies, measuring instruments, description of the participants, framework development, data analysis details, research limitations and validation.

3.2 PHILOSOPHICAL CONSIDERATIONS

This section discusses the research approach, namely the main philosophical considerations of this research, which are grounded on implicit and explicit philosophical perspectives, because ignoring such philosophical considerations could have a negative impact upon the quality of research. Easterby-Smith *et al.* (2008) argued that in research it is very important to have a good understanding of the philosophical positioning of the research because this can help in better understanding the differing research designs and methodologies which could be used for a particular piece of research as well as ultimately identifying the best design and method to be applied to the research. Also, as argued by Wing *et al.* (1998), different research approaches support different ways to proceed in the pursuit of knowledge. The philosophical position of any research is supported by several philosophical considerations. Although there is no pre-ordained position which best represents an appropriate research design and approach, as illustrated in Figure 3.1, every research tradition is based upon certain assumptions associated with differing combinations of ontological, epistemological and methodological assumptions.

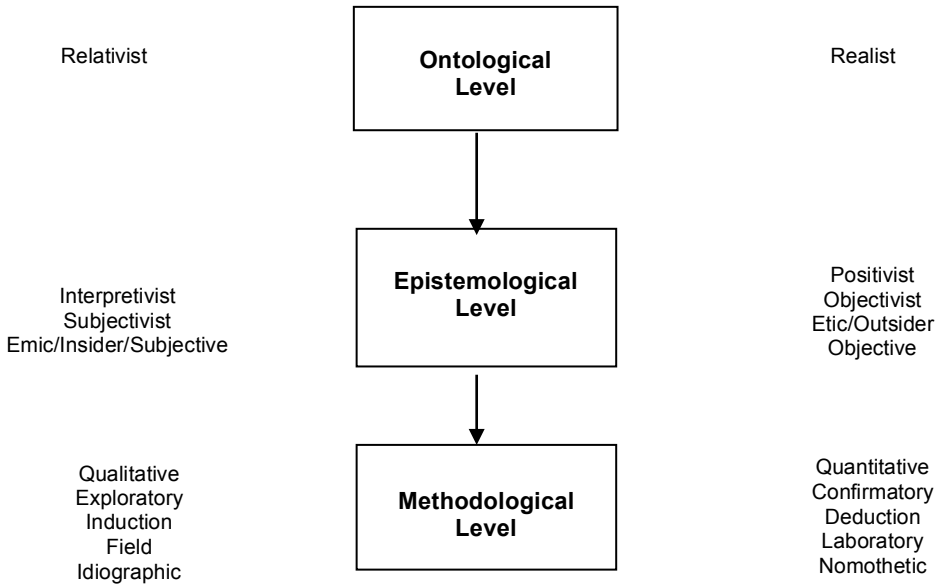


Figure 3.1: Dimensional hierarchy and major related dichotomies in research
Source: Khazanchi and Munkvold (2003)

Indeed, according to Bryman (2008), the two main philosophical positions of social research are ontological and epistemological considerations, both of which are discussed in the following part of this section, which presents the philosophical assumptions adopted in the course of this research.

3.2.1 Ontological consideration

According to Smith (2003, p.155), ontology as a branch of philosophy is "the science of what is, of the kinds and structures of objects, properties, events, processes and relations in every area of reality". Also, Smith highlighted that sometimes ontology is used in a broader sense, to refer to the study of what *might* exist. Moreover, ontology is the nature of the world around us and for researchers it is the particular slice of reality each researcher chooses to address (Hirschheim, 1992). Guba (1990) and Fellows and Liu (2008) both considered that the ontological debate is simply focused on the nature of human knowledge or the assumptions in conceptual reality.

In this regard, Fitzgerald and Howcroft (1998) considered the existence of relativist and realist ontological positions, where at one extreme there is the relativist position, which

holds the belief of the existence of multiple realities as subjective constructions of the mind where the perception of reality is directed by socially transmitted teams and can vary according to language and culture. In this reality, concepts such as right and wrong, goodness and badness, truth and falsehood cannot be absolutes as they can change from culture to culture and situation to situation. At the other extreme there is the realist ontological position, which is based upon the belief that the external world comprises of pre-existing hard and tangible structures. These structures exist independently of an individual's cognition and ability to acquire knowledge, which is a practical position unconcerned with an abstract or idealistic view of life.

At the ontological level, this research is common with many other studies and is based upon the realist position. However, this research takes the form of critical realism, which is a philosophy of science that prioritises ontology over epistemology in the sense that, for critical realists, the way the world is should guide the way knowledge of it can be obtained. Critical realism is derived mainly from the work of Bhaskar (1998) and developed by Fleetwood and Ackroyd (2004) and Reed (2005) for organisational and management studies.

3.2.2 Epistemological consideration

According to Guba (1990), epistemology is about the theory of human knowledge, how we acquire knowledge and how we recognise the subject of study or the relationships between the knower and known, as such, epistemology needs to address the following type of questions:

- What is knowledge?
- How is knowledge acquired?
- What do people know?
- How do we know what we know?
- How can we judge what is true and false?

Therefore, as presented by Burrell and Morgan (1992), such epistemology questions should determine if knowledge is acquired or personally experienced. Ontological considerations involve a logical investigation of the different ways in which things are thought to exist and in research this involves whether or not the researcher views the

world from an objective or subjective perspective. Arlbjørn and Halldorsson (2002) considered that a positivist perspective views reality as an entity that exists and can be measured, whereas an interpretive perspective views reality as a subjective interpretation. Indeed, the two distinct philosophical approaches for developing research are positivist and interpretive. These approaches explain the philosophical assumptions that researchers have about the world, the nature of knowledge and knowing, the role of values and how to go about studying phenomena (Easterby-Smith *et al.,* 2008 and Remenyi *et al.,* 1998). Researchers in natural sciences have traditionally adopted a positivist epistemological approach, with the belief that the world conforms to fixed laws of causation, however, its adoption in the social sciences has been less successful (Hirschheim, 1992).

The positivist epistemological position advocates that complex issues can be tackled using a simplified or fundamental approach with a strong emphasis on objectivity, measurement and repeatability. Therefore, it is considered that a positivist approach should enable the researcher to be objective and observe reality in an unbiased manner (Bryman 2008 and Fitzgerald and Howcroft, 1998). Moreover, the positivist approach is a quantitative approach and is based upon the understanding that the research problem should be analysed and measured through objective methods rather than subjective. Such an approach requires an understanding of social life and is based on a philosophy that phenomena exist in causal relationships between quantifiable and directly observable variables. Therefore, positivist studies are generally associated with the testing of theories, which requires the formulation of hypotheses for subsequent verification with the aim of achieving a predictive understanding of phenomena (Easterby-Smith *et al.,* 2008; and Remenyi *et al.,* 1998).

Contrary to this positivist position, the interpretivist epistemological position, which advocates the absence of a universal truth, places more emphasis on the realism of context and is considered critical to apply a scientific model to social study. The understanding and perspective of and interpretation by the researcher of research findings become the point of reference. As such, it is not possible for the researcher to be strictly neutral when adopting an interpretivist epistemological position in research. For example, researchers become totally involved in their research, and their values and beliefs likewise become the driving force in interpreting research findings (Bryman, 2008 and Fitzgerald and Howcroft, 1998).

Moreover, when researchers adopt an interpretive approach they start their research with the assumptions that access to reality is only through social constructions such as language, consciousness and shared meanings. Researchers have to try and understand phenomena through the meanings that people place on them because interpretive research focuses on the holistic complexity of decision-making as situations evolve rather than placing pre-ordained definitions upon dependant and independent variables (Easterby-Smith *et al.,* 2008 and Remenyi *et al.,* 1998). Table 3.1 highlights the distinctions between positivist and interpretivist perspectives discussed in this Section 3.1.

Table 3.1: Distinctions between positivist and interpretive perspectives

	Positivist Perspectives	**Interpretivist Perspectives**
Basic beliefs:	• The world is external and objective • Observer is independent • Science is value-free	• The world is socially constructed and subjective • Observer is part of what is observed • Science is driven by human interests
Researcher should:	• Focus on facts • Look for causality and fundamental laws • Reduce phenomena to simplest elements • Formulate hypothesis and test them	• Focus on meaning • Try to understand what is happening • Look at the totality of each situation • Develop ideas through induction from data
Performed methods include:	• Operationalising concepts so that they can be measured • Taking large samples	• Using multiple methods to establish different views of phenomena. • Small samples investigated in depth

Source: Easterby-Smith *et al.* (2008)

Whereas the positivist approach is a quantitative approach, the interpretive approach is a qualitative approach based upon the understanding that reality is holistic and rather than being objectively determined is socially constructed. Section 3.3 discusses quantitative and qualitative research approaches.

3.2.3 Methodology – philosophical position of this research

As highlighted earlier in previous sections, the two main philosophical positions of social research are ontological and epistemological considerations. Fitzgerald and Howcroft (1998) included another important philosophical consideration, which could be included as a fourth level to those considerations shown in Figure 3.1, termed the axiological level. Axiological considerations explore strategies and practices which contribute to improved performance, innovation and continuous improvement in the oil and gas sector. Table 3.2 summarises the main philosophical considerations discussed so far in this study.

Table 3.2: Summary of philosophical considerations

Ontological Considerations	
Realist • External world comprises pre-existing hard and tangible structures. • Structures exist independent of individual's ability to acquire knowledge.	**Relativist** • Existence of multiple realities as subjective construction of the mind. • Perception of reality is directed by varying socially transmitted terms.
Epistemological considerations	
Positivist • Applications of natural science methods to the study of social reality and beyond. • World conforms to the laws of causation and complex issues can be resolved by reductionism.	**Interpretivist** • Absence of universal truth and emphasis on realism of context. • Understanding and interpretation come from researcher's own frame of reference.

Source: Bryman (2008; 2012)

At the ontological level, this research adopted the realist position because the number of ways Nigerian oil and gas project managers' work on oil and gas mega-projects varied considerably. Moreover, this research also considered that the investigation should be conducted in a practical rather than abstract way. In addition, it was essential to investigate the actual project delivery strategies in the oil and gas sector.

At the epistemological level, this research adopted the interpretivist position because the nature of the research problem was focused on examining the extent to which knowledge management strategies contribute to adding value in oil and gas projects in Niger Delta. The second epistemological level, was linked to proposing solutions to knowledge-based management challenges in the Nigerian oil and gas industry. Moreover, Seymour *et al.* (1997) emphasised that the interpretive approach is valuable for identifying problems in the oil and gas sector because it can recognise the differing viewpoints of various people in the industry.

According to Bryman (2012), interpretivism involves researchers to interpret elements of the study, thus interpretivism integrates human interest into a study. Accordingly, *"interpretive researchers assume that access to reality (given or socially constructed) is only through social constructions such as language, consciousness, shared meanings, and instruments*" (Myers, 2008, p.38). Development of interpretivism philosophy is based on the critique of positivism in social sciences. In this study, interpretivism was associated with the philosophical position of idealism, and was used to examine diverse people and technology approaches. The adoption of interpretivisim, allowed the researchers to examine differences in organisations in a great level of depth. The primary data generated via interpretetivism studies might be associated with a high level of validity because data in such studies tends to be trustworthy and honest (Bryman 2012).

3.3 QUANTITATIVE AND QUALITATIVE

As highlighted by Neuman (2005), although quantitative and qualitative research strategies differ in many ways they can still be complementary strategies. Nonetheless, the decision-making process to choose the most appropriate research strategy depends upon various variables such as the purpose of the study and the type and availability of the required research information (Naoum, 2007). This research has followed a qualitative and quantitative strategy for the research design and methodology. This section discusses the two main available research strategies, namely quantitative and

qualitative, and clarifies the reasons for the choice of research strategy adopted in this research.

3.3.1 Quantitative research

As illustrated in Figure 3.1, quantitative research is associated with a deductive approach, which handles research problems by using mathematical and statistical techniques to identify facts and causal relationships. The quantitative type of research strategy adheres to the practices and norms of the natural scientific model, which is positivist in nature, and views social reality as an external and objective reality. Quantitative research is, therefore, 'objective' in nature and based on testing a hypothesis or a theory consisting of a number of variables (Fitzgerald and Howcroft, 1998; Naoum, 2007).

The most common data collection techniques in quantitative research are questionnaires, texts and existing databases (Frechtling and Sharp, 1997). As such, the collection of hard reliable data is an essential part of the quantitative research strategy, where the collected data samples are relatively large and representative. The results of the data collection can then be generalised with respect to a larger population and evaluated by using a sophisticated statistical technique (Bryman, 2008 and Fitzgerald; Howcroft, 1998). However, the validity of the results of the data collection can be totally dependent upon on the choice of an appropriate measuring instrument and how accurately it measures targets (Patton, 2002).

The main steps in quantitative research are presented in Figure 3.1. These steps as presented are somewhat idealistic because quantitative research is rarely so linear, however, these steps are indicative of the main steps in quantitative research (Bryman, 2008). Naoum (2007) concluded that the selection of quantitative research is best suited to the following circumstances:

- When you want to find facts about a concept, a question or an attribute; and
- When you want to collect factual evidence and study the relationship between these facts in order to test a particular theory or hypothesis.

The use of quantitative research strategies has received criticisms from researchers regarding its appropriateness as a research strategy, and the following criticisms of such a research strategy were highlighted by Bryman (2008, p.159):

- Failure of quantitative researchers to distinguish people and social institutions from 'the world of nature';
- Measurement process possesses an artificial and spurious sense of precision and accuracy;
- Reliance on instruments and procedures hinders the connection between research and everyday life; and
- Analysis of relationships between variables creates a static view of social life that is independent of people's lives.

3.3.2 Qualitative research

Quantitative research strategy was originally developed to study natural phenomena in the natural sciences, whereas the qualitative research strategy was developed in the social sciences to enable researchers to study social and cultural phenomena. According to Schwandt (2007), qualitative research is a diverse term covering many different techniques to describe, decode, translate, and understand the meaning, rather than the measurement or frequency of phenomena in the social world. Quite simply, qualitative research is based on text rather than numbers. Moreover, Kaplan and Maxwell (1994) argued that it is essential to understand the informant's point of view and the particular social and institutional context at play and such is not possible when textual data are quantified. Maxwell (1998) further argued that the strengths of qualitative research are founded on its:

- Inductive process;
- Focus on specific situations or people; and
- Emphasis on words rather than numbers.

The key differences between quantitative and qualitative research strategy is that quantitative researchers often deal with many cases consisting of a minimal number of quantified variables, whereas, qualitative researchers work on a minimal number of cases consisting of many qualitative variables (Ragin, 1987). Also, unlike the deductive

approach adhered to in quantitative research, qualitative research follows an inductive approach in relation to theory. It is focused on the spoken word rather than the quantification of collected data and subsequent data analysis. Also, whereas quantitative research is objective, qualitative research is subjective in nature and is exploratory and attitudinal (Frechtling and Sharp,1997). As such qualitative researchers tend to be more reliant upon an interpretive approach in the pursuit of research findings, which follows a more non-linear research path as opposed to the more linear path preferred by quantitative researchers as depicted in Figure 3.2. Therefore, the medium of qualitative research strategy is more suited to cases and contexts (Neuman, 2005), where a small number of representative cases are usually investigated and informants or respondents are selected to fill a given requirement (Sherif, 2002).

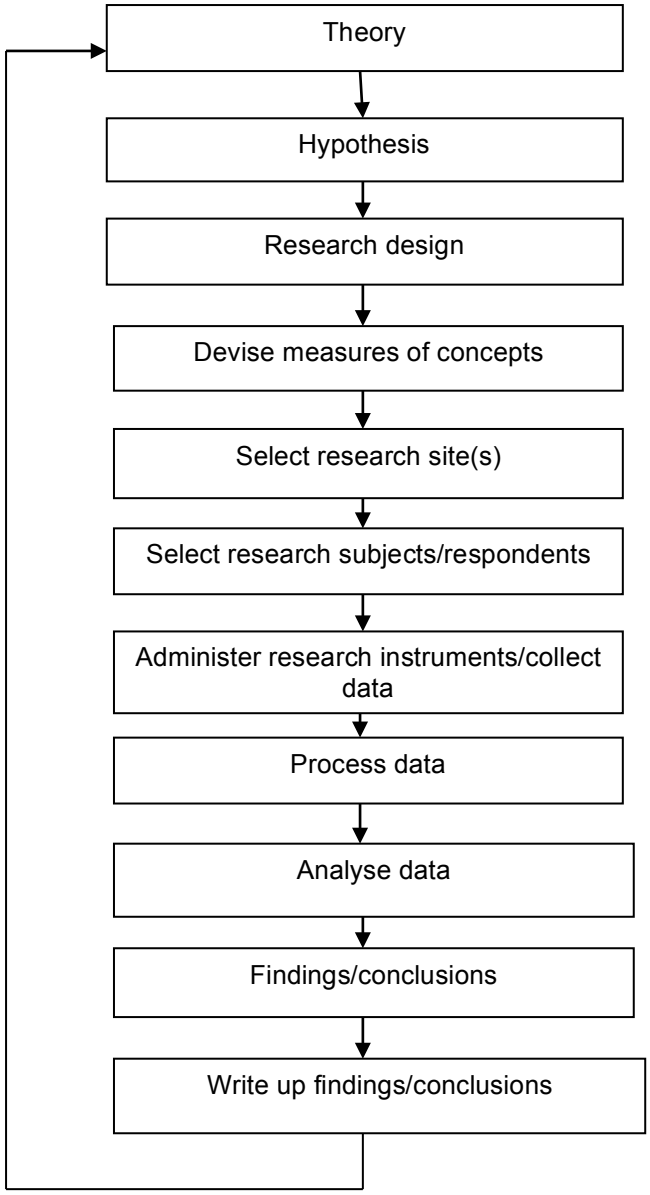


Figure 3.2: The process of quantitative research

Source: Bryman (2008)

The three following kinds of research data are generally collected by qualitative researchers:

- In-depth and open-ended interviews;
- Direct observations; and
- Written documents.

Such qualitative research data can be unstructured or semi-structured but nonetheless both can yield quotations, descriptions and excerpts. However, the credibility of qualitative research depends on the skill, competence and rigour of the researcher (Patton, 2002). Ultimately, as argued by Fitzgerald and Howcroft (1998), qualitative research strategy is more responsive to the needs and nature of a research situation than the quantitative research approach and process because qualitative research data are soft, rich and deep and determine what things exist rather than how many there are.

Figure 3.3 presents the main steps involved in the qualitative research process where research questions are driven by theoretical issues, which in turn drive the data collection and analysis (Bryman, 2008). The applicability of employing a qualitative research strategy requires the following type of research problem (Baiden, 2006)

- There is no existing research data on the topic and the most appropriate unit of measurement is not certain; and
- The concepts to be researched and assessed on a nominal scale, with no clear demarcation and involve exploring behaviour or attitudes.

However, Bryman (2008, p.391) highlighted that qualitative research has been the subject of criticisms from researchers and these critics have argued that such a research strategy:

- Is too impressionistic and subjective and the findings rely too much on the researcher's often unsystematic views about what is insignificant and important;
- Is difficult to replicate because it is unstructured and often reliant upon the researcher's ingenuity;
- Has problems of generalisation because the scope of the findings of qualitative research is often restricted when unstructured interviews are conducted with a small number of individuals in a certain organisation or locality; and
- Lacks transparency due to the difficulty, which sometimes arises from the establishment of what the researcher actually *did* and how the study's conclusions were arrived at.

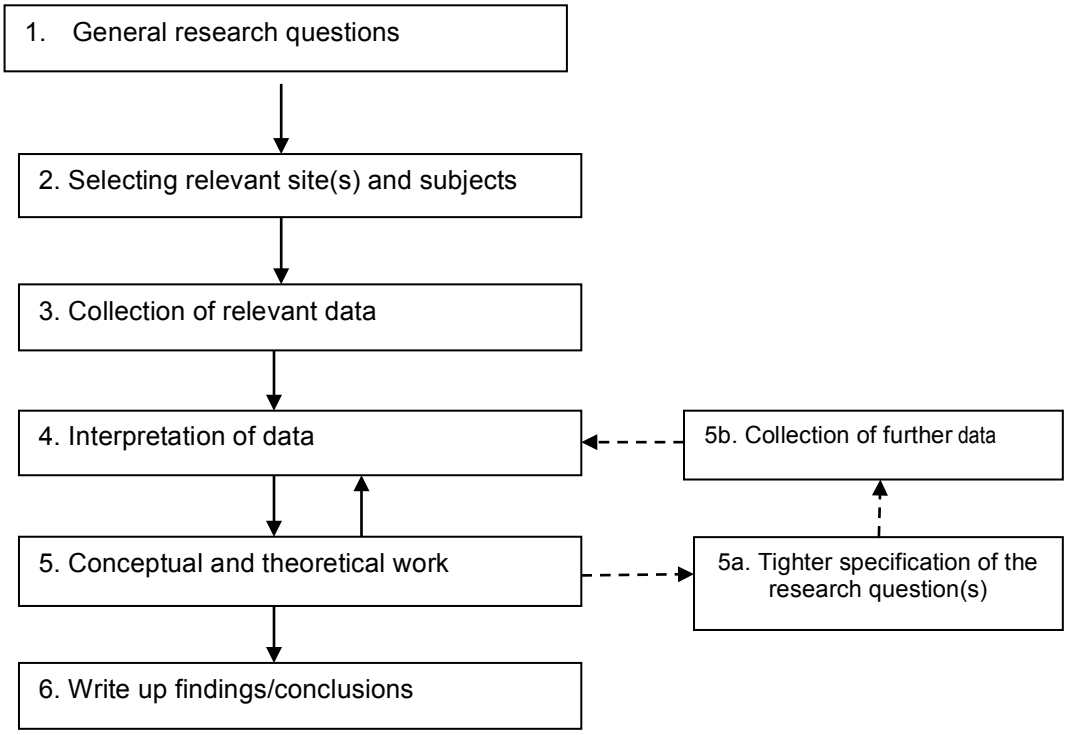


Figure 3.3: An outline of the main steps of qualitative research

Source: Bryman (2008)

As shown in this section, research strategies are in general terms either quantitative or qualitative. However, it has been suggested that research is best served by using both strategies through triangulation (Love *et al.,* 2002; Ragin, 1987). White (2000, p.67) also argued for triangulation and stated that *"researching the same topic using a number of different techniques is complementary, with the outcome resulting in a more thorough understanding of the problem under investigation"*. According to Denzin (1971) and Denzin (2006), triangulation is a notion introduced from military studies, whereas White (2000) considered that triangulation originally comes from navigational practice where a number of reference points can be used to locate an exact position. In terms of research, Kelle (2001) considered triangulation was initially borrowed from the realm of quantitative psychological methodology: within the framework of a theory of psychological testing. Regardless, triangulation has been suggested as a way to make research studies more robust and rigorous through the validation of results through differing strategies to best ensure that the results are not just a function of the research strategy. This is particularly so for case studies (Yin, 2009).

3.4 THE DEBATE ABOUT QUANTITATIVE AND QUALITATIVE

Since there is a plethora of published material on research methods, broadly divided into qualitative and quantitative, it is important to appraise these different research methods in order to ascertain the most appropriate method for this research. Many qualitative authors (Neurath, 1959) argue that interpretative approaches to research, such as ethnography arise out of a critique of positivism's tendency to reduce human action to the status of automatic responses excited by external stimuli. Essentially, this reduction can be achieved by ignoring the subjective dimensions of human action, that is, the internal logic and interpretative process by which action is created. A number of authors (Bryman, 2004; Fitzgerald and Howcroft, 1998; Gill and Johnson, 1997) have justified such an approach by preventing a divorce of the social sciences from the natural sciences; attempts at such a severance being perceived because of the residues of theology (Bryman, 2004). Other authors, (Smart, 1976) have justified their concern to follow what is assumed the approach of the natural sciences by expressing the evident operational successes of the former.

According to Giddens (1976), the result of the positivist's concern to emulate science methodology necessitates a denial of the importance of human subjectivity, a denial usually supported by further methodological criteria. As Giddens (1976, p.19) stated:

"The specific unreliability of the interpretation of consciousness indeed whether by self or by an observer, has always been the principal rationale for the rejection of verstehen by such schools. The intuitive or empathetic grasp of consciousness is regarded by them merely as a possible source of hypothesis of human conduct".

On the other hand, Denzin (1997) argued that interpretative approaches such as ethnography reject the positivist's over deterministic orientation towards an understanding of human action and behaviour. Instead, Denzin (1997) shows that unlike animals or physical objects, human beings are able to attach meaning to the events and phenomena that surround them and from these interpretations and perceptions select courses of meaningful action, which they are able to reflect upon and monitor. These subjective processes provide the sources of exploration of human action and thereby constitute the rightful focus for social science research. The aim of such interpretative approaches is thus to understand how individuals make sense of their world, with human action being conceived as purposive and meaningful rather than

externally determined by social structures, drives, the project environment or economic stimuli.

Researchers are thus confronted with a philosophical choice regarding the nature of human action and its explanation, which has direct methodological implications. Which set of philosophical assumptions are implicitly or explicitly adopted regarding what Denzin (1997) termed '*human nature'* influences our subsequent choice of particular '*modes of engagement'* and what we see as warranted in research. According to Barrell and Morgan (1979), if researchers accept the philosophical assumptions of qualitative and its consequent epistemological prescriptions, we are invariably drawn towards the exclusive utilisation of nomothetic methodology, conversely, if researchers' philosophical orientations are interpretative, the ensuing epistemological mandate impels us towards a more idiographic methodology such as qualitative as it enables verstehen.

Notwithstanding the above criticism, qualitative researchers are more apt compared to quantitative researchers to confront the constraints of the everyday social world, such as experiences of individuals involved in managing a project. They see this world in action and embed their findings in it. Quantitative researchers abstract from this world and seldom study it directly. They seek a nomothetic or etic science based on probabilities derived from the study of large numbers of randomly selected cases. These kinds of approach stand above and outside the constraints of everyday life (Bryman, 1988), and they would not be suitable for the study of the experiences of individuals involved in heavy construction engineering. Qualitative researchers are committed to an emic, idiographic, case-based position, which directs their attention to the specifics of particular cases, accepting that rich descriptions of the social world are valuable, whereas quantitative researchers, with their etic commitments, are less concerned with such detail.

According to Bryman (1988), qualitative research is holistic and humanistic in its approach. It is holistic in that descriptions of behaviour encompass the context. The humanistic side of qualitative refers to the motivating purpose, which is to achieve an understanding of a specific research problem through the perspective of other people. Research in social sciences has been influenced by two major theories "positivism" and "phenomenology". The concept of "positivism," which underlies quantitative, emerged through sciences such as biology, physics, and chemistry. Bryman (2004) believed that,

the purpose of quantitative methodology is to describe a given set of phenomena with the purpose of controlling them through certain interventions. The researcher must minimise biases and personal opinions, to remain as objective as possible. Qualitative research methods or phenomenological studies were developed in such disciplines as anthropology and sociology. Because project management involves the study of human behaviour, qualitative methodology is often employed there as well. The phenomenologist gathers descriptive data and seeks to understand how individuals experience and interpret their worlds.

Because of the nature of work in other cultures, qualitative research has been effectively utilised in cross-national / cross-cultural studies (Seringhaus and Geunther, 1991). Usunier (1998) claimed that if you are to understand the people, the society, and the culture in which you are working it is imperative that you immerse yourself in a programme of systematic observation and research. Thus, the historical application of both quantitative and qualitative research supports its application in the present study.

However, according to Bryman (1988) the argument that a qualitative and quantitative research represents a different epistemological implication is thought to be an exaggeration that is not held by all researchers. Some suggest that qualitative and quantitative methods are appropriate to different kinds of research problems, implying that the research problem determines or should determine style of research (Easterby *et al.,* 2003). While Bryman (1988) stated that certain research problems could not be addressed by quantitative methods, for example, capturing the individual point of view, examining the constraints of everyday life and securing rich descriptions, reflect a commitment to qualitative research methods. Therefore, these views imply that the decision over whether to use a quantitative or qualitative approach should be based on 'technical' issues regarding the suitability of a particular research problem.

In Creswell (1998), qualitative and quantitative should be used if the research topic needs to be explored, as was the case in this study; secondly, if there is a need to present a detailed view of the research topic and finally one should choose qualitative and quantitative research if they will be studying individuals in their natural setting. This does involve going out to the field of study, gaining access, and gathering material. Considering the aim and objectives of this research and given little was known empirically about the strategies and practices which contribute to improved performance,

innovation and continuous improvement in the oil and gas sector, both qualitative and quantitative were used. The literature search revealed that there were already external factors, which influenced the implementation of knowledge management strategies on oil and gas projects in Nigeria (Ekemena, 2011; Nwafor and Salau, 2009). These factors were assumed as integral to everything, which took place in the projects but rather than attempting to make the connections between the two explicit, the study focused on the experiences of the individuals involved in oil and gas project management. This opened up the possibility of developing a clear understanding of strategies and practices that could be used to address operational issues and enhance knowledge management based systems in the Nigerian oil and gas industry.

3.5 COMBINING QUANTITATIVE AND QUALITATIVE RESEARCH

In this research, participants were interviewed in their own working environments and the focus was on participant understandings and experiences of implementing knowledge management tools. Field and Morse (1998) urge the employment of a qualitative approach especially in extracting data from experts in the field; while Bryman (1988), Easterbly *et al.* (2003), and Tilden *et al.* (1990) hold that, a quantitative method using interviews with knowledgeable participants enriches and extends understanding of the topic, and provides valuable data. Turner (1981) further argued that qualitative research is likely to generate detailed, significant data that can be used by both the researcher and participants. Bryman (1988) further stated that by combining the two, the researchers' claims for the validity of his or her conclusions are enhanced if they can be shown to provide mutual confirmation.

The use of multiple methods or triangulation was an attempt to secure an in-depth understanding of the phenomena in question. In this research, the data were collected in the form of in-depth interviews and a questionnaire. According to Denzin and Lincoln (1998), the combination of multiple methods to collect data in a single study is best understood as a strategy that adds rigour, breadth, and depth to the investigation. Rigour was achieved by focusing on verification strategies. These included the responsiveness of the researcher during the data collection and data analysis period, methodological coherence, and sampling strategy. In developing a research approach, careful consideration must be given to how best to collect and analyse data covering possible differences in project management practice. A solution would seem to be to focus the research on ensuring diversity in the sample, in terms of heavy construction

engineering projects managed by subjects. Such diversity will ensure that potential differences in practice can be identified and it will facilitate the analysis of any influences on different projects that are researched. As well as considering developments in project delivery, in terms of operational effectiveness and the influences on such developments, a research study of views based on actual practice may lead to some suggestions for modification of the existing theory.

3.6 METHODOLOGICAL ISSUES OF THIS RESEARCH

According to Usunier (1998), the search for equivalence and comparability across cultures and countries appears as a natural undertaking in cross-cultural research, whether in management, sociology, or psychology research. Usunier (1998) argued, if researchers compare across cultural contexts, they would need to apply concepts and research techniques that are understood in similar ways in all cultures. Moreover, researchers need to check that the same data collection procedures do not lead to biased findings in one of the contexts under investigation. In this research, the search for equivalence was therefore found to be the most important methodological aspect of cross-cultural project management research. Studies, which strongly adapt purely emic techniques easily, forget that there is always a need for a minimal level of commensurability. A general problem that has been highlighted by Usunier (1998) is the relevance of western models or frameworks that offer the implicit starting base for the comparison process. This is viewed by Usunier (1998, p.102) as a positive attribute. Usunier further argues that the issue here is not to criticise them but rather to face a paradoxical situation. That is the dominant culture in terms of theories, languages used, and cultural origin of the researchers tends to frame the relevance of the research topics, concepts and methodologies used while at the same time sincerely trying to introduce new insights in different contexts.

3.6.1 Conceptual and functional equivalence

It is suggested by Tincknell *et al.* (2004) and Usunier (1998), that a basic issue in cross-cultural research is the determination of whether the concepts applied have similar meaning across the units studied. Gray (2002) further stated that problems of conceptual equivalence are frequent when testing the influence of certain constructs on behaviour. For example, the following statement from Geertz (1983) gives an indication of how difficult it can be to reach true conceptual equivalence between cultures and insists on difference in nature:

"The Western conception of a person as a bounded, unique, more or less integrated, motivational and cognitive universe, a dynamic centre of awareness, emotions, judgement and action, organised in a distinctive whole……is, however incorrigible it may seem a rather peculiar idea, within the context of the world's cultures" (Geertz 1983, p.59).

As observed in this study, basic concepts such as knowledge management practices and operational effectiveness are often used in management research questionnaires where perceptions and motivation for action are related to self-image and interaction with other individuals in a particular social and cultural setting. However, it is always important to question the conceptual equivalence of all these words, especially when constructing a cross-cultural questionnaire survey as in this research.

3.7 RESEARCH STRATEGY EMPLOYED IN THIS STUDY

The following section will discuss the broad issues of quantitative methods. Part one examines internet questionnaire design and pilot study. Part two examines sampling technique employed, location of sample, sample size and quantitative data analysis.

3.7.1 PHASE ONE: QUANTITATIVE

Having formulated a set of research questions, a strategy needs devising for the research questions to be answered. Saunders *et al.* (1997, p.74-81) describes the three traditional research strategies as survey, case study and experiment. An experimental strategy is based on laboratory type research applied in natural sciences. Given the nature of the research being carried out in this work, the experiment strategy does not seem appropriate. To consider different project managers, knowledge management based systems, organisation and project environments it seems practical to apply a strategy based on work in the field, rather than in the laboratory.

According to Hutton (1988, p.8), survey research is the method of collecting information by questioning a sample of participants drawn to be representative of a defined population. Surveys are a widely accepted research design and involve eliciting information from individuals through interviews and questionnaires. Ghauri *et al.* (1995, p.58-60), claimed that the survey research can be "descriptive" and/or "analytical / explanatory". Analytical research aims to understand the relationships between

variables. In contrast, descriptive studies aim to provide an accurate profile of chosen phenomena, whether it is people, situations or events.

Bryman (2004), Denzin (1997) and Dillman (1978), suggested that in order to maximise survey response, the researcher must minimise the cost of responding and maximise the rewards. Minimising can be achieved by making it easy, no need to search files for answers etc. Maximising in this sense could mean appealing to the respondents' sense of loyalty to their own industry. The questions, who are they, why did they not respond and would they share the view of those who did respond need to be addressed. Surveys allow variables to be identified. Surveys also show how variables relate to one another and how that relationship might change with time. Variables can be dependent, i.e. the input to a relationship. Dependent variables would include performance perception and attitudes or personal impressions. The final type of research strategy is the case study. Yin (1984, p.14) defined a case study as a:

> "*Method of organising data for the purpose of analysing the life of a social unit - a person, family or an organisation".*

A case study strategy is a means of gaining a richer understanding of the context of the research problem. As already highlighted, a survey seems an appropriate method for obtaining data from a variety of organisations, such as, project managers and project environments. However, richness could be added to the data obtained from these different project organisations through detailed studies of a number of selected organisational cases.

A further question in selecting a research strategy concerns the time perspective. It could be argued that research that considers both changes and developments over time will use longitudinal, whilst research that considers particular phenomena at a particular time will apply cross-sectional studies. This study focused on investigating how organisations handles project related factors and the attitudes of senior project management practitioners in different project environments to help our understanding of knowledge management based systems in oil and gas projects.

3.7.2 Internet questionnaire design

The detailed design of the questionnaire needs to be carried out with due regard to the areas to be investigated by the survey. In this respect, it was found useful to refer back to the subject matter of the research questions stated in the introduction. As was stated in the introduction to this chapter, the research approach must allow an investigation of a broad range of team issues, incorporating behavioural and management features. The specific elements to be investigated were identified from the topics covered by the research questions. Therefore, taken from the headings contained in the statement of the problem in the literature reviewed, the specific topics for investigation were knowledge management practices and knowledge management based systems.

Given that the purpose of the research was to investigate the research questions in the statement of the problem, there was an effort to make the questions, clear, brief, simple, and still meaningful in order to omit ambiguity. The areas included in the questionnaire were in part, developed by considering the data required relating to the subject areas of the research questions**.** The specific content of the Internet questionnaire was designed to investigate senior project management practitioners. Although this was a useful classification in terms of emphasising the different broad elements incorporated within the discipline of knowledge management. Careful consideration of the areas for inclusion in the questionnaire contributed to the collection of valid data.

The design of a good questionnaire is a very difficult exercise (Bell, 1993). The validity and reliability of the data are also influenced by the design of the questionnaire. The design of the questionnaire was carried out with due attention to the areas of:

- Questionnaire focus;
- Questionnaire phraseology;
- Form of response;
- Question sequence;
- Overall presentation; and
- Introduction to respondents.

These are identified by Dillman (1991); Gill and Johnson (1991) Moser and Kalton (1971) and Oppenheim (1992) as the six key areas of questionnaire design. The questionnaire comprised three main areas. The final questionnaire and a covering letter is shown in Appendix A and B.

3.7.3 The questionnaire and pilot study

According to Oppenheim (2003), the reliability and validity of any data collected by the survey will depend in part on the rigour of the pilot testing of the questionnaire. A lack of reliability due to subject error may arise when the answer a participant gives is influenced by extraneous factors, such as the working environment or work load. In this research, the potential for subject error is probably related to the workload of the participant. The questionnaire is demanding on a participant's time and if the participant feels completing the questionnaire is an unreasonable use of valuable time it might have a negative effect on both the completeness and accuracy of the findings. To overcome this problem, the phraseology of the questions was made simple and this was achieved after a thorough review with my Director of Studies. In addition, great emphasis was put on making sure that the researcher came up with a focused internet questionnaire.

To consider the validity of the questions, Oppenheim (2003) proposed focusing the piloting of an interviewer-administered questionnaire on a number of factors:

- Clarity of instructions;
- Questionnaire length;
- Significant topic omissions;
- Any other comments;
- Unclear or ambiguous questions; and
- Questions a respondent was uneasy about answering and any other comments.

In order to address the above areas, a two stage piloting process was arranged. In the first stage of piloting, a draft copy of the questionnaire was given to six senior members of the academic staff at Liverpool John Moores University: one specialising in statistical analysis, another specialising in questionnaire design. There were four experienced academic staff who were knowledgeable in the field of project management. Feedback was received from each member of staff and modifications were subsequently made to the questionnaire. In the second stage of the piloting, the modified postal questionnaire was administered to thirty experienced senior project managers at a workshop. Table 3.3, illustrates the areas covered in terms of questionnaire validity in the piloting process.

Table 3.3: Questionnaire feedback

Area of feedback	**Phase1:** Academic staff Liverpool John Moores University	**Phase2:** European Construction Institute Members (ECI)
1. Questionnaire Phraseology	Feedback	Feedback
2. Questionnaire Length	Feedback	Feedback
3. Unclear or ambiguous questions	Feedback	Feedback
4. Significant topic omissions	Feedback	N/A
5. Questionnaire Focus	Feedback	N/A

After carrying out the piloting process, some changes were made to the draft questionnaire. No major substantive modifications were made, except for small alterations to question phrasing, sequencing, terminology, and some reduction to the questionnaire length.

3.7.4 Sampling technique employed

Sampling is the process of examining a representative number of parts of a population in order to gain an understanding of some feature or attribute of that population (Easterby *et al.* 2003). Any knowledge thus gained can only be an estimate of the characteristics of the whole population. The level of accuracy of that estimate depends upon the size of the sample, how it was selected, and the extent of variability within the population. The quantitative researcher uses statistical tools designed to provide a representative sample of a known population but all statistical sampling is subject to experimental error. It is worth noting that all surveys are concerned with identifying the research sample that will provide all the data necessary for answering the original research questions.

Gill and Johnson (2002) define three types of sampling techniques “random sampling or probability”, “simple random” and “stratified sampling”. Deciding whether to use random, simple, or stratified sampling depends upon ensuring that those who participate are a representative sub-set of the research population and so any findings can be generalised or extrapolated to that target population with confidence. The aim of random sampling is to ensure that participants who are involved in a study are a representative sub-set of the research population and thus any findings can be generalised to that

target population with confidence. The first phase involved in this method includes selecting a list of participants from the research population from which a random sample may be drawn. Problems may arise since any systematic discrepancy between the research population and the sampling frame is a key source of error because it means that the entire target population is not correctly represented.

Oppenheim (2003) suggested that when a good sampling technique is in place and the population is accessible, a good sampling technique to employ is simple random sampling. This will involve the completely random selection of population members so that each member has an equal chance of being selected for the sample. An alternative sampling strategy, explored is called stratified sampling. This requires a researcher to have prior knowledge of the make-up of the population from which a random sample is to be drawn. For example, the researcher can be aware that there may be a particular population characteristics or a stratum (colour / gender) that makes the random sampling from within the specific sub-group that exhibits this particular characteristic necessary if the sample is to be representative and proper conclusions drawn. This is particularly important if one wants to know the strata in the population which may have a systematic influence upon the dependent variable or other important factors. In this study, the focus was on eliciting information from a disparate set of senior managers in a cross-section of projects.

According to Oppenheim (2003), the population must be clearly defined to ensure that accurate, unambiguous, and reliable conclusions are obtained. That is, defining the population is crucial so that research findings can only be legitimately applied to the population being studied. It was possible to obtain information about the wider population i.e. the numbers of senior managers who work in heavy construction engineering organisations and have been involved in managing oil and gas projects. In light of the above, this research adopted a simple random selection to ensure each individual had an equal probability of being selected from the population.

3.7.5 Location of sample

Given that the population from which the sample is to be drawn is senior managers who have some involvement in oil and gas projects. It was necessary to contact individuals in organisations where projects were being undertaken (or have been / will be undertaken). The most useful method of identifying potential sources of information was

the researcher's network of contacts in the area of heavy construction engineering project management. This network included contact through the European Construction and Institute, the Federal Ministry of Petroleum Resources in Nigeria. However, over-reliance on one particular contact might result in over representation in one area. Using this network, contact was made with project directors in a number of organisations after methodologically gathering data from oil and gas in Niger Delta and the UK. The objective of the research and the required participation in terms of time were discussed; and manager's suitability, in terms of their involvement in projects was assessed. None of the organisations contacted in the UK and Nigeria refused to participate.

3.7.6 Sample size

Gill and Johnson (2002) argued that in order to generalise from a simple random sample and avoid sampling errors or biases, the sample needs to be of an adequate size. What is adequate will depend on a number of issues, which often confuse people carrying out research for the first time. It is important that the absolute size of the sample is selected relative to the complexity of the population, the aims of the study and the kinds of statistical manipulation that will be used in data analysis and not the proportion of the sample selected relative to the complexity of the population. From the literature Brewerton and Millward (2001); Gill and Johnson (2002), suggested that larger sample sizes reduce sampling error but at a decreasing rate. A number of statistical formulas can be used to determine sample size but what is most useful in quantitative data analysis is the simplicity of reading the tables that have been developed to calculate sample size whilst taking into account the variance of the population, the magnitude of acceptable error and the kind of analysis to be used.

Therefore, in deciding upon a suitable sample size, the choice of the simple random sampling method means there is a requirement for a sample size to be achieved to allow generalisations to be made about the wider population with any statistically based degree of confidence. However, Sekaran (1992) argued that sample sizes larger than thirty and less than five hundred are appropriate for most research. Given the need for in-depth information, constraints of time and cost, and research approach, it seems sensible to aim for a sample size towards the upper end of the size limit specified by Sekaran (1992). To aim for a sample size at the upper end of the thirty to five hundred range, the parameters shown in Table 3.4 were used to determine a certain minimum size of sample.

Table 3.4: Matrix of industry, projects managed, project role, number of years worked in sector and years involved in managing oil and gas projects

Projects Managed	Project role	Numbers of years worked in sector	Years involved in managing oil and gas projects
Exploration and production	Project directors, Project managers, Project engineers	1-5 years; 11-15 years; 16-20 years	1-5 years; 11-15 years; 16-20 years
Offshore	Project directors, Project managers, Project engineers	1-5 years; 11-15 years; 16-20 years	1-5 years; 11-15 years; 16-20 years
Downstream	Project directors, Project managers, Project engineers	1-5 years; 11-15 years; 16-20 years	1-5 years; 11-15 years; 16-20 years

In the four sections of the questionnaire, the participants specified their socio-demographic characteristics and then identified a project they had completed. In choosing the sample size, the key aim was to achieve a balance between the level of representation required within the matrix represented by the maximum sample size, and the time and cost constraints involved in obtaining data from the chosen respondents. Finally, three hundred postal questionnaires were distributed to senior managers in Niger-Delta and the UK and one hundred and thirty two were returned giving a response rate of forty-four percent.

3.7.7 Quantitative data analysis

According to Bryman (2004), most researchers find dealing with quantitative data quite daunting. Bryman (2004) further claimed that most researchers are quite comfortable with quantitative research methods and analysis; they tend to avoid using quantitative statistics. However, it is worth noting that the ability to perform quantitative data analysis is increasingly becoming an important skill for researchers to possess. The availability of computer software programmes such as SPSS (13, 14, 15, 16 and 17) that can be used to analyse data has meant that researchers do not have to be able to perform quantitative statistical analysis. During the data analysis phase, the researcher found that one has to know the appropriate analysis to perform and in addition how to do it to obtain the required information.

After reviewing a number of packages (SPSS for windows 13, 14, 15, 16 and 17), it was concluded that SPSS for windows was best suited for this study. Bryman and Cromer (2005) suggested that the great merit of using a package like SPSS is that it will enable a researcher to analyse data very quickly and in many different ways. In other words, it does help researchers to eliminate those long hours which would have been spent in working out scores, carrying out involved calculations and making those inevitable mistakes that so frequently occur during the analysis phase. Secondly, it also provides researchers with the opportunity for applying more complicated and often more appropriate statistical techniques, which would not have otherwise been attempted.

In this study, computer assisted analysis (SPSS for windows 17.0) was used to identify characteristics of the respondents, their knowledge levels and the significance of the results. Cross tabulations and descriptive analysis of the data were completed. Descriptive analysis was used to determine measures of central, frequency, median, variability and relationships, whereas cross tabulations were used to demonstrate the presence or absence of a relationship. The t-test was used to compare the means of a criterion variable for two dependent samples. The t-test is appropriate when you have a single interval dependent and a dichotomous independent, and wish to test the difference of means between samples. For this study, the mean was calculated in a sequence, which was categorical in nature: very important (VI), fairly important (FI), and slightly important (SI) and not important (NI). These qualitative measurements were ranked in order, and thus considered ordinal. In the computation of the t-test, each of the participant's observations was replaced by ranks. That is all scores from all respondents were combined and ranked in a single series.

According to Bryman and Cramer (2005), Field (2005), the t-test is a parametric test assuming a normal distribution but when its assumptions are met it is more powerful than corresponding two-sample non-parametric tests. There are three types of t-tests:

- One-sample t-test: test whether the mean of one variable differs from a constant;
- Independent sample t-test: is used to compare the means of two independently sampled groups, and
- Paired sample t-test: is used to compare means where the two groups are correlated as in before-after, repeated measures, matched pairs, or case control

studies. The algorithm applied to the data is different from the independent sample t-test but interpretation of output is otherwise the same.

In order for one to carry out any of the above tests, you need to select, analyse, and compare means. In a paired sample t-test, two paired variables are selected (use shift select; the "before" and "after" responses must be organised as two variables in the data set for matched pairs or case control study, the response for each test subject and its matched control subject must be in the same case in the data file). The data, which was to be analysed quantitatively, was preceded by an adequate preparation that comprised of editing, categorising, data acquaintance, testing reliability and validity.

3.8 PHASE TWO: QUALITATIVE RESEARCH

The following section will focus on broader issues of qualitative methods. Part one explores interviewee selection, data collection method, and research limitations. Part two looks at the validation and verification process.

3.8.1 Literature control

A literature review was performed to determine what is known about the specific research problem of knowledge management based systems in Nigeria and the UK. The review was conducted into a variety of project management disciplines. From the foundation of the review, a research problem was defined (strategies and practices that could be used to address operational issues and enhance project delivery), thus determining the direction of the fieldwork. This procedure is in line with the purpose of literature control, as defined by May (2002), who indicated that literature should assist the researcher in planning the narratives for the actual research. At the end of the process, the narratives were compared with the research into the relevant literature in order to draw relevant conclusions.

3.8.2 Purpose of this research

The aim of this study was to increase 'verstehen' or understanding, of the factors, which could enhance project delivery in Nigeria. The basic premise of the qualitative approach is to emphasise the qualitative aspects of human behaviour (Bryman, 1988; Usunier, 1998). According to Weber (1947), he began to apply the term 'verstehen' to this phenomenological approach, referring to a phenomenologist as one who seeks to gain an understanding. Adding to that definition, Denzin and Lincoln (1998, p.44) stated:

"Verstehen refers to the unique human capacity to make sense of the world."

Because human beings have an exclusive form of consciousness from other forms of life, they have the ability to empathise with others through personal experience. According to Denzin and Lincoln (1998), the qualitative researcher pursues 'verstehen' in social-cultural context, as opposed to merely explaining the dynamics of the situation. Denzin and Lincoln (1998) further described the qualitative researcher as one concerned with naturalistic observation of reality from within the situation, rather than defining an objective reality from the perspective of an outsider, which is the goal of qualitative research. The philosophy of 'verstehen', which motivates the methodology of qualitative inquiry, is also the essence of working with individuals in other cultures within a project environment.

Qualitative research endorses this goal, as the researcher seeks to understand the inside perspective of a research problem. The literature review for this study defined some of the possible causes of project complexity that were involved in projects. The fieldwork carried out in Nigeria and the UK confirmed that there were many sources, which gave rise to operational complexity. The management of knowledge in oil and gas organisations was of specific interest to this research. Through the literature and the research, this study defined qualities of responsive management that are conducive to minimising operational complexity within a project environment. More specifically, this research attempted to pinpoint knowledge management strategies necessary to enhance project delivery in Nigeria.

3.8.3 Researcher: Ethical consideration

Because qualitative research is generally carried out in the social sciences, the research involves the actions and reactions of individuals. Gill and Johnson (1997) defined ethics as the moral principles, which determine the rules and expectations of correct conduct in a given setting. In research, these socially accepted strategies apply to the rights of the participants and to the responsibilities of informed researchers. A participant should feel safe throughout the interview process. This safety should include freedom from both emotional and physical harm. Physical harm is not usually an issue, however, emotional harm may become a problem depending on the nature of research and the resulting questions used during the interview process. Emotional harm may be inadvently caused by the researcher, if he or she pursues issues that bring pain to the participant. A

sensitive researcher should be able to perceive an uncomfortable response and shift the questions of investigation in another direction.

In this study, the setting of the interview was the participant's office. The researcher's inexperience of interviewing (project directors, project managers, project engineers) meant that the researcher was unable to anticipate some situations or know what was likely to happen, such as cancellations at short notice and disagreements of opinions between participants. The effects of such situations on the data collected were minimised by allowing as much flexibility as possible including informing participants to choose to discontinue or opt out if they felt that the issues being discussed were too sensitive. Fortunately, this did not prove to be the case. However, everyday life can never be pre-planned and this meant the researcher had to respond to all sorts of factors and considerations that arose from situations that could not have been totally foreseen.

A participant has the right to personal privacy. The right is protected through the sensitivity of the researcher who must refrain from delving into issues, which would encroach on the privacy of the participant. The researcher's responsibility is to be aware of the participants' need for privacy throughout the interview process. The right to privacy encompasses the rights of confidentiality and anonymity. Bryman (2004), referred confidentiality as the way in which data is handled. Anonymity in research means that collected data should not be associated with an individual or the individual's company in any way. Anonymity is safeguard with code names. In this research, the researcher was careful to protect the rights of privacy, confidentiality, and anonymity of the participants. Participants were not asked questions, which would affect their rights of privacy, confidentiality, and anonymity. Confidentiality was dealt with through the open use of a digital voice recorder. Because the nature of the research involved the explanation of knowledge management strategies on projects, the researcher requested that the participants refrain from using the names of co-project workers on the tape recording. Instead, participants referred to individuals as Person A, B, C or D. Anonymity was not only achieved by using code names during the interviews but also in the typed transcripts of the interviews.

3.9 INTERVIEWEE SELECTION

Denzin and Lincoln (1998) noted that interviewee variety is essential to the profundity and richness of data obtained in qualitative research. The aim of this was to explore

expert views from successful project directors, project managers, and project engineers on knowledge management based systems within the Nigerian and UK oil and gas sector. The main advantage of this sample was that each participant had worked on projects in developing countries. This allowed the researcher to focus in-depth on the experiences of each participant. This was particularly important because the research subject is in a research area of which there is little available data in Nigeria and UK. The participants worked in various types of organisation formations and project arrangements. All participants were considered to have practical understanding of knowledge management based systems and their views were considered those of knowledgeable practitioners. The following is a summary background of the organisations used in this study, for the purposes of confidentiality, the firms name have been changed. For the purposes of identification, the eight organisations have each been given one-letter identification from (A) to (H). Participants have been given an alphabetical identification that links them to the organisation they work for as illustrated in Table 3.5. A summary profile of the twenty participants involved in this study is provided in Section 3.9.11.

3.9.1 Company A

Company (A) is an international oil and gas exploration and production company with a strategic focus on Africa, the Middle East and the North Sea. The Company has grown by acquiring under-developed properties in established basins and has increased its production by utilising advanced and proven technologies. Company (A) strategy is to build on the significant growth and profit enhancement opportunities within their existing licence areas while also pursuing new venture opportunities.

3.9.2 Company B

Company (B) is a global group of energy and petrochemicals companies with around 87,000 employees in more than 70 countries and territories. Company (B) use advanced technologies and take an innovative approach to help build a sustainable energy future. Their strategy to generate profitable growth remains to drive forward with their investment programme, to deliver sustainable growth and provide competitive returns to shareholders, while helping to meet global energy demand in a responsible way. In upstream they focus on exploring for new oil and gas reserves and developing major projects where their technology and know-how adds value to the resource holders. In

downstream their emphasis remains on sustained cash generation from existing assets and selective investments in growth markets.

3.9.3 Company C

Company (C) is a world-class oil and gas services company based in Nigeria. Company focus on quality, cost-effective, innovative and cutting-edge solutions designed to meet the present day challenges of the oil and gas industry and other industrial markets in Nigeria. The company's footprints are in almost all the major oil and gas projects particularly the offshore fields and they provide a full range of offshore and onshore support solutions.

3.9.4 Company D

Company (D) in its short period of existence has, become a highly reputable 100 per cent indigenous oil field support company that specialises in the provision of logistics and engineering support services to the Nigerian oil and gas sectors. Company (D) was incorporated to bridge the gap in indigenous participation in the oil and gas Industry.

3.9.5 Company E

Company (E) knowledge, technical innovation and teamwork are at the centre of their business. For more than 80 years, they have focused on leveraging these assets to deliver solutions that improve customer performance. Today, company (E) real-time technology services and solutions enable customers to translate acquired data into useful information, and then transform this information into knowledge for improved decision making anytime, anywhere. Harnessing information technology in this way offers enormous opportunities to enhance efficiency and productivity. This is a quantum leap from providing traditional 'just-in-case' information to delivering 'just-in-time' knowledge that meets the changing needs of projects.

3.9.6 Company F

Company (F) is a worldwide leader in the design, manufacture and sale of equipment and components used in oil and gas drilling and production, the provision of oilfield inspection and other services, and supply chain integration services to the upstream oil and gas industry. The company is committed to project specific solutions through its vast industry experience.

3.9.7 Company G

Company (G) in the UK invests in multiple business sectors. Company (G) oil and gas pipeline solutions business inspects more than 104,000 miles of pipeline across 80 countries yearly. They also manufacture products and provide services for oil and gas exploration and production.

3.9.8 Company H

Company (H) is a subsea engineering, construction and services company serving the offshore energy industry. Registered in Luxembourg and with its headquarters in London in the United Kingdom. Successful projects is the core business of company (H), they are committed to safely deliver tough and complex offshore projects on schedule, on budget and at the agreed standard.

3.9.9 Company J

Company (J) is one of the world's leading integrated energy companies. They are commitment to getting results the right way—by operating responsibly, executing with excellence, applying innovative technologies and capturing new opportunities for profitable growth. They are involved in virtually every facet of the energy industry. They explore for, produce and transport crude oil and natural gas; refine, market and distribute transportation fuels and lubricants; manufacture and sell petrochemical products; generate power and produce geothermal energy; provide renewable energy and energy efficiency solutions; and develop the energy resources of the future, including research into advanced biofuels.

3.9.10 Company L

Company (L) is a world leader in project management, engineering and construction for the energy industry. From the deepest subsea oil and gas developments to the largest and most complex offshore and onshore infrastructures, their 40,000 people are constantly offering the best solutions and most innovative technologies to meet the world’s energy challenges. Present in 48 countries, Company (L) has state-of-the-art industrial assets on all continents and operates a fleet of specialized vessels for pipeline installation and subsea construction.

Table 3.5: Profile of projects and participants

Organisation	Profile of projects	Participants
A	Energy and Petrochemical	A
B	Energy and Petrochemical	S
C	Energy and Petrochemical	R
D	Energy and Petrochemical	J
E	Energy and Petrochemical	L, P, Q
F	Energy and Petrochemical	C, I
G	Energy and Petrochemical	D, E, F, K
H	Energy and Petrochemical	B, O
J	Energy and Petrochemical	M, N
L	Energy and Petrochemical	G, H

The ten organisations were selected from a diverse oil and gas organisations to ensure that a variety of project environments would be examined. Interviewing more than one project leader in an organisation allowed more information about their actual practice (and opinions) to be obtained. In order to investigate the factors that influenced knowledge management based systems it was necessary to have a range of organisations in terms of projects managed. The ten organisations that were selected, where twenty of the participants interviewed, operated in the energy and petrochemical sector. The selected organisations were well balanced in terms of oil and gas projects managed. In general, terms there was a link between the existence of project work and the type of projects undertaken.

3.9.11 Sampling and gaining access

According to Marvasti (2003), defining the target population and selecting the sampling technique lies at the core of any qualitative research. First, the population must be clearly defined to ensure that accurate, unambiguous and reliable conclusions are achieved. Defining the population is crucial because research findings can only be legitimately applied to the population under study. May (2002), argued that bias in the selection of the sample can be introduced if the sampling is not random and the sampling frame that serves as the basis for the selection does not involve the population adequately, completely or accurately or when some sections of the population are

impossible to find or refuse to co-operate. Therefore, knowing who can grant or block access to individuals is part of the overall sociological knowledge required for a qualitative study. However, the consent of the gatekeeper does not necessarily allow direct access to individuals as was discovered in this research. Numerous gatekeepers were encountered in this research, signifying the complex process in negotiating access.

Ticknel *et al.* (2004) stated that a researcher must locate individuals who meet certain criteria and who are willing to participate in a research study. To ensure that appropriate recruitment of senior managers, various organisations were contacted. The gatekeepers included board members of ECI (European Construction Institute) and Company directors in Nigeria and the UK. Between them, these individuals allowed access to their senior project management practitioners. Huberman and Miles (2002, p.23) suggested that the population for a study is:

> *"The group from which the researcher wants to gain information and draw conclusions"*

From that large group, a researcher selects the sample, which will yield desired data. After selecting the largest population, the size of the sample must be determined. There are no rules for choosing the size of a sample in qualitative study (Bryman, 2004; Creswell, 1994). The size of the sample is connected to the purpose of the research and the ability of the researcher to get information-rich data. May (2002) addressed this specific issue by suggesting that the sample size is dynamic and ad hoc, and relies on the availability of the participants and saturation of the data, rather than targeting representatives to generalise to a larger population. Sample sizes for qualitative research should be judged according to how well they fulfil the aim of the research, rather than applying predetermined logic for probability sampling, as used by quantitative researchers (Bryman, 1988).

For this investigation the researcher seeked individual perspectives on knowledge-based management systems from senior project management practitioners within the oil and gas sector. Somekh and Lewin (2007, p.76) define population as "all the people or phenomena under study, from whom a sample will be selected for research". Robson (2002) elaborate further on this to suggest that a sample is "nothing more than simply a selection from the population that is specific to the study". For this investigation the

researcher used purposive sampling as well as quota. “Purposive sampling uses an institute or group with whom the researcher has an established relationship or those who responded to a request for volunteers to participate in the research, whereas quota sampling is similar to stratified sampling but individuals are selected to fill quotas to represent relative proportions of specific characteristics” (Somekh and Lewin, 2007). Participants were selected using purposive sampling as the process involves obtaining all possible cases that fit particular criteria and selects cases with specific purpose in mind (Neuman, 2006).

As Denzin and Lincoln (1998) stated, purposive sampling is recommended for qualitative research. The underlying principle in strategies of purposive sampling is choosing information-rich cases. The researcher chooses purposive sampling technique in qualitative research. It was critical to find participants who had managed oil and gas projects successfully and experienced impacts of knowledge management strategies as illustrated in Table 3.6.

Table 3.6: Sample of projects managed by participants

Year managed	Participant	Project	Impacts of knowledge management strategies	Project outcome
2010	A	Energy	Impacts were seen	Successful
2005	B	Energy	Impacts were seen	Successful
2011	C	Energy	Impacts were seen	Successful
2007	D	Energy	Impacts were seen	Unsuccessful
2007	E	Energy	Impacts were seen	Successful
2012	F	Energy	Impacts were seen	Successful
2006	G	Energy	No impact in project	Successful
2006	H	Energy	Impacts were seen	Successful
2013	I	Energy	No impact in project	Successful better than expected
2010	J	Energy	Impacts were seen	Successful
2008	K	Energy	Impacts were seen	Successful
2008	L	Energy	Impacts were seen	Successful
2009	M	Energy	Impacts were seen	Successful
2009	N	Energy	Impacts were seen	Successful
2007	O	Energy	Impacts were seen	Successful
2006	P	Energy	Impacts were seen	Successful
2005	Q	Energy	Impacts were seen	Successful
2008	R	Energy	Impacts were seen	Successful

2005	S	Energy	Impacts were seen	Successful
2008	T	Energy	Impacts were seen	Successful

In the first phase, senior managers in the purposive sample were contacted and asked to complete a project questionnaire. The questionnaire [see Appendix C] was initially piloted to ensure that it met the objectives of identifying the participants who had experienced cultural issues on projects in developing countries. Once the project background of participants was verified, the sample was purposively selected. Usunier (1998) stated that where researchers want to compare across cultural contexts, they need to use concepts and research instruments that are understood in similar ways. In all cultural studies, as in this study, the researcher made sure that the same data collection procedures did not result in biased findings. The search for equivalence was the most important methodological aspect in this research. In order to define a sampling procedure for this research, the researcher selected a method, which was based on several national or cultural samples, each being fully representative of the populations of the country. The sample was designed to obtain Nigerian and UK participants with the requirement of having experienced positive impact of knowledge management based systems on oil and gas projects. The second requirement for selection was that participants had successful managed complex project teams, and the third requirement was that participants had worked on oil and gas projects. As the research participants had not been randomly selected no claim can be made of achieving representation of the wider oil and gas industry. This research instead achieved an in-depth insight into knowledge management systems within the oil and gas industry by interviewing participants' with specific experience. Each participant had previous project management experience. Interviewing various oil and gas professionals allowed the researcher to analyse and cross-compare all interview responses. Furthermore, the twenty participants varied in terms of project background as shown in Table 3.6. The variety lent multiple perspectives to the interview process. The twenty interviews provided rich data, which proved to be more than sufficient for this research.

Following confirmation with initial gatekeepers, letters were distributed to the senior managers. The gatekeepers facilitated the undertaking of the study among the senior managers within their organisations. The process of recruiting participants was a lengthy one and lasted over two and half months [September 2013 - Mid November 2013]. The researcher visited the organisations in Nigeria and UK carrying out the interviews. The

aim of this was to provide all the participants with an information sheet about the study. It was made clear to the participants that participation was voluntary. Within this context, the researcher continually emphasised that the study had a primary focus, with the findings being part of an accumulative body of knowledge about how best to address operational issues and enhance knowledge management based systems in the Nigerian oil and gas industry.

At the start of each interview carried out in this study, participants were advised to read and to sign a statement of consent [see Appendix D]. The statement of consent briefly highlighted the purpose of the research project, and then explained that the interviews would take the form of a structured discussion. The consent form also assured the participants of complete anonymity during the research process. The interviews took place in offices. Appointments were made with the participants, so each participant had a planned interview time. During the interviews the doors were closed this gave participants a sense of privacy and confidentiality. The digital recorder was placed on the desk in clear sight. Participants were aware of its presence but accepted it. There were few interruptions in the interviews. The digital recorder was turned off during the interruptions. Interruptions were also noted on the typed transcript.

One of the key advantages that emerged after the interview process is that the sample size used for this research allowed the researcher to focus in-depth on social issues in different types of projects. This was particularly important because the research subject is in a research area of which there is little available data in Britain and Nigeria. The following is a summary profile of the twenty managers involved in this study [see Table 3.7]; for the purpose of confidentiality, the researcher used alphabetical letters to represent names of participants.

Table 3.7: Summary profile of twenty managers involved in this study

Participant	Gender	Sector	Current Job	Numbers of years worked in sector	Number of years managed projects	Role and Responsibility
A	Male	Energy	Project Manager	29	17	Managing projects
B	Male	Energy	Project Leader	18	7	Planning
C	Male	Energy	Project Manager	27	15	Managing projects
D	Male	Energy	Chief Project Manager	19	10	Managing projects
E	Male	Energy	Project Manager	12	5	Planning
F	Female	Energy	Junior Project Manager	10	4	Managing projects
G	Male	Energy	Chief Project Manager	14	6	Managing projects
H	Male	Energy	Project Engineer	20	10	Co-ordination of work
I	Female	Energy	Project Engineer	15	7	Managing projects
J	Male	Energy	Project Manager	20	10	Managing projects
K	Male	Energy	Junior Project Manager	15	6	Co-ordination of resources
L	Male	Energy	Project Manager	20	11	Managing projects
M	Male	Energy	Project Leader	14	3	Co-ordination of work
N	Male	Energy	Project Engineer	17	5	Managing projects
O	Male	Energy	Project Engineer	15	6	Managing projects
P	Male	Energy	Project Leader	11	5	Co-ordination of work
Q	Male	Energy	Project Engineer	19	9	Managing projects
R	Male	Energy	Project Engineer	20	11	Managing projects
S	Male	Energy	Project Manager	23	9	Managing projects
T	Male	Energy	Project Manager	25	11	Managing projects

3.9.12 Fieldwork experience

The length of fieldwork varies according to the collection of data. Ideally, fieldwork should continue until the data reaches saturation point, when the data begins to repeat itself. Huberman and Miles (2002) addressed the issue of fieldwork by suggesting that the researcher should continue until the research questions are fully answered and the purpose of the research is completed. Whilst joining in with the debate Denzin and Lincoln (1998) argued that fieldwork must be done long enough to gain in-depth

understanding of the participants and the context under study. The fieldwork for this study was accomplished during [November 2013 - February 2014]. The data collected were rich and informative.

During the interview process, the researcher had to maintain an open mind. This required flexibility in the research design. Even though the researcher adopted a flexible approach, the author had to remain focused on the objective of the research throughout the data collection process. In qualitative research, interviews are the most common method of data collection. Face to face, interviews with people create opportunities for an in-depth understanding of a situation and a context. May (2002), suggested that questionnaires and interviews aid in data collection by asking individuals questions, rather than only observing their behaviour. Qualitative interviews are meant to be flexible and dynamic, and are described as open ended, non-standardised, non-directive, and unstructured (May, 2002). According to Denzin and Lincoln (2003), the main aim of interviews is to obtain information, which cannot be gained in another way.

There is considerable variation in interview style within the context of qualitative research. Richards (2005) highlighted that interviews can vary on a continuum from very informal to very formal. In a formal interview, the researcher asks pre-arranged questions and in an informal interview, the researcher tailors the questions to the responses given during the interview. Although the interview method was found to be effective in this study, one should always adopt a cautious approach. Leaning toward an informal conversational interview, Steinke *et al.* (2004) emphasised that only truly open-ended questions allow participants to answer in their own terms. Steinke *et al.* (2004) further stated that self-report answers, as in the case of interviews, might contain data, which is incomplete or distorted. This can arise when the topic of study is threatening to the participants, if the participants fear that honest answers may harm them, or if the questions call for a higher level of insight than possessed.

Denzin and Lincoln (2003) listed four types of interviews:

- Closed fixed response interview: in this approach, questions are predetermined and responses are fixed;
- Standardised open-ended interview: in this approach, all questions are open-ended. This method of interview reduces the naturalness of the questions. This style is helpful when organising and analysing data;

- Interview guide approach: in this approach, the researcher works out an outline of the topics before the interview. This approach continues to be conversational and can be adjusted to a situation; and
- Informal conversational interviews: this style allows maximum flexibility in studying a phenomenon; however, it makes data analysis difficult.

The researcher used the interview guide approach, in keeping with the qualitative method employed in this research. The opening request for each interview was describe your role and responsibility in the organisation. During the interviews the researcher attempted to respond to comments with 'how' questions to maintain openness and to elicit an undirected response. At other times, the researcher asked questions to clarify information. The literature review prior to the interviews assisted the researcher in asking questions. When recording the field notes, the researcher was careful to make detailed and accurate notes in a systematic manner. Since the researcher used a qualitative method, the field notes were obtained by commencing each interview with one question, than maintaining an open conversation with the participants. As already, highlighted the other fieldwork tool used was the recorder. During the interviews, the researcher was aware of the need to listen carefully and to ask open-ended questions. At the same time, the researcher understood the need to keep the conversation on topics related to the study, such as knowledge management.

3.9.13 Leaving fieldwork

Gaining access for fieldwork is different as it involves forming a relationship with the participants. Within these social setting individuals are affected to varying degrees by the presence of the researcher and research activities. In negotiating entry to organisations, the initial relations of fieldwork were a balance between sincerity and artificiality. However, over time, these relationships became meaningful; highlighting that qualitative research relies upon establishing and building relationships of significance with others in the field. Bryman (2004) further suggested that these relationships give a qualitative research its intensity and quality. Leaving fieldwork was therefore not going to be easy. To overcome the above, when the researcher obtained consent at the beginning of the data collection the researcher made sure that the aims and objectives of the research were explained to all participants.

3.9.14 Qualitative data analysis

In any qualitative research, data analysis becomes an ongoing process; meaning that the researcher has to make thoughtful, informed decisions throughout the data collection procedure Bryman (2004). According to Lewis and Ritchie (2003), the thread of analysis is woven through the interview process, when the researcher starts to record 'personal comments' beside the narrative data. The thread then winds through a coding process, which is a way to sort a large quantity of descriptive data. Finally, the thread completes its journey as the data is interpreted and new findings declared. Thus, the researcher seeks to define themes, which will lend a coherent synthesis to the data. In a qualitative inquiry, data analysis begins during the interviewing phase as new avenues of research begin to emerge. The researcher records insights and interpretations beside the actual narrative data. During the analysis, broad themes and patterns are looked for, rather than narrow, precise variables of qualitative research (Bryman, 2004). As possible topics become evident, the researcher may try to verify the research area during the interviews.

For this research, data was not a distinct stage of the study. Formally, it started to take shape in analytic notes; informally it was embodied in thoughts, ideas, hunches, and emergent concepts and continued into the writing up process. Even though the data analysis phase was placed after the fieldwork phase, the data analysis phase was an ongoing process of fieldwork itself, rather than as a final stage in a linear model. Qualitative researchers (Bryman, 2004; Denzin and Lincoln, 1998; Huberman and Miles, 2002; Silverman, 2001) stress the continuous interconnection of fieldwork and interpretation. Bryman (2004) addressed it as a spherical sequence, whereby the researcher's original theoretical position is continuously altered or refocused by the fieldwork in a dynamic dialectical method. At the end of fieldwork, the researcher had two methodological and theoretical notes, together with over three hundred and seventy-five pages of transcribed material.

At the conclusion of the transcription, the researcher must find a way to study, sort and analyse a large quantity of data. In analysing results of a qualitative research, the researcher is expected to add his own impressions and feelings to the data, then to interpret the data through reflection and introspection (Huberman and Miles, 2002). Computers can easily offer assistance in the management of complex data (Richards and Richards, 1998). After reviewing a number of software packages, the researcher came to conclusion that the NVivo was best suited for this research. The basic process

in using the NVivo to assist in the analysis of data is to import and number the files, code data files and search the coded segments. The NVivo software has a number of facilities that allows a researcher to code items of text and then retrieve the codes in order to undertake analysis of the data. All interviews were recorded and transcribed verbatim and they were then analysed through the use of a qualitative analysis software package NUDIST NVivo^{TM}. During the analysis, broad themes and patterns were looked for, rather than narrow, precisely variables of qualitative research.

One of the primary functions of this software that emerged was the ability to add memos to sections of the data, as thoughts and connections were made during all phases of the data analysis. It enabled the researcher to sort through the data and at the same time allowed exploration for patterns and recurring phenomena. This allowed the researcher to compare, contrast, and synthesise. The codification system was drawn from the initial interview questions that had been based on appraisal of key issues arising from the literature. It is essential that the codes be not seen as ends in themselves, as the answers are not in the codes but in us, and the data (Seidel 1998, p18). For this research, the available information was entered into a computer. Data was then first coded, searched according to codes and the underlying themes and patterns revealed. Initial and subsequent impressions and thoughts were recorded in detail emphasising the organic nature of this method for data analysis. As the data analysis progressed, further details were obtained, with sections of data intensively analysed. At this stage, the researcher had already generated some categories through the ongoing theoretical reflections and applied these for initial coding purposes, refining and extending the categories as she went along. In some cases, a particular section would fall into more than one category, but this seemed to indicate the interlinking of themes rather than a fault in coding.

The data material was further coded using shallow categories (Davies, 1999). This was followed by a more specific search (Spradley, 1979) that allowed the identification of broad themes in this research that could be developed subsequently by adding clusters of codes. As the researcher progressed with the data collection, certain themes became increasingly robust such as the notion of communication, whilst others changed ‘shape’. There was a continual measurement and refining of concepts as the fieldwork proceeded. The researcher purposely sought different examples that may disprove some initial theoretical constructs. As the analysis proceeded, the researcher developed

working categories that explained cultural complexity on project teams. Following the construction of a category, the next component of the process was the presentation of the data in a narrative form supported by evidence from the statements recorded during the interview phase and making theoretical references as necessary.
In the next phase, the generation of themes was an ongoing and development process, garnered in part by the application of a large number of codes. Four main parent codes (or clusters) provided meaningful categories. These included:

1. Reviewing current project management in Nigeria and comparing it with practices in the UK;
2. Determining the importance of knowledge management based systems in delivering successful projects in the oil and gas industry of Nigeria;
3. Examining the extent to which knowledge management strategies contribute to adding value in oil and gas projects being delivered in Nigeria;
4. Identifying strategies and practices which contribute to improved performance, innovation and continuous improvement in the operations of the oil and gas industry in Nigeria.

As illustrated, there was a logical progression to the order of the parent codes. This was an attempt to ensure that the main objectives of the research were met. Once this phase was complete, the researcher took each topic in turn and inserted the relevant interview extracts. Explaining the phases of the data analysis makes it appear straightforward. However, in reality it has been a prolonged and complicated procedure, at times challenging, at other times exciting.

According to Bryman (2004), a qualitative researcher should take into account personal bias and refrain from making value judgements about the opinions and views of participants. Bryman (2004) further suggested that a qualitative researcher is expected to add his own impressions and feelings to the data, then to interpret the data through reflection and introspection. The conclusions in a qualitative research are the insights the researcher believes she or he has gleaned as the result of a lengthy, intensive effort. Whilst joining in with the debate Fielding (1993) addressed this specific issue by suggesting that understanding is achieved when the researcher knows the rules and can communicate them to members of the culture in such a way that if a colleague were to follow them he or she would be able to empathise with the group. Furthermore,

members of the culture often validate these meanings before presenting the findings; this was achieved by presenting the findings to participants in Nigeria and the UK.

3.10 DATA COLLECTION METHODS

A combination of strategies was used, namely semi-structured interviews and a postal questionnaire. This was found to be particularly important in this study as participants were selected from a cross-section of project teams, organisations, and project environments. Having chosen a research strategy, the specific data collection device needs considering. Jobber (1991) identified three choices of survey methods: postal, telephone and face-to-face interviews. The main advantage of face-to-face is its ability to cover complex issues. Adopting a semi-structured questionnaire with topics as opposed to questions provides maximum flexibility during an interview. The length of time devoted to each topic depends upon the responses given and new topics can be applied, as they appear relevant. Face-to-face interviews allow the maximum amount of probing. Probe questions can be used to understand what the participant is saying or exploratory questions designed to ensure that the participant gives as full an answer as possible. Internet questionnaires must be fully structured, as clarification is not possible. A questionnaire ensures consistency and uniformity in approach in obtaining data from a disparate set of participants. There are two broad types of questionnaire: interviewer-administered and respondent / self- administered.

As highlighted in the introduction to the chapter, this study considered knowledge management based systems across a variety of organisations and project environments. The study design addressed these considerations and, given the amount, variation and potential complexity of the data required, a self-administered / respondent questionnaire was used. The data and information from the survey helped to establish a good background, test the significance of the study, acquire an overview of current practices and delineation of primary synthesis for the development of the framework. The data collected at the preliminary phase served as a background for further steps, namely, semi-structured interviews.

One approach employed to this research was a series of semi-structured interviews with senior managers from differing backgrounds. The use of interviews allowed the researcher to elaborate points, which were unclear to participants. It also enabled the

researcher to clarify meaning of questions and provided the opportunity to introduce the research topic and motivate the respondents to provide honest answers. Additionally, it provided the opportunity to explore some issues and allowed the researcher to classify (or at least) clarify the responses to such questions into useful categories during the course of the interviews. In the present study it was used to derive senior managers' constructs of operational effectiveness and knowledge management based systems. The method employed helped to evaluate senior managers' attitudes and perceptions as well as to refine and improve the development of the framework. Case studies were employed to validate the framework developed using data information derived from the last two steps. This would provide the opportunity for a combination of respondent / self administered postal questionnaire and interviews to yield a better consistency of the findings since it allowed a systematic comparison of different organisations by exploring different management features and examining different levels of behavioural variables involved. Employing various data collection methods provided a complete picture of the issue under investigation if it is admitted that it has more than one dimension (Bryman, 2004). The following sections present the issues involved.

3.10.1 Internet questionnaire

A preliminary survey was carried out with project managers and consultants in the UK. In an effort to maximise the response rate, complete anonymity was assured to respondents. The main purpose of the questionnaire included:

- To explore respondents' views about knowledge management practices;
- To explore respondents' views about barriers encountered when implementing knowledge management strategies; and
- To explore respondents' views about operational effectiveness.

The questionnaire was found to be the most appropriate instrument for this study for many reasons, which included:

- Questionnaire was found to be a quick and generally inexpensive means of obtaining data from people;
- For this study the questionnaire was found to be one of the easiest instruments to test for reliability; and
- Data was obtained from respondents in a wide spread geographical area; and
- since anonymity was assured, it was observed that respondents were more likely to provide honest answers in this study.

The disadvantages in a questionnaire were identified as:

- Respondents had to be literate;
- In the case of any ambiguous items, some respondents did not have the opportunity to clarify the questions. These two disadvantages were addressed by making sure that the organisations selected for this study had a background in heavy engineering project management; and
- It was also observed that use of a postal questionnaire required the respondents to complete the answers without any help from an interviewer. The questions had to be in simple form. This was addressed by carrying out a two stage piloting process as discussed.

Since the participants were presented with a similar questionnaire, variability in answers did not attribute to variability in the question, but only attributed to variability in the people answering.

3.10.2 Interview

According to Bryman (2008), interview is a method of data collection in which the interviewer obtains responses from participants in a face-to-face encounter or over the telephone. Interviews are used frequently in descriptive and qualitative research studies. In this study, semi-structured interviews were used. A preliminary survey was carried out with experienced project managers in UK. The purpose of the survey was to assess clarity of questions, timing, and suitability of the respondents for the study and to establish its reliability and validity. The interview schedule included closed and open questions. The purpose was to obtain rich data about attitudes, opinions, and experiences of people involved with oil and gas projects. The interviews were solely conducted by the researcher.

Interviews are used when the collection of data is considered necessary to understand complex behaviours and processes in depth (Schensul *et al.* 1999 and Patton 2002). Therefore, interviews need to adhere to an established line of enquiry, but at the same time the researcher needs to facilitate the interview to be fluid rather than rigid in nature. Indeed, interviews can vary in their nature and can be structured, semi-structured and unstructured (Legard *et al.* 2003 and Patton 2002). However, Nachmias and Nachmias (1996) identified the focused interview, which is a variation of the structured interview, as

another category. In the structured interview, the format is more rigid and assumes that the researcher knows exactly what information is needed and has a list of pre-determined questions to ask each and every interviewee. However, in certain instances, the researcher may obtain additional insight by asking unscripted questions dependent upon the circumstances or answers provided by interviewees. As highlighted by Sekaran (1992, p.192), the result of such an interview process is that *"new factors might be identified and a deeper understanding might result"*.

Researchers have neither a pre-determined list of questions, nor a predetermined structure to ask questions in unstructured or non-directive interviews. Moreover, researchers do not direct interviewees and encourage them to both relate their experiences and reveal their attitudes and perceptions on the subject matter. In this interview method, researchers have the opportunity to probe deeper into the subject matter whenever interviewees are willing to be questioned in depth. This research followed a semi-structured interview approach with a view to enabling a deeper insight in the research problems by achieving a free flow of information from interviewees. The more flexible nature of such an interview approach also encouraged the interviewees to fully participate in the interview process and expand upon areas of research interest in a more comprehensive way rather than simply answering one dimensional questions (Fellows and Liu 2008; Patton 2002 and Schensul *et al.* 1999).

In-depth interviews are also suitable since a 'culture,' in this case experiences of individuals involved in heavy engineering project management, can be covered more completely by interviewing since one can usually talk about many more events than by merely observing or using closed questions. A semi-structured interview was adopted in this study, in which a list of topics to be covered was drawn up. Twenty interviews were carried out with senior managers: ten in Nigeria and ten in the UK. Questions were asked to elicit knowledge management implementation on oil and gas projects. The purpose of the interviews was to get views from participants about:

- Degree of success encountered in achieving knowledge management implementation;
- Benefits of knowledge management strategies;
- Strategies and practices which contribute to improved performance, innovation and continuous improvement in the oil and gas sector; and

- Uses of knowledge management tools and techniques.

Advantages of interview method included:

- By focusing on knowledge management based systems, most of the data obtained from Nigeria and the UK were used in this study; and
- In order to obtain in-depth information, the need for confidentiality and protection of participants was assured to participants.

The disadvantages included:

- Interviews were found to be time consuming;
- In this study, arrangements for interviews were difficult to make. This was mainly because a number of project managers had on-going projects to manage; and
- During the interviews, a number of participants were anxious because answers were being recorded.

The information obtained from the twenty interviews that were conducted was found to be very useful in addressing the research objectives.

3.11 RESEARCH LIMITATIONS

All scientific research, qualitative and quantitative has limitations. This section will consider the general limitations of this research, as well as the unique limitations, which apply in a project management study. Quantitative research methodology of scientific inquiry has prized objectivity as a key characteristic, however, qualitative research has been accused of too much subjectivity, because the researcher completes the process of data collection and data interpretation (Richards, 2005). Qualitative research usually involves quite a small sample of participants. This may be seen as a limitation in the world of quantitative inquiry, but it is one of the keys to the process of qualitative study. The essence of qualitative research is to develop an understanding of participants in their natural setting (Denzin and Lincoln, 2003). This in depth data is most likely achieved through a small sample.

It is suggested by Gray (2002); Tincknell *et al.* (2004) that the main issue in the cross-cultural sampling techniques is the selection of samples that can be considered comparable across nations. Usunier (1998) highlighted that it is extremely difficult to

reach perfect comparability. In this study, the limitations were considered when the research findings were being interpreted. Hofstede (1991) clearly addressed this issue by suggesting that samples of cultures should not be confused with samples of individuals. Hofstede (1991) further draws attention to the risk of abusive stereotyping, whereby a nations' characteristics are calculated as individuals' characteristics or where mean values are calculated on the scores from each of the questions.

According to Usunier (1998), one can address the sampling issue by selecting a method based on several national cultural samples, each being fully representative of the populations of the country or culture, which it attempts to represent and furthermore provides comparable data across other countries or cultures. Secondly, estimating sample size is important. The application of traditional statistical procedures such as constructing confidence intervals around sample means or hypothesis testing is difficult to use in a cross-cultural setting in as much as they need precise estimates of the variance of the various populations that been compared. For this study, variance estimate was achieved by selecting a sample size from the two countries and taking into account their respective peculiarities.

3.12 VALIDATION, VERIFICATION, RELIABILITY, AND RIGOUR

In a research context, verification can be defined as the provision of a description of others' understandings and perceptions of the goodness of data. There are four established test of research quality (Creswell, 1994). Construct validity: the application of an appropriate research approach; Internal validity: the demonstration of cause and effect relationships; External validity: establishing the type of and extent to which the research findings are capable of generalisation beyond the realm of the study itself. Fourthly reliability: recording the methods and systems used in the research process to enable it to be respected. The validity and the reliability of qualitative and quantitative findings involve assessing their plausibility and credibility and that of any evidence provided in support of them; secondly, how convincing is the relationship between the variables and categories. Validity and reliability were achieved by first assessing the plausibility in terms of already existing knowledge on some of the knowledge management issues raised by participants.

The verification took place after the interpretation of data; this involved presenting the framework to the main participants of this study in Nigeria and the UK. This was

achieved through workshops and group discussions. These workshops enabled the framework to be continuously adjusted and refined. The main purpose of this process was to ensure that the framework that was developed was not influenced by the researcher's own interpretation and thus distanced from the reality in question. The validation took place after the verification process; this involved presenting the proposed model to a different group of managers who were not involved with the study. This was achieved through a focus group. In this research, rigour was achieved by focusing on verification and validation; this included the responsiveness of the researcher during the fieldwork, methodological coherence, sampling, data analysis and thinking theoretically.

The research methodology described in this chapter is presented in the following diagram (*see Figure 3.4*). It demonstrates four different stages of the work. Stage I was accomplished, by defining the research problem. Stage II involved contacting organisations in Nigeria and the UK, academic staff at Liverpool John Moores University and ECI members for a preliminary survey, this was followed by stage III, which represented the data collection and data analysis, and finally stage IV a representation of the data verification and validation.

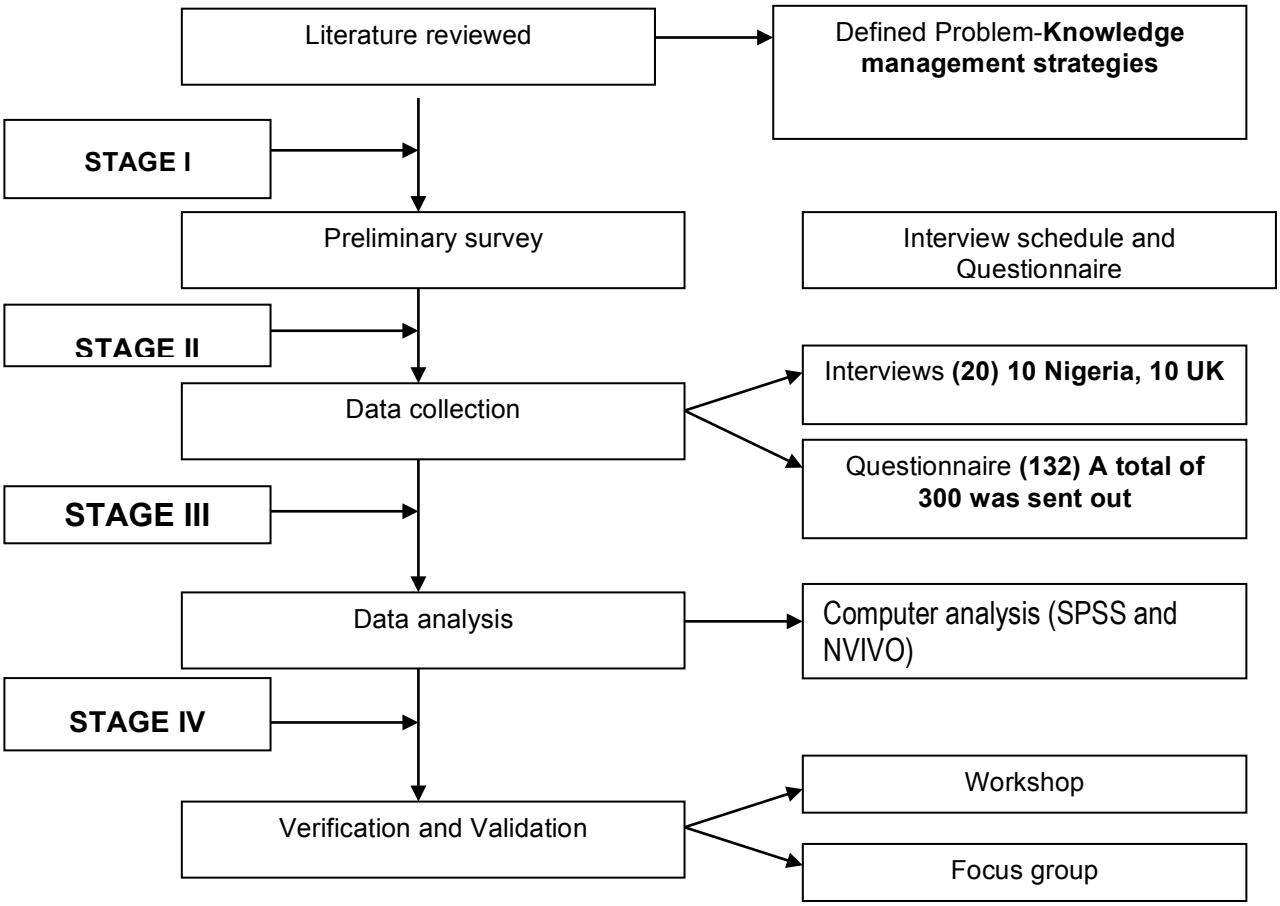


Figure 3.4: Research methodology adopted in this stud**y**

3.13 CHAPTER SUMMARY

This chapter contains information about the research approach and the research methods used in this study. It has presented the main philosophical views behind research methodologies. A review of methods available for quantitative and qualitative was then conducted focussing on data collection methods, data collection techniques, sampling techniques and analysis techniques. The choice of both quantitative and qualitative strategies adopted by this study was then justified. The main differences between quantitative and qualitative research strategies were discussed. In terms of research approach and research method the chapter highlights the reasons for using survey and interviews. The need for diversity in terms of projects managed and organisation suggested a survey is more appropriate for this study. Secondly, the large amount, variety, and potential complexity of data required in this study suggested that interviews were the most appropriate method to use. Following this review, this chapter provides details about the design of the questionnaire and participants in the context of obtaining valid and reliable data. The detailed design of the questionnaire is discussed and the chapter provides a rationale for including specific topics for data collection. A rationale for using simple random sampling is provided. Interactive workshops and group discussions were chosen to allow data validity, consensus building, and sense of framework ownership. The next two chapters will be a discussion based upon the accounts of senior managers Nigeria and the UK.

CHAPTER FOUR: QUALITATIVE FINDINGS

4.1 INTRODUCTION

This chapter presents results and discussion of the qualitative findings relating to knowledge management strategies and practices in oil and gas organisations in Nigeria and the UK. Participants in Nigeria and the UK identified a number of key factors influencing implementation of knowledge management practices in oil and gas organisations. During the analysis of the qualitative data, three themes emerged these were importance of knowledge management in delivering successful projects in the oil and gas industry of Nigeria, extent to which knowledge management strategies contribute to adding value in oil and gas projects and strategies which contribute to improved performance, innovation and continuous improvement in the oil and gas industry. These were further sub-divided into twelve sub-themes as presented in Table 4.1. Table 4.1 illustrates the link between the research objectives, themes and research method used.

Table 4.1: Knowledge management themes

Research objectives	Themes	Research method used
Objective 2: Determine importance of knowledge management based systems in delivering successful projects in the oil and gas industry of Nigeria	• Minimizing downtime • Results and using past successes for a business case rationale	Semi-structured interviews with participants from Nigeria and UK.
Objective 3: Examine the extent to which knowledge management strategies contribute to adding value in oil and gas projects being delivered in Nigeria.	• Community of practice • Collection method • Best practice sharing system	Semi-structured interviews with participants from Nigeria and UK.
Objective 4: Identify strategies and practices which contribute to improved performance, innovation and continuous improvement in the operations	• Databases • Software tools • Portals • Groupware • Communities of practice	Semi-structured interviews with participants from Nigeria and UK.

of the oil and gas industry in Nigeria.	• Best practices groups • Peer review groups	

For each set of research objectives, a primary research method was adopted and other research methods were chosen to provide supporting information thus enabling triangulation of results (refer to the method section). This research approach served to reduce or eliminate the potential disadvantage of adopting a purely one-dimensional research approach whilst gaining the advantages of each, and of the combination – a multi-dimensional view of the subject, gained through synergy (Fellows and Liu, 2008). During the discussions, the effectiveness of knowledge management was explored, and the facilitation factors that may influence project teams to adopt strategies in achieving effective team performance were analysed. This analysis was conducted as experiences and attitudes are known to be construed by choices available to individuals. In this chapter, for the purposes of classification the twenty participants have each been given one-letter identification from (A) to (T).

4.2: OBJECTIVE 2-MPORTANCE OF KNOWLEDGE MANAGEMENT BASED SYSTEMS IN DELIVERING SUCCESSFUL PROJECTS IN THE OIL AND GAS INDUSTRY OF NIGERIA

As shown in this study, the oil and gas industry has taken advantage of knowledge management (KM) developments for more than a decade (Abdul-Aziz and Lee 2007; Grant 2013; Bairi *et al.* 2013). The industry has experienced rapid changes and so many mergers that a one-worded petroleum company name now seems like an oddity. Throughout the rapid advance of technology, an extension of offshore drilling, numerous acquisitions, the growing reliance on foreign oil sources, and a focus on environmental issues, KM initiatives have played a part in making operations more efficient and effective (Parsat *et al.,* 2011; Mckenna and Wilczynski, 2006).

For instance, during the interviews participants from Nigeria and the UK noted that when oil and gas companies have been faced with new technology, outsourcing, new partnerships, and government regulation, their KM teams have provided support through technology and knowledge transfer, as well as asset management. When business issues involved capacity management, cost reduction, and the environment, KM played a part through forecasting/scheduling and process and technique innovation. To improve

speed and convenience, KM initiatives have expanded to address point-of-sale technology adoption and procedure effectiveness.

The twenty participants claimed that KM has been proven to increase stock market valuation, assist in growth through acquisition, lead to better-developed products, and encourage intelligent leadership for tenacious early adopters. For example, participant (A) definition of KM is apt for much of the industry: processes, tools, and behaviours that deliver the right content to the right people at the right time, and in the right context so they can make the best decisions, exploit business opportunities, and promote innovative ideas.

In this study most of the participants, have embraced KM:

For example, according to participant (S):

> *"We learned that we could use knowledge to drive learning and improvement in our organisation. We gave emphasis to shopping for knowledge outside our organisation rather than trying to invent everything ourselves. Every day that a better idea goes unused is a lost opportunity. Participant (S) further accentuated that we have to share more, and we have to share faster."*

According to participant (J):

> *"Most oil and gas organisations in Nigeria face a common challenge: using knowledge more effectively than their competitors do."*

Participant (R) defined:

> *"Knowledge management as the framework for innovation to succeed in the new business while adapting employees to the rapidly changing operating environment."*

In addition participant (D, E, F and K) noted that:

> *"We got into KM because we had a number of projects going on that it was difficult to standardise without limiting creativity. … Through KM, different senior*

managers not only share experience and knowledge, but go forward to create what we call 'contamination centres' where people infect each other with ideas."

Participant B and O went on to suggest that:

"We must become specialist in capturing knowledge, integrating and preserving it, and then making what has been learned quickly and easily available to anyone who will be involved in the next business decision."

As shown from the reviewed literature, knowledge management may not be a novel concept, but an existing KM infrastructure can be a cost-effective means of addressing new and/or increasingly pertinent operational issues in the oil and gas projects, including retaining valuable knowledge during a period of work force aging/diminishing and increasing efficiency through communities of practice (Mckenna and Wilczynski 2006). As affirmed by participants from the UK, a number of oil and gas organisations are fine-tuning their best practices transfer process using content management systems and communities of practice to further minimise downtime at field sites across the globe.

4.2.1 Minimizing downtime

It is worth noting that the cornerstone of knowledge management is sharing best practices and lessons learned. For instance, organisations like Chevron Texaco, Schlumberger, and ExxonMobil have improved their efficiency by institutionalising a knowledge-sharing culture (Grant, 2013). As these organisations collect large amounts of data, content accessibility and organisation become pressing issues. There was a consensus that the magnitude of content has increased dramatically, but the time to find and understand it has not. According to Amin *et al.* (2001), the next step in KM library management is creating content management systems to further minimise the time between having a problem/issue and finding a solution/effective approach. Knowledge management provides context for content management.

Batley (2007) showed that content management systems of people, processes, and technology provide meaningful and timely information to end users by creating processes that identify, collect, categorise, and refresh content using a common taxonomy across the organization. As reported by participant C, content can include databases, audio clips, competitive data, presentations, publications, e-mail virtually any artifact of transactions or dialogue or creative work, inside or outside the organisation.

Users can access internal and external content from the same system and with the same queries, yet still know the source of the content.

Participants L, P and Q stated that the adoption of content management systems reflects a growing strategic importance of online services and delivery systems within the oil and gas industry. As shown from the reviewed literature (Amin *et al.,* 2001; Carrillo 2004), knowledge management provides context for content management by enabling the successful application of the content to today's issues. Schlumberger, a best-practice partner in APQC's 2001 study 'Managing Content and Knowledge', is a leading example (Grant, 2013). Grant (2013) found that knowledge management and content management are interrelated at Schlumberger. The company formed the Schlumberger KM group in 1998 to develop and deploy processes and technology to improve organisational performance and reduce cost for Schlumberger and its customers by enabling individuals to capture, shares, and apply their overall knowledge in real time (Grant, 2013).

It is worth highlighting that the primary impetus for Schlumberger's content management business case was that employees needed access to online information in order to more effectively perform their jobs. The organisation was hosting numerous Web sites, which was confusing to both employees and customers and resulted in redundant and obsolete information, as well as substantial operational overhead (Grant, 2013). The initial content management systems were deployed across the enterprise, with approximately 50,000 employees (that number has since increased by more than 25,000) and 600,000 external customers. Schlumberger began the content management initiative with a small team consisting of five staff members devoted to KM. Schlumberger spent about four years developing its current content management systems.

Grant (2013) claimed that, the initial investment required for the content management systems at Schlumberger was more than $1 million. Schlumberger factored in the time savings of its employees and the cost savings based on server and other information technology consolidation as part of the business case. Beyond the hard numbers, the investment in content management was justified because of its substantial increase in service quality to customers, which indirectly leads to revenue enhancement and cost savings in the field.

A number of participants from UK noted that they have three primary content management initiatives in place:

1. **The Knowledge Hub** ("The Hub") is an intranet and Internet enterprise information portal that provides employees and customers uniform access to information. According to the participants, the main aim of the Hub is to consolidate Web sites and provide access to:

- Knowledge repositories;
- Project management and collaboration spaces;
- Real-time stock and industry activity;
- A help desk, and
- Support for multiples internal and external audiences through threaded discussions community repositories and collaboration technology.

A key feature of the Hub is the seamless view it provides to the end user, whether it is an employee or a client. All data is stored in one repository, and the portal posts only the appropriate information for each customer type.

2. **Real-time News:** is a news-based corporate portal, hosted on the Hub, which is updated every hour with the most current industry and corporate news. Participants from the UK stated that clients and employees can search, categorise, and customise the data. Real-time news allows employees to be in close touch with their clients in real time; the aim is also to align the perspective of the employees with that of their clients.

3. **The In Touch Knowledge Hub** provides a single electronic interface for data exchange on oil products and services between the field and its technology centres. Through the In Touch application, the field has easy user-friendly interchange capabilities with these technology experts and access to validated data, electronic documentation, knowledge repositories, and training aids.

It was also emphasised by participants that some of the operational challenges that oil and gas organisations have had to address during the implementation of its content management system involved ensuring connectivity worldwide in geographically dispersed project teams, technology maturity, technology project cycle time, and finding skilled programming resources. Participants further confirmed that they have had to handle a number of cultural issues to make the content management evolution a success. For instance, participants C and I stated that one issue they have had to consider was changing the work environment of their employees. As confirmed by participants G and H, people are typically resistant to change and its resulting uncertainty, which must be addressed and managed. Another issue for participants was the fact that it is a decentralised organisation, where local managers have the tendency to build their own silos. As observed during the fieldwork, a number of organisations are transnational and have to handle multiple languages for both employees and clients.

Some lessons learned from oil and gas organisations in UK are as follows:

- It is important to realise that knowledge management and content management are the tools to help oil and gas organisations reach their business goals, and they are not the solutions in and of themselves;
- Craft a solution that is applicable across the project, and adopt an evolutionary approach as business needs require, rather than assume it will be a one-time technology that can be implemented;
- Putting aside technology and process, fundamentally the people involved in the knowledge and content management effort will really make the difference;
- The cost of initial content migration is substantial - not only will the company have to migrate existing content, but also much of that content will need to be revisited and revised before it is made available to the company population; and
- Time and money will inevitably be wasted due to failed technologies or technologies that don't live up to their promises. The tools to publish content should be very easy to use.

Participants in this study envisage an ever-increasing range of commercial technology in the future of content management.

- This will include more automated support for the classification of knowledge objects, for the assembly and reuse of content, and for multiple touch points (e.g., personal digital assistants and phones);
- Extensible mark-up language will be standardised across the organisation as a basis for content creation and publishing, and content editors will have increased control over the publishing process (e.g., defined work flows for specific tasks); and
- Finally, there will be better technology available to provide more support for distributed authorship, editing, and publishing.

A number of participants from Nigeria confirmed that, they are planning to introduce open architectures, which will enable the use of best-of-breed commercial technology.

4.2.2 Results and using past successes for a business case rationale

Another advantage of using an existing KM infrastructure to address new challenges is that an organisation believes its own KM success stories; senior management and the work force have seen the benefits of a KM initiative first-hand (Ahola and Davies, 2012). Gaining support may be easier, and the KM approach can be refined based on initial lessons learned.

- At organisation (A), the In Touch system created a centralised knowledge-based organisation, with easy access to information. The results were $150 million cost savings a year, a 95 per cent reduction in time to resolve technical queries, and a 75 per cent reduction in time to update engineering modifications.

It has conclusively been shown (Grant, 2013), that to create a single, global company and reduce cycle time, Shell established global CoPs, broke down the "old boys" network, transferred best practices, and shared stories "from the edge." These efforts led to $200 million per year costs savings, a reduced number of wells, increased facility uptime, and reduced design and planning errors. In 1998 BP Amoco documented $700 million in savings from knowledge sharing.

- At Chevron, savings from 1991 to 1999 were $650 million from just one community effort. Chevron's energy-use network generated an initial $150 million in savings in its first year with a total over time of $650 million. Across Chevron, from 1992 to 1999, productivity increased 30 percent and employee safety improved 50 per cent. "Of all the initiatives we've undertaken at Chevron during the 1990s, few have been as important or as rewarding as our efforts to build a learning organisation by sharing and managing knowledge throughout our company (Grant 2013).

From the reviewed literature, it has been suggested that the oil and gas industry has been a clear leader of the quality movement and in knowledge management (Ahola and Davies, 2012; Parast *et al.,* 2011). Those who have found success with KM principles can now take advantage of an established infrastructure and a more knowledgeable work force and KM team to address pertinent challenges, be they acquisitions, globalisation issues, reducing downtime, organising content, or organising people. According to Derr (1999), oil and gas organisations that aren't broken but are still pursuing continuous improvement "Decentralised organisations, especially global companies, will always be challenged to achieve uniform performance in sharing knowledge just as they are in other areas." The key is to view the differences as opportunities rather than deficiencies."

A key observation from the fieldwork was the role of KM as a major force changing thinking and management practices among the oil and gas organisations. Not only did all the organisations visited institute KM systems and processes, at most of these companies senior project leaders offered explicit recognition of the importance of knowledge management within corporate management systems as a whole and as a major contributor to performance enhancements. For example, participants B and O suggested that:

> *"We learned that we could use knowledge to drive learning and improvement in our company. We emphasize shopping for knowledge outside our organisation rather than trying to invent everything ourselves. Every day that a better idea goes unused is a lost opportunity. We have to share more, and we have to share faster".*

Participants L, P and Q, similarly identified the central role of KM:

> *"All companies face a common challenge: using knowledge more effectively than their competitors do". Several national oil companies also adopted KM.*

Participant C commented:

> *"We got into KM because we had so many projects going on that it was difficult to standardise without limiting creativity. … Through KM, different leaders not only share experience and knowledge, but go forward to create what I call 'contamination centres' where people infect each other with ideas".*

At organisation B, participant S was emphatic that:

> *"We must become experts in capturing knowledge, integrating and preserving it, and then making what has been learned quickly and easily available to anyone who will be involved in the next business decision".*

4.3 OBJECTIVE 3-EXAMINE THE EXTENT TO WHICH KNOWLEDGE MANAGEMENT STRATEGIES CONTRIBUTE TO ADDING VALUE IN OIL AND GAS PROJECTS BEING DELIVERED IN NIGERIA

It is worth mentioning that in the oil and gas sector, there are three main components: exploration, refining and retail (Mckenna and Wilczynski 2006). In addition there are intermediate links, including oil pipelines, maritime and land transportation. Among them, the exploration aspect is the starting point for the use of knowledge management. Exploration is highly competitive, is truly global, and uses the latest technology (Mckenna and Wilczynski 2006). In this study, it has been demonstrated that high levels of exploration is a knowledge - based business. For instance Geologists and geophysicists use their knowledge to determine the rock beneath the surface. In addition drilling engineers use their knowledge to consider how the distribution of drilling can be optimized, in order to achieve optimum efficiency; drilling workers are using their knowledge and experience to achieve faster, more efficient, more secure oil exploration purposes (Prassl *et al.* 2005).

According to participants D, E, F and K:

- Senior project management practitioners need to be able to keep abreast of company and industry design and construction of drilling platforms, so as to be able to control the cost, efficiency and drilling operation of the knowledge.

- Senior project management practitioners need to quickly access company-related knowledge, to be able to solve the problem within the shortest possible time and to avoid duplication of errors committed by other refineries. At the refinery, security is a big problem, therefore, an important part of knowledge management is the sharing of security experience.

The third business is the retail and market. As suggested by both sets of participants, this is a low margin business which simply does not make much money. A number of gas stations usually make money from the sale of merchandise or other items more than the sale of gasoline profits. Therefore, this piece is to focus on the drivers of the business operating costs, client buying, brand management and market position. In short, both sets of participants agreed that this is the oil industry, faced with many challenges and business drivers of different factors: the front-end requires a lot of investment and cost, complexity, and at the retail end of the back-end gross profit was low. Given this complexity, all oil and gas companies are facing the same problem. From the above, it is not difficult to understand why many oil organisations will invariably make use of knowledge management as a measure to address these issues.

4.3.1 VALUE ADDED TECHNIQUES BEING APPLIED

4.3.1.1 Community of practice

As highlighted by the participants, this approach is very popular in the exploration area, and very effective, because at the front end a lot of the business, such as drilling, geology and geophysics, are knowledge-intensive fields. For example participant Q explains:

> *"Our success is built on the basis of highly qualified staff – with them, we can quickly determine the deep underground or underwater oil fields thousands of inches below the surface. Maximising the use of knowledge and skills of these employees are our most important strategic initiatives. Participant S further*

suggested that oil organisations connects to these people of different communities of practice, not only through the form of electronic discussion groups to communicate regularly or irregularly - face to face meetings are also held."

4.3.1.2 Collection method

It is worth noting that collection method approach is to collect the corresponding law, that knowledge is collected and shared (Anderson and Boulanger 2004). Here is a valuable tool within the portal. Statoil's portal is called Faros, it will process all kinds of exploration-oriented learning, connecting communities of practice and knowledge (Grant 2013). For instance, organisation A has deployed a portal known as the Olympus. The system is built around the work processes and not only allows project engineers to remotely login to get access to a variety of reference materials, but also a large number of best practices and various communities of practice. As observed in organisation A, a complete network supporting the operation of Olympus, each site has a "champion" (champions), they are responsible for knowledge of the site manager role.

4.3.1.3 Best practice sharing system

From the reviewed literature the best practice sharing system is also used in a number of oil and gas organisations in Nigeria and the UK. Participant O stated that:

"If not every day a good idea is adopted, it is the loss of an opportunity. We need to share more things, and want to share faster"

Organisation a use internal and external benchmarking (Benchmarking), to determine what is best practice, and where they can use it. At one stage they also produced a "best practice resource map", to show them where knowledge exists in the company. During the fieldwork, the researcher noted that they use a best practice team and network of actors, as a mechanism for knowledge sharing, best practices, supported by a shared database. Recent evidence suggests (Grant, 2013) that Shell Oil Company purchased the Ford Motor Company's "best practice replication system" (Best Practice Replications System, referred to as the BPRE), and used it for the discovery of new oil fields and gas field development process. Their system is called "Pearl" (Pearls), allowing the team to identify and track companies in specific sectors or groups of best practices.

Several studies have revealed that knowledge management tools and techniques have had a major impact in the oil and gas sector (Dowood and Bates, 2000; Grant, 2013; Kozman and Gimenez, 2004; Mckenna and Wilcynski, 2006). Examples include:

- Identification of design flaws in specific tools, upgraded measurements - while drilling signal detection capabilities, customised software solutions to meet specific client needs and the transfer of annular-pressure-while-drilling interpretation techniques from the Gulf of Mexico to Brazil.

- In Nigeria, lessons learned on prior wells aided the successful drilling of a high-risk well and helped avoid two potential stuck-pipe incidents through appropriate and timely preventive actions. Offset wells had experienced continual problems with stuck pipe, hole-cleaning deficiencies and annular overloading, lost circulation, depleted formations and over-pressured shales. None of these problems impeded successful completion of the new well.

Knowledge management is fundamental in constructing drilling solutions that integrate surface and down-hole equipment, sensor, software and data-communication technologies. Individual measurements require process and workflow optimisation to maximize their value. Data must be provided in the form of usable information. This information must also be scalable and sharable with all disciplines, allowing experts to interpret data in real time and provide reliable decision support to the rig (Gabarini *et al*., 2008; Neri 2010).

Participant P stated that knowledge management is an essential foundation for e-Business initiatives. According to Participant P

> *"First, because, the benefits that a company captures from its knowledge-management programs are also beneficial to suppliers and partners. Secondly, because the portals constructed for internal access by employees also provide a natural communication interface with these groups. Third, much of the knowledge management that companies are trying to reuse is actually generated beyond the single enterprise, or within the extended enterprise that includes these groups and others."*

Both set of participants noted that they expect suppliers to deliver electronic inventories of their products and services as a basis for improving the cost-effectiveness of procurement. Participant N acknowledged that the construction of comprehensive e-Catalogs and their linkage to e-Price List has resulted in time and cost savings and improved decision-making about product and service offerings to meet the needs of local asset managers. This linkage includes access to legacy data on technology and service applications.

Today's wide variety of oilfield electronic initiatives, some simple and others highly sophisticated, span activities from procurement, as just described, to the acquisition and divestiture of oil and gas assets through portals. The expansion of the electronic world brings with it major challenges - such as computer and information security. Security, confidentiality and protection of proprietary information are crucial in the relatively open environment of the internet. There was a consensus that these principles must be honored because of the immense value of upstream exploration and exploitation information. Participant P stated that special attention must be paid to security. There are four main issues: authentication, authorisation, confidentiality and integrity.

Participant in the UK highlighted that, the value that knowledge-management technology and a knowledge-sharing culture can reap is being consistently demonstrated throughout the oil field. Collaboration tools have opened a new era for rapid and easy access to, and interchange with, technical experts regardless of where they reside. Knowledge-sharing is rapidly becoming an integral part of everyday oilfield operations. Participant I, suggested that one-stop search capabilities, aided by case-based reasoning applications for indexing, information classification and extraction aid speed, precision and recall of information and knowledge, with multilingual and multiple media capabilities. Just-in-time knowledge delivery has led to a fully functional knowledge-powered enterprise.

This venture has been fuelled by real-time knowledge management-powered enterprise. As claimed by participant I, the knowledge-powered venture fosters knowledge creation and innovative thinking, both in tangible and intangible ways, by continuous learning. The enterprise replenishes and renews its stocks of knowledge, leading to substantial improvements in efficiency, productivity and service quality. By leveraging the collective knowledge of workers, oil and gas organisations in Nigeria can reinvent themselves,

whether they are producers of oil and gas or suppliers of oil products and services. This vision promises to transform project delivery in Nigeria and build the foundation for future growth and profitability initiatives within the oil and gas sector.

As demonstrated in this study, effective knowledge management should dramatically reduce costs. Most individuals, project teams and organisations are today continually 'reinventing the wheel'. This is often because they simply do not know that what they are trying to do has already been done by others elsewhere. They do not know what is already known, or they do not know where to access the knowledge. Continually reinventing the wheel is such a costly and inefficient activity, whereas a more systematic reuse of knowledge will show substantial cost benefits immediately.

As well as reducing costs, effective knowledge management should also dramatically increase our speed of response as a direct result of better knowledge access and application. Effective knowledge management, using more collective and systematic processes, will also reduce our tendency to 'repeat the same mistakes'. This is, again, extremely costly and inefficient. Effective knowledge management, therefore, can dramatically improve quality of products and/or services. There was a consensus among the participants that knowing your primary stakeholder needs, secondary stakeholder needs, client needs, industry needs, has an obvious immediate effect on our relationship management. As shown in this chapter, it is very easy to see how effective knowledge management based systems will greatly contribute to improved excellence, which is to:

- Dramatically reduce costs;
- Provide potential to expand and grow;
- Increase value and profitability; and
- Improve operational effectiveness.

4.4. OBJECTIVE 4-STRATEGIES AND PRACTICES WHICH CONTRIBUTE TO IMPROVED PERFORMANCE, INNOVATION AND CONTINUOUS IMPROVEMENT IN THE OPERATIONS OF THE OIL AND GAS INDUSTRY NIGERIA

Not surprisingly information technology (IT) played an important role in knowledge management systems in the oil and gas industry (Neri, 2010). Some organisations, such as Schlumberger, have relied heavily on information technology and the codification of information to reach their knowledge management objectives (Grant, 2013). It has been

conclusively shown that others, such as Shell, and BP, emphasise a less formal and more people oriented approach to knowledge management (Mckenna and Wilcynski, 2006). Regardless of which approach firms have taken, participants noted that IT was an important facilitator for many of the technology and people-based activities important to knowledge management success. Participants acknowledged a number of key strategies and practices which contribute to improved performance and innovation: They comprised the following:

4.4.1 Databases

The twenty participants involved in this study believed that information technology (IT) has facilitated the assembly of databases that can serve as corporate memories for important information including best practices, technical and managerial performance data, company yellow pages, and supplier and customer information. For instance, it was found that a number of organisations rely heavily on the use of IT to create and use directories useful to the management of knowledge. Intranets serve as a common medium of access to information and a variety of tools and repositories, such as the Schlumberger Knowledge Hub (the company-wide directory and expertise finder), data dictionaries, supplier contracts, digital libraries, catalogs, general news, manuals and online training modules, and bibliographic databases (Mckenna and Wilcynski 2006).

In this study it was established that a number of organisations have developed databases of best practices like Chevron Texaco's Lessons Learned Database and BP's database of After-Action-Reviews meant to capture positive and negative experiences (Grant, 2013). It has been conclusively shown that other databases facilitate the meeting of experts including Yellow Pages of Engagements and BP Amoco's Connect – a voluntary intranet Yellow Pages directory that makes it easier to find expert help containing details of more than 12,000 employees (Derr, 1999; Grant, 2013; Neri, 2010). Evidence shows that ExxonMobil has been working towards a single database for safety which will hold the records for all incidents and near misses worldwide. They are also developing another database that collects and aggregates environmental performance indicators for corporate wide reports (ExxonMobil 2013). Often firms provide support personnel or reference librarians who act as knowledge brokers and assist users in searching these databases.

4.4.2 Software tools

An important aspect of databases is the ability to link them and make them widely accessible. All the participants acknowledged that software tools associated with databases help users navigate, find and apply useful information relatively quickly and at a low cost. For instance, organisation K uses several databases linked by Oracle's web-based ConText search engine to develop an integrated document management system. It consolidates organisation K's operational and legacy databases in a data warehouse. Organisation B has In Touch—a real time tool that helps capturing, managing, and sharing operations-related knowledge with the intent of faster and more reliable services for customers, accelerated product development, and significant financial benefits. Using the Web-based system, field staff can access validated data, information, and knowledge twenty-four hours a day, seven days a week. In addition to rapid problem-solving, this level of technical collaboration provides technology centres with a better understanding of customer needs, leading to more rapid development and deployment of products and services.

4.4.3 Portals

All the participants stated that another important aspect of IT-enabled KM is the ability to provide users a personalised, single point of access for the applications and content they need. For this purpose, internet portals are especially useful. A portal is a single gateway through which employees, customers, or partners can retrieve and share knowledge. As it was suggested by Participant F, portals can help reduce the inconvenience and inefficiency caused by using multiple applications by integrating a wide range of application programs so that information can be exchanged and shared irrespective of a type of application. For instance organisation H's Plumtree portal is a good example. It serves as the doorway to the network. The first three pages of the portal display links, calendars, a place where users can upload and share documents, and tips for finding specific information. Further into it, each separate network has its own page that is more specific. On the Reservoir Surveillance network, users will find information about that area, key contacts and items of particular interest to that network.

4.4.4 Groupware

A number of participants from Nigeria and the UK agreed that, collaboration software and groupware make it possible for groups and teams to interactively share knowledge. Groupware helps create a shared space where users can exchange knowledge and

manage common tasks and resources (Smolnik and Erodmann 2003). Various types of groupware have helped the creation of virtual communities to enable the management of knowledge. David *et al.* (1999) found that during the early 1990s, Lotus Notes and similar groupware revolutionised communication and collaboration among many of the majors by providing email, mailing lists, and document sharing. Subsequent developments in groupware provide more sophisticated support for virtual communities. For instance, TechLink is a Conoco tool that links all 6,000 engineers and scientists worldwide (Grant, 2013). It originated in drilling and productions, but was effective enough to be used in other areas, and is now used company-wide. ConocoPhillips has continued to develop this tool to hook up employees with each other.

As shown in this chapter, off-the shelf collaboration tools have been very useful in enhancing the use of virtual project teams even in organisations that do not emphasise it in their knowledge management approaches. Initiated in 1995 as a visionary experiment, the Virtual Teamwork program at BP brought together desktop video conferencing and collaboration technologies with behaviour change coaching (Grant, 2013). Almost 1,000 BP staff and over thirty of its key partners and suppliers regularly used this capability to transfer knowledge face-to-face. **Table 4.2** shows the principal phases of KM and the IT tools relevant to each.

Table 4.2: Principal phases of knowledge management and information technology tools

Phase of knowledge management	Information technologies and tools	
Capture and Store	Electronic Document Management System (EDMS) Database Management System (DBMS)	**Internet and Intranet**
Search and Retrieve	Information Retrieval	
Send critical information to individuals or groups	Push/agent, e-mail	
Structure and Navigate	Classification, World Wide Web/HTML	
Share and Collaborate	Workflow, Groupware, e-learning, Virtual Communities	
Synthesize	Data mining, Business Intelligence	
Profile and Personalize	Agents, Portal	
Solve or Recommend	Case-based reasoning, Rule-based Systems	

Source: (Grant 2013)

Carrillo (2004) demonstrated that while the initial impetus for KM was advances in IT, during the past five years the major driver behind KM has been the desire to leverage employee-based tacit knowledge. For instance, Shell and BP, facilitating knowledge exchange between people has provided the central thrust of their KM programs. Participant H highlighted that:

> *"When you start talking about knowledge, it's really about people. According to participant H the challenge for the companies has been to go beyond occasional bilateral knowledge exchanges, to form interactive groups that share knowledge in a rich, continuous and dynamic manner."*

Leavitt (2000) showed that since 1998, all the oil and gas organisations have established informal or semi-formal groupings of employees that share common technical or professional interests for the explicit purpose of sharing knowledge. These knowledge-sharing groups go under a range of different names. For example, community types within ExxonMobil include: Communities of Practice, Best Practice Communities, and Communities of Interest (ExxonMobil, 2013).

4.4.5 Communities of practice

According to Wenger *et al.* (2002), of all the tools of KM used in the oil and gas sector, the most widely and enthusiastically adopted have been communities of practice. These have been described in different ways in the industry (Wenger *et al.,* 2002):

- Participant M defined communities of practice as *"Groups of people geographically separated who share information, insight and advice about a common interest or practice"*;

- Participant P suggested that communities of practice, also referred to as networks, were defined as: *"Informal networks of people with common job functions who meet to share knowledge, leverage experiences, and improve individual and collective capacity to contribute to the success of the business"*; and

- Participant L defined them as *"A group of people who share a common area of expertise and need similar solutions to common problems"*.

Participant O described communities of practice as:

> "*Groups of people who come together to share and learn from one another face-to-face and virtually. They are held together by a common interest in a body of knowledge and are driven by the desire to share problems, experiences, insights, templates, tools, and best practices"*.

Participant O highlights that despite some differences in definition and nomenclature, the approach of the different companies to setting up and operating communities of practice were very similar. As observed, the starting point for most organisations was Exploration and Production where all the organisations established communication and consultation networks among engineers and technical personnel for the purpose of sharing know-how and expertise. However, the success of communities of practice resulted in their tendency to extend company-wide reaching both downstream businesses and corporate support functions—health and safety, energy efficiency, process engineering, web application development, retailing to mention a few.

Communities of practice are seen as the most effective mechanism to facilitate knowledge transfer (Carrillo, 2004). They are an integral part of a learning environment, and a catalyst for the deployment of innovative ideas. Through their participation in communities, members seek others who are doing similar things or face similar problems, and who can quickly answer their questions, recommend products and procedures, or become mentors. Community involvement not only allows participants to make a contribution, but it allows them to strengthen and fine-tune their own skills, creating even greater potential value for the organisation. The main differences between the organisations in their use of communities of practice relates to the degree of formalisation, the processes through which they are formed, and the extent of company support given to them (Carrillo, 2004).

For instance, organisation B's approach to knowledge management was centred upon its communities of practice. Organisation B had a KM director and four assistants responsible for guiding development of new communities and staying involved with them

after deployment through quarterly meetings. Each Community of Practice featured at least one full time Knowledge Broker who was responsible for monitoring and moderating a community portal, facilitating the personal networking by making sure the right people talk to each other. They watch every thread, make sure a Subject Matter Expert is found for every question, and double check solutions posted by community members. The Knowledge Brokers also keep in touch with each other. There are roughly 350 Community of Practice members to each Knowledge Broker. The Knowledge Broker usually reports to a global operations manager. In addition organisation B had Knowledge Champions, who are individuals appointed by VPs. In addition to their regular full-time (non- KM) responsibilities, they act as touch points for the Knowledge Brokers functioning as the liaison / support for the community.

At organisation J, over 100 communities of practice existed in 2004 linking professionals across refining, retail, drilling, energy management and information technology businesses, among others. Each network had a charter, an implementation plan, designated leaders and core members. CoPs crossed business units and tended to be glob al in scope. There were four major network groups: Reservoir Management, Drilling and Completion, Facilities and Operation; each comprised a number of smaller networks with more specific expertise. For instance, there were eight separate networks in the Facilities and Operation group.

At organisation D, communities of practice began as spontaneous associations, but tended to become increasingly formalised over time. In order to achieve greater coherence and effectiveness, mergers between communities were encouraged. The end result was just three Global Networks: Surface, Sub-surface, and Wells. By 2008, organisation D had fourteen Global Networks covering the following areas: benchmarking, competitive intelligence, commercial, eBusiness, human resources, health, safety, and environment, IT, knowledge sharing, opportunity evaluation consistency, Procurement, Subsurface, Surface, Special Interest Areas and Wells. In addition to its global networks, Organisation D also had a number of local networks. In exploration and production, these include: 4D networks, completions network, drilling network, geophysics network, petro-physics network, reservoir engineering network and several others.

Organisation G's seventeen communities of practice covered the main technical areas of exploration and production. Although participation in the communities was voluntary, organisation G's communities had become central to its operating strategy and were heavily supported with corporate IT resources. The communities of practice were integrated into organisation B's systems for the technical assistance, project documentation, and best practice transfer. Organisation E made communities of practices a core component of its attempt to build a knowledge sharing culture. Starting from simple groupware in 2000, organisation E introduced some 300 CoPs which in turn fed a knowledge database and "knowledge marketplace" where project teams could buy and sell their knowledge using virtual points. This practice made it possible for project teams to identify who needs what type of knowledge as well as the owners of current knowledge. It is worth highlighting that organisation E may be characterised as following a "personalisation strategy", which focuses on people-to-people communication, as opposed to the "codification strategy", which relies on IT to automate knowledge sharing processes (Hansen *et al.,* 1999).

4.4.6 Best practices groups

Several of the participants interviewed from Nigeria and the UK had groups or project teams working on the recording and sharing of best practices:

- Organisation A has application teams that travel to different sites identifying, collecting, and disseminating information on best practices. These project teams work with local teams to implement Best Practices, taking into account the contextual differences of each situation;

- Organisation L has established knowledge communities of employees with common interests. For example, a group of project engineers from six refineries in Aberdeen (UK) shared information on best practices via the company intranet and periodic face-to-face meetings. Participants found it difficult to adopt practices and suggestions from co-workers with whom they did not have a personal connection. But working within a small, targeted group helped them create a pool of knowledge that they do not hesitate to dip into and use. Beginning with Aberdeen refineries, Organisation L launched its "PEARL" (Practice Excellence through Accelerated Replication) methodology during 2000.

As mentioned by participants G and H, this approach was adopted from Ford Motor Company, which introduced the system in the mid-1990s. As observed during the fieldwork, it involves using communities of practice to identify successful practices (i.e. an activity that is successful at a particular location), to examine its relevance to other locations, and to document it and communicate it to other community members.

- At organisation B, the identification and validation of best practices is one of the central roles of the communities of practice. Each community member was encouraged to identify good practices that they then submit to the community as best practice proposals. Once the community validates the practice, it is stored in the Knowledge Hub. The "Knowledge Champion" within each community has the role of encouraging the submission of best practice proposals, validating the proposals, and integrating the new practice into the community's knowledge repository.

There was a consensus among both set of participants that the opportunities for communication and collaboration made available by information technology and the new thinking about horizontal coordination ushered in by KM led to significant stages in operating practices among several of the organisations. For instance at organisation H, in particular, KM was concerned less with establishing a parallel structure for managing knowledge sharing than with making existing working project teams operate more effectively. During the fieldwork, the researcher noted that organisation H's virtual project teams began in drilling where it was noted that isolated drilling teams making critical decisions with very little time for analysis or consultation would benefit substantially from closer contact with colleagues in other locations. Through groupware and video links, organisation H established real time communication between drilling teams in different locations, with suppliers and contractors, and with business unit mangers.

4.4.7 Peer review groups

All twenty participants acknowledged that, one of the most powerful KM tools for oil and gas organisations has been the "lessons learned" methodology pioneered by the US Army (Slabodkin, 2006). For instance, in one of the group discussion with senior managers, the researcher noted that organisation G introduced group sessions in which

staff from recently completed projects meet and record lessons learned from their experiences with the project. The sessions were facilitated by a project director and the discussion was captured in project reports then made available to other teams. Similar groups were formed around activities such as due meticulousness, operational effectiveness and specific functional organisational areas.

4.4.8 KM and human resource training

A number of the organisations linked training and career management to their KM systems. For instance, in IT intensive organisations in the UK, the web-based systems supporting knowledge capture and knowledge transfer were used to support on-line training that was designed for focus, flexibility, and accessibility. Participant R stated that web-based training was organised around series of tutorials. According to participant R, such training was especially important for new hires as a means of getting new organisational members familiar with systems and procedures. A number of participants from Nigeria, found training for experienced engineers to be a greater challenge. Participants from Nigeria highlighted that virtual project teamwork initiative requires substantial investments of training and coaching for older and more senior personnel. Organisation E's much admired training curriculum was found to be oriented not only towards technology training but also towards developing a culture of sharing knowledge through seminars, employee rotation and other activities.

In this chapter, it has been conclusively shown that knowledge management objectives are inevitably intertwined with regular functions of the human resource divisions of the petroleum firms. At organisation C, knowledge management considerations played a role in the selection of young talent. As claimed by participant R, further, career tracking by human resource departments accomplished two knowledge management objectives:

- It helped maintain a record of the tasks, roles, and experience on specific projects, so that when issues or problems arise in the future, individuals with relevant and pertinent experience can be consulted; and

- Career tracking also helped to increase job satisfaction and professional development opportunities, which reduces turnover and keeps intellectual capital within the organisation.

A major problem for organisations in Nigeria was knowledge loss resulting from employees retiring or leaving the company to join other companies. For instance in organisation C a number of the participants were well aware of the impact of the aging of the employee population and the turnover and institutional knowledge loss associated with retirement. There was a consensus among the twenty participants, that managing the risks of “brain drain” was a key element in in the oil and gas sector.

Alam *et al.* (2010) highlights the need to recruit and train the right people. Employee careers must be managed so that individuals choose to stay with the company and the benefit of their knowledge is not lost to a competitor. Participant D suggested that there are well-defined career requirements and competency milestones to guide employees along their career paths. Efforts are made to develop a career path that takes full advantage of an individual’s capabilities, which improves job satisfaction. As claimed by participant D, younger employees and those entering senior management positions are mentored by more seasoned individuals, who pass on their expertise and therefore preserve their tacit knowledge. It is imperative to have a formal succession plan to ensure that all skill positions are covered. Thus organisations should attempt to take specific actions to deal with the ‘people’ dimension of knowledge management.

All the twenty participants acknowledged that the problem of knowledge loss through human resource attrition was a source of concern for the global industry as a whole. As a result, a number of inter-organisational and industry-wide knowledge-sharing networks have been established (Sanchez and Palacios, 2008; Marouf, 2007; Rangachari, 2009). These include a global benchmarking group, an independent group is made up of representatives from the largest oil companies which establishes a common set of definitions and standards as regards technology and processes in the oil and gas industry and collects information and performs studies on different practice areas, primarily in upstream activities. Also, industry and trade associations permit networking and the exchange of information between other sectors.

4.5 CHAPTER SUMMARY

This chapter has described participants’ accounts of knowledge management in the oil and gas sector. The results of the interviews indicated that the increasing business regulatory needs, globalisation and competition continue to increase. Participants in the UK showed that a number of oil and gas organizations will find that they must go beyond their own historical experience, knowledge creation and application. The results of the

interviews indicated that the extent of knowledge sharing is complex in oil and gas projects and is influenced by leadership style, innovation and team integration. Though opinions towards knowledge sharing appeared to be similar between the two countries, project leaders in UK appeared to be well equipped.

Participants in the UK showed that oil and gas organisations need to make clear goals for knowledge management implementation and measure progress along the way. The discussion in this chapter shows that good knowledge management strategy is based on: simplicity, efficiency and standardisation. This chapter provides a new perspective on the interpretation of knowledge value creation in the oil and gas sector. As shown in this chapter, the challenge of project leaders implementing knowledge management tools is to be conscious of their project environments and to build effective structures and procedures that promote knowledge sharing. In the next chapter, quantitative results are presented in relation to knowledge management.

CHAPTER FIVE: QUANTITATIVE FINDINGS

5.1 INTRODUCTION

This chapter will present quantitative findings obtained from the participants relating to the concept of knowledge management. In order to explore knowledge management based systems among the survey participants it was necessary to access the following factors: the participants' places of work, job titles, project roles and project management experiences. As a consequence of the breadth and depth of the questionnaire survey (see Appendix B), two different broad categories emerged from the findings. This chapter discusses the different categories and commences with a presentation of the profiles of the participants followed by a discussion of the two categories. They included knowledge management technology approaches and knowledge management people approaches.

5.2 Survey participants place of work

To achieve a diversity and variety of project environments, thirty-one organisations were selected from a number of business sectors. The business classification used by the European Construction Institute (ECI) at Loughborough University and the Federal Ministry of Petroleum Resources in Nigeria were applied to ensure representation from oil and gas organisations. The organisations that were surveyed were mainly involved with oil and gas projects in Nigeria and the UK. The main purpose of the sample was to appraise knowledge management based systems, which contribute to improved performance, innovation and continuous improvement in oil and gas projects. The actual figures and gender spilt are as illustrated in Table 5.1.

From the analysis, it was noted that within Nigeria and the UK there was a high proportion of men in managerial positions. This was expected since most women who embark on careers within the sector are in engaged in supporting project roles. As noted in the literature reviewed, the industry's market is segregated both horizontally and vertically by sex (BP, 2013). From Table 5.1, the statistic highlights oil and gas as the most male dominated. Whilst many would argue this is an important point, it has received little attention in practice. A key feature about the sector was that some organisations in Nigeria and the UK had a certain level of knowledge management strategies. Using this criterion, the researcher identified a number of large and medium

sized organisations in Nigeria and the UK, selecting the companies and the research participants based on the size of their international operations and record of utilising knowledge management tools. It is worth noting that, in recent years, career prospects for women in the oil and gas sector have improved and increasing number of women are taking advantage of those opportunities.

As observed from the reviewed literature, the oil and gas sector offers opportunities not provided by other heavy engineering sectors (BP 2013; Mckenna and Wilczynski, 2006). While the sector acknowledges it still has work to do in terms of a gender balanced pool of talent, the results of this study indicate that sector initiatives and programs to engage women about opportunities oil and gas are making a slight impact. According to BP (2013), the barriers and challenges women frequently face in the oil and gas sector include:

- Discrimination;
- Societal conditioning;
- Lack of qualified personnel; and
- Family care responsibilities.

Recent evidence suggests (Scottish Enterprise, 2011), that implementing STEM (science, technology, engineering and math) programs in schools, offering flexible working arrangements and implementing organisation policies to encourage an improved gender balance could be used to address the above. The industry needs to find creative ways to attract women, not just primary and secondary level, but at an undergraduate and post graduate level. It must also continue to work to attract women working in other heavy engineering sectors. For instance, participants F and I were asked to give their views on gender balance.

Participant F stated that:

> "*The oil and gas sector is one of the promising industries, offering a vast variety of opportunities. If you are a woman seeking a fast-paced and challenging environment, the energy sector is the right step into a rewarding career. As a female, I need to be aware that women in the oil and gas sector occupy less senior roles and are more likely to experience career barriers in a male*

dominated work environment. Equal gender representation in the oil and gas sector is an important variable in determining career development for women."

Participant I suggested that:

"I find that women constantly have to prove themselves where male counterparts are taken to have already proved themselves with less experience and education. There is always an attempt to pay women less."

In order to attract more women into the oil and gas sector, the industry in Nigeria and the UK must focus on improving its image. Even though the oil and gas sector in Nigeria and the UK are working hard to attract more women into the sector, there is still a great deal of work to be done.

5.3 Participants job title and project role

There was a diverse pool of participants, including managers who were residents of highly developed areas and cities in Nigeria and the UK. Typically, participants had previously worked in international environments; therefore, the national culture of participants was the primary dissimilarity. As illustrated in Table 5.1, participants were split into five project titles. Again, a similar situation of male dominance was apparent in terms of project titles. Statistical evidence in this research indicates that the majority of male participants in Nigeria and the UK were senior project management practitioners, this is perhaps surprising since there were no female project engineers. It was found that the majority of female participants worked as project leaders. It could be suggested that women do not naturally choose oil and gas management as a career so making this difference in gendered choice acceptable within the oil and gas sector.

Some of the female participants in this research pointed out that the lack of success in attracting women is mostly rooted in its unpopular image. Women participants in Niger and the UK argued that the oil and gas sector is seen as a tough, heavy, and dirty sector. This unhealthy situation does not augur well for attempts to diversify the oil and gas profession to make it more reflective of the community it serves. As a result, if the working environment is not right for women, it is likely that others, such as disabled individuals and members of black and minority ethnic groups will also fail to thrive.

Table 5.1: Profile of survey participants' project title

Job title	Male	Female	Number
Project manager	23	1	7
Project leader	67	3	70
Chief project manager	11	2	13
Junior project manager	26		9
Project engineer	33		33
Total	**126**	**6**	**132**

Table 5.1 shows that a large proportion of participants, identified management as their main project work area. Those participants involved with management were evenly distributed among those working in petrochemical projects.

5.4 Oil and gas management experience

To establish the experience of participants, a question pertaining to the number of years involved in managing oil and gas projects was included. Participants' levels of experience in relation to the management of projects differed greatly. This has been illustrated in Table 5.2, which illustrates that the difference between males and females involved in managing oil and gas projects is less than ten years. This suggests that the concept of gender equality in heavy engineering project management is beginning to be readdressed. Perhaps in fifteen to twenty years' time the findings could be different.

Table 5.2: Profile of survey participants' time involved in managing projects

Time involved in managing projects	Male	Female	Number	Percentage
More than 20 years				
16-20 years	106		109	80.3
6-15 years	20	3	23	17.4
1-5 years		3		2.27
Less than a year				
Total	**126**	**6**	**132**	**100**

The largest proportion of participants 80.3 percent had sixteen to twenty years' experience of managing projects. The remainder of the participants are fairly balanced between six to fifteen years of experience (17.4 per cent) and one to five years of experience (2.27 per cent). The most striking feature was the low proportion of female participants involved in managing oil and gas projects in Nigeria and the UK. In Nigeria,

only two female participants completed and returned the postal questionnaire, the remaining four were from organisations based in the UK.

This again highlights the fact that a high level of heavy engineering project work is carried out by males. It is clear from the above that, despite some proposals for change in the oil and gas sector, the climate for practicing oil and gas project management is not providing adequate scope for women to thrive. This unhealthy situation does not prefigure well for attempts to diversify the profession to make it reflect the composition of the populations of Nigeria and the UK. From the findings, a key distinction that emerged between the two groups showed that UK participants had more international work experience, with the majority having more than fifteen years of oil and gas project management.

5.5 Senior managers' response to questionnaire findings

This section presents a summary of the questionnaire, which was used to measure the attitude and experience of senior managers in Nigeria and the UK towards various workplace issues. As previously mentioned, five sub-categories emerged which have been presented in Table 5.3 and 5.4. The aim of the questionnaire was to assess the participants' views on knowledge management strategies and practices within their organisations. A copy of the questionnaire is included in the appendices (see Appendix B).

Table 5.3: Summary responses of knowledge management technology approaches

Level of importance	VI	I	FI	SI	NI	Mean N=132	Median
Knowledge management technology approaches (KMTA)							
THEME 1: KMTA							
Collaborative technologies	79 (59.3%)	48 (36.1%)	6 (5%)	0	0	1.45	48
Instant messenger	86 (65%)	43 (32.2%)	4 (3%)	0	0	1.38	43
Intranets	41 (31%)	89 (67%)	3 (2.3%)	0	0	1.71	41
Records and information management	36 (27.1)	76 (57.1%)	13 (10%)	8 (6%)	0	0.95	24.5
Search	8 (6%)	29 (22%)	96 (72.1%)	0	0	2.66	29
Web 2.0-Blogs	22 (17%)	91 (68.4%)	13 (10%)	7 (5.3%)	0	2.03	12
THEME 2: KMTA							
Web 2.0-Folksonomies and tagging clouds	103 (77.4%)	24 (18%)	6 (5%)	0	0	1.27	24
Web 2.0-Social networking	99 (74.4%)	26 (20%)	8 (6%)	0	0	1.32	26
Web 2.0-Wikis	87 (65.4%)	41 (30%)	5 (4%)	0	0	1.38	41
Case based reasoning systems	91(68.4%)	39 (29.3%)	3 (2.3%)	0	0	1.34	39
Group discussion support system Artificial neural networks	44 (33.1%)	85 (64%)	3 (2.3%)	0	0	1.67	44
Semantic search engines and link machines	112 (84%)	14 (11%)	7 (5%)	0	0	1.21	14
Tags	85 (64%)	36 (27%)	12 (9%)	0	0	1.45	36
THEME 3: KMTA							
Communication and collaboration systems	93 (70%)	35 (26.3%)	5 (4%)	0	0	1.33	35
Document management system	124 (93.2%)	6 (5%)	3 (2.3%)	0	0	1.09	6
Content management system	42 (31.6%)	80 (60.2%)	11 (8.3%)	0	0	2	42
Knowledge mapping tools	106 (80%)	22 (17%)	5 (4%)	0	0	1.24	22
UK=66, Nigeria=66 **Total**=132							
Measuring instrument: Very important **(VI)**, Slightly important **(SI),** Not important **(NI)**, Important **(I)**, Fairly important **(FI)**							

5.6 KNOWLEDGE MANAGEMENT TECHNOLOGY APPROACHES (KMTA)

5.6.1 Theme 1: KMTA

Within the context of this study, the purpose of this category was used to create and share knowledge. The findings indicate that, the factor regarded as most important is 'instant messenger', with a percentage score of 65. This is closely followed by 'collaborative technologies', 'intranets', 'records and information management', 'web 2.0 blogs' and 'search', with percentage scores of 59.3, 27.1 and 6 respectively. Overall, participants considered this group of factors as very important. It emerged that in some organisations the importance of knowledge management technology approaches in theme one varied between different levels of organisations and phases of projects. The variation in levels of importance expressed by different participants who at times were involved within the same project was very striking, this suggests that knowledge

management strategies should be flexible and a mechanism put in place to monitor continuously the process. In addition, researchers and project experts could face challenges devising a prescriptive method. They need to be more knowledgeable of the projects and individuals involved. Similarly, senior project management practitioners should re-examine knowledge management based systems jointly with the team.

From the results, the participants emphasised the timely provision of knowledge management tools. It is important in a project based oil organisation that there are sufficient suitable knowledge management technologies, and experienced senior project management practitioners available to monitor team performance. In this category, it was found that the two groups differed in a number of ways, for instance a majority of participants in the UK felt that 'collaborative technologies' was the most important variable whilst a high proportion of participants in Nigeria agreed that 'intranets' was the more important factor when updating project records. Interestingly, female participants considered 'web 2.0-blogs' as the most important. This is not surprising given the fact that most oil and gas projects have different specifications, scope, and schedules. However, it is essential to highlight that for a high performing project team greater clarity needs to be placed on both variables.

5.6.2 Theme 2: KMTA

In this survey, 84 per cent of participants agree that if oil and gas project teams are to be effective, they need to have semantic search engines and link machines (*see Table 5.5*). For a high performing oil and gas project team, 77.4 per cent of participants stated that web 2.0-folksonomies and tagging was very important. In this category, the significant finding was that there was no difference between participants in Nigeria and the UK when it comes to development of information technology. In terms of knowledge management technologies, participants from Nigeria and the UK rated highly, case-based reasoning systems, web 2.0 social networking, web 2.0-wikis, and tags. The results show that senior project leaders need to hold ad hoc review meetings with project teams. In order to fully implement knowledge management based systems, the project leader has to make sure that they do have a balanced project team which has within it most, if not, all the expertise necessary to deliver team goals.

The results of the study for this question clearly demonstrate that individuals in high performing integrated project teams usually have considerable freedom of action on

projects. It is the responsibility of the project leader to make sure that the alignment of objectives and members of a project team will be pulling in the same direction. The main purpose of developing a set of reciprocated goals is to harness the power of the whole team. There will always be problems in oil and gas projects. Ghani (2009) noted that the tools for knowledge management are focused on assimilation, comprehension, and learning of the information by individuals who will transform data and information into knowledge. It is worth mentioning that knowledge is strictly linked and connected to the individual (or group) who creates it, which may cast doubts on the availability of information systems tools to effectively support knowledge management.

5.6.3 Theme 3: KMTA

In this survey, participants in Nigeria and the UK both considered 'document management system' as very important. One hundred and twenty-four (93.2 per cent) out of one hundred and thirty-two participants agreed that a centralised knowledge management system helps oil and gas organisations accelerate their efforts to backfill their technical capability gaps, recognise and anticipate problems, and avoid reinventing the wheel across multiple projects. As illustrated in Table 5.3, 'document management system' is the most important variable. As argued in the qualitative findings, it is essential for project leaders to create a common understanding between project team members. Interestingly, 70 per cent of participants considered 'communication and collaboration systems' and 'knowledge mapping tools' as quite important.

Thomas and Thomas (2005) argued that a structured team selection process should be based on a clear value criteria and a robust scoring method for qualitative and quantitative criteria, as the foundation of selecting an effective integrated project team, fully aligned and focused on delivering best value on projects. In this category, the survey results suggest that knowledge management should be holistic, it should include the establishment of institutional mechanisms to capture and disseminate information relevant to project teams.

These findings reveal that the knowledge chain consists of seven links:

- Listing the existing knowledge;
- Determining the required knowledge;
- Developing new knowledge;
- Allocating new and existing knowledge;

- Applying knowledge;
- Maintaining knowledge; and
- Disposing of knowledge.

Nonaka and Ryoko's (2003) study showed that it is essential to ensure that positive inducements are in place, which will encourage disposing of knowledge within a project environment. Nonanka and Ryoko maintain that knowledge management is something that must be created and shared. According to Ghani (2009), knowledge management is essentially about tacit knowledge (TK). It is aimed at making TK explicit and then sharing that for reuse across an organisation. As noted from the reviewed literature, the following can be expressed as knowledge management lifecycle (Ghani, 2009):

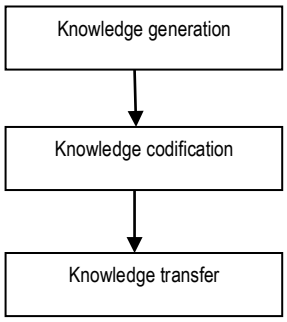


Figure 5.1: Knowledge management lifecycle

Source: Ghani 2009

All these phases come under the umbrella of knowledge management. It is worth mentioning that knowledge management initiatives are often expressions of part of this process. A number of oil and gas organisations are concerned with the first phase: knowledge creation, innovation or organisational learning. Others are concerned with capturing tacit knowledge for codification. This means recording videos or feeding data into a database. As shown in this study, knowledge transfer is sharing knowledge. This means a database of information with access methods (Ghani, 2009).

5.7 KNOWLEDGE MANAGEMENT PEOPLE APPROACHES (KPMA)

5.7.1 Theme 1: KPMA

Aligning knowledge management people approaches with a project environment is the ongoing process of agreement on a set of common objectives. The process for aligning knowledge management people approaches must be done thoroughly because in oil and gas projects, project team members come from different departments and cultures.

In this category, there were two main categories as shown in Table 5.4. In this dimension, the two criteria with the highest levels of agreement as to their importance were ‘gone well/not gone well exercise’ and ‘knowledge audit’, with 95.5 per cent and 95 per cent of participants, respectively, stating that these criteria were very important.

Seventy-one per cent of the participants stated that to be effective, communities of practice should be formed by senior project leaders who engage in a process of collective project delivery in a shared domain. As shown in this study (Mckenna and Wilczynski, 2006; Scottish Enterprise,2 2011), the concept has been adopted by oil and gas organisations because of the recognition that knowledge is an essential asset that needs to be managed strategically. For high performing oil and gas project teams, the project director and project manager need to provide detailed project specification to the team. As illustrated in this dimension, 67 per cent of the participants agreed that project leaders should embed some sort of organisational human resource when managing projects.

In this category, it emerged that for a high performing project team greater clarity is needed. For high performance teams the project manager needs to set high specific goals for the team. Setting collective or individual goals within a project team is not enough for project performance excellence, although it is essential to set knowledge management strategies and project work plans. To certify the whole integrated team is pulling in the same direction and to make sure the team is equally supporting each other, it is vital for the project manager to ensure that the seven variables are aligned. This can be best achieved through regular project team meetings. The results of this dimension clearly demonstrate that there should be an understanding within the project team that, not only does each individual project team have a responsibility to complete their own goals but there is also an obligation that team members jointly support each other where appropriate.

5.7.2 Theme 2: KMPA

The five main criteria that emerged are as represented in Table 5.4. In terms of percentage scores, the factor regarded as important is ‘leading practice identifying and sharing’ 95.5 per cent as shown in Table 5.4. This is closely followed by ‘knowledge centre’ and ‘knowledge market place’, with mean scores of 1.04, 1.09 and 1.11. The project manager has to set a tone for the project, which will be conducive to the

achievement of knowledge management objectives. Enabling oil and organisations to capture, share and apply collective experience and expertise of their project teams, is seen as fundamental in the sector. According to Smith and Farquhar (KM, 2000), to make progress in this area, issues of technology, process, people and content must be fully addressed.

It is worth noting that, in the oil and gas sector, knowledge management happens in the background - in real time. It is done by every project team member as part of their day-to-day job, embedded in the knowledge management lifecycle. In order for the process to be successful, senior managers, need to ensure that people are easily able to obtain data and knowledge they need to deliver their project tasks. In addition, senior project leaders also need to ensure that the team interacts well within the project life cycle. In order to achieve the above, the project director and project manager need to establish a common team culture from the outset and ensure that all team members are aware of their roles and responsibility in achieving the shared goals. A summary of the results is presented in Table 5.4.

Table 5.4: Summary responses of knowledge management people approaches

Level of importance	VI	I	FI	SI	NI	Mean N=132	Median
Knowledge management people approaches							
THEME 1: KPMA							
After action review	6 (5%)	13 (10%)	114 (86%)	0	0	2.81	13
Community of practice	94 (71%)	32 (24.1%)	7 (5.3%)	0	0	1.34	32
Embed in organisational HR	89 (67%)	33 (26%)	11 (8.3%)	0	0	1.41	33
Gone well/not gone well exercise	127 (95.5%)	6 (5%)	0	0	0	1.04	3
Knowledge audit	126 (95%)	4 (3%)	3 (2.3%)	0	0	1.2	4
Knowledge bank	33 (25%)	13 (10%)	87 (65.4%)	0	0	2.5	33
Knowledge café	18 (14%)	74 (56%)	41 (31%)	0	0	2.17	41
THEME 2: KMPA							
Knowledge centre	125 (93%)	13 (10%)	87 (65.4%)	33 (25%)	0	1.09	33
Knowledge market place	123 (92.5%)	6 (5%)	4 (3%)	0	0	1.11	6
Leading practice-identifying and sharing	127 (95.5%)	6 (5%)	0	0	0	1.04	3
Narrative project case study	44 (33.1%)	44 (33.1%)	6 (5%)	0	0	1.71	44
Peer assist	88 (66.2%)	31 (23.3%)	14 (11%)	0	0	1.29	31
UK=66, Nigeria=66 **Total**=132							
Measuring instrument: Very important **(VI)**, Slightly important **(SI)**, Not important **(NI)**, Important (I), Fairly important **(FI)**							

5.8 Exploring differences between scores on variables

Measures of association are usually utilised to determine and describe the nature of any relationship between different variables. In this study, the measuring of variable association was found to be essential in that it was used to explain and illustrate the potential relationship between the variables. The display of relationships between the variables added rigour to this study. Obviously, the above depended on the aim and objectives of this study. The two main issues linked with the measuring association are the extent and direction of the association and cause-effect inferences. There are a number of statistical tests used to determine whether a difference between two groups or variables is significant. In deciding the most suitable statistical test to analyse data, it is vital to bear the following considerations in mind: if the data are categorical or non-categorical.

In this study, t-test was found to be the most appropriate since the study dealt with more than two sets of means. From the qualitative findings, it was revealed that there was no consensus on the influence of some of the variables affecting project performance. Therefore, it was decided to establish the degree to which participants in Nigeria and the UK agreed to the rankings of variables affecting knowledge management implementation. For this purpose, the t-test was used to assess whether the means of the participants' findings from the UK and Nigeria were statistically different from each other. By matching the two means, it was found that the degree of error deriving from differences between the Nigerian and the UK participants was reduced. The analysis helped to show a significant relationship between the five category's mean scores.

5.8.1 T-test for two unrelated means

In this study, the t-test was used to determine if the means of the two samples differed. This was achieved by comparing the difference between the two means with the standard error of the difference in the means of each variable, which is calculated using the following expression:

$$t = \frac{\text{sample one mean} - \text{sample two mean}}{\text{Standard error of the difference in mean}}$$

The standard error of the difference in means, like the standard error of the mean is usually distributed. To compare the two means for each variable, the following

procedure was followed using SPSS for windows 12.0:-**Analyse**-**Compare Means**-**Independent-samples T Test** [opens independent-Samples T test]-**satis**-button-[puts satis under **Test Variables**-[e.g. achieving project team goals]-**Define Groups**-in box beside **Group 1**: Nigeria-box beside **Group 2**: UK-**Continue**-**OK**. If not using SPSS the following equation can be used:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{s_{\overline{X}_1 - \overline{X}_2}} \text{ where } s_{\overline{X}_1 - \overline{X}_2} = \sqrt{\frac{s_1^2 + s_2^2}{n}}$$

This equation is only used when the two sample sizes (that is, the *n* or number of participants of each group) are equal as in this study. Where *s* is the grand standard deviation (or pooled sample standard deviation), 1 = group one, 2 = group two. The denominator is the standard error of the difference between the two means. Alternatively, some researchers use the control group standard deviation for a more conservative estimate (Bryman and Cramer 2001). Table 5.5 presents the rankings of knowledge management factors provided by participants in Nigeria and the UK. These rankings were adjusted for tied ranks. The t-test values for each variable are 18.054, 18.054, and 17.830, respectively. In order to determine the level of importance for each variable, the mean and percentage score was used.

In terms of percentage scores the variable regarded as the most important is 'leading practice identifying and sharing' (percentage score 95.5) as illustrated in Table 5.8.1. This is closely followed by 'knowledge centre' and 'document management system', with percentage scores of 95.5 and 95.5 respectively. Content management, knowledge mapping tools, records and information management, communication and collaboration systems, knowledge audit, gone well/not gone well exercise, narrative project case study and knowledge market place have the eight highest percentage scores. Despite this difference, the results show a significant agreement between the variables by both participants from Nigeria and the UK.

Participants in Nigeria and the UK agreed that some variables were important as shown in Table 5.5. The frequency distributions for the other twenty-three variables show little evidence of agreement that they are important measurements of knowledge sharing and project performance success. The exception is 'communication and collaboration systems', 'knowledge audit', 'gone well/not gone well' and 'narrative project case study',

with participants believing their very important criterion of knowledge management and project performance success. The mean scores of each variable confirm these results. This was achieved by comparing the two mean scores of each variable from the two samples. The middle criterion of ‘collaborative technologies’ has a mean score of 1.29, which, indicates a balance opinion of moderate importance and the least possible criterion of ‘search’ has a mean score of 2.81, which indicates a conclusive opinion of ‘low importance’. The results show there is significant difference in the ranking of knowledge management strategies between participants in Nigeria and the UK.

Table 5.5: Mean and percentage scores perceived by participants and the results of unrelated t-test

	Variables	Mean N=132	Std. Deviation	Std. Error Mean	Mean Difference	T Test Value	Median	Importance %
1	Leading practice-identifying and sharing	1.04	0.45831	0.08511	1.53655	18.054	3	95.5
2	Knowledge centre	1.04	0.45831	0.08511	1.53655	18.054	3	95.5
3	Document management system	1.04	0.45831	0.08511	1.53655	18.054	3	95.5
4	Content management system	1.2	0.45648	0.08627	1.55429	18.017	4	95
5	Knowledge mapping tools	1.09	0.04601	0.08695	1.55036	17.830	6	93.2
6	Records and information management	1.11	0.45898	0.08833	1.56815	17.753	6	92.5
7	Communication and collaboration systems	1.21	0.38309	0.0782	1.52042	19.442	12	84
8	Knowledge audit	1.24	0.38473	0.08022	1.53522	19.137	22	80
9	Gone well/not gone well exercise	1.27	0.38715	0.08254	1.55	18.779	24	77.4
10	Narrative project case study	1.32	0.37279	0.08336	1.5965	19.152	26	74.4
11	Knowledge market place	1.34	0.28678	0.06955	1.56941	22.564	32	71
12	Community of practice	1.33	0.27079	0.0751	1.56615	20.853	35	70
13	Embed in organisational HR	1.34	0.2818	0.08496	1.59909	18.821	39	68.4
14	Intranets	1.41	0.28641	0.0716	1.58813	22.18	33	67
15	Collaborative technologies	1.29	0.28834	0.06796	1.55111	22.823	31	66.2
16	Issue resolution	1.38	0.27867	0.08812	1.629	18.486	41	65.4
17	Group discussion support system Artificial neural networks	1.38	0.1468	0.05993	1.505	25.112	43	65
18	Semantic search engines and link machines	1.45	0.2648	0.07644	1.59583	20.877	36	64
19	Peer assist	1.44	0.00577	0.00333	1.44333	26.769	45	61
20	Knowledge bank	1.45	0.00577	0.00333	1.44667	26.873	48	59.3
21	Knowledge café	1.67	1.13161	0.05886	1.588	26.981	44	33.1
22	Case based reasoning systems	2	0.25967	0.9815	1.66429	16.957	42	31.6
23	Web 2.0-Wikis	1.71	0.15305	0.07653	1.5775	20.614	44	31
24	Web 2.0-Social networking t	1.71	0.26082	0.08694	1.69333	19.477	41	31
25	Web 2.0-Folksonomies and tagging clouds	0.95	0.40931	0.08932	1.5481	17.332	24.5	27.1
26	Web 2.0-Blogs	1.41	0.28641	0.0716	1.58813	22.18	33	25
27	After action review	2.03	0.45597	0.08942	1.62115	18.129	14	17
28	Tags	2.17	0.32652	0.11544	1.74875	15.148	41	14
29	Instant messenger	2.66	0.43976	0.10089	1.68158	16.668	29	6
30	Search	2.81	0.51118	0.10224	1.636	16.002	13	5

5.9 CHAPTER SUMMARY

The findings presented in this chapter show a multiplicity of participants surveyed in terms of participants place of work, participants job title, project role and project management experience. Findings of the project management experience shows most

of the participants had been employed for more than five years in the sector. Although introducing some bias to the survey, this high level of experience ensured that precise and representative data was obtained from participants regarding their organisations and projects managed. The results of the survey show that the participants had been sampled across all possible functional project work areas. Likewise, the results in this chapter showed that participants surveyed carried out a variety of project roles. As established in this chapter, the sample selected ensured a participant had either direct or indirect involvement in oil and gas project management. This is reflected in the levels of project management experience reported.

The findings presented in this chapter allow a number of broad conclusions to be drawn in respect of the research questions posed in Chapter One. These conclusions will be useful when discussing the aim and objectives in the discussion chapter. The outcomes from the statistical tests suggest that a number of factors have a significant influence on knowledge management strategies. In terms of the relative importance attached to individual knowledge variables, the findings show that a participant involvement in projects is only significant in influencing perspectives of a small number of success criteria. Specifically, senior project management practitioners involved with implementing knowledge management tools in oil and gas projects highly rated leading practice identifying and sharing with knowledge centre as the most important. In terms of achieving knowledge sharing, participants suggested for a high performing team, communication and collaboration systems need to be provided to the project team in order for the project work to be carried out and for the team to be effective; in addition, participants noted that knowledge mapping tools are very important.

The statistical t-test results further show that project leaders in Nigeria and the UK agreed that successful project performance can be achieved by creating a knowledge centre within the organisation. This suggests that there are no differences between the two samples. In achieving knowledge management goals within a project team, participants highlighted that greater supervision and commitment from senior managers is essential. This suggests that there are no differences, perhaps in terms of team performance and knowledge goal achievement. It is worth mentioning that, all the key variables identified have an impact on each other. The next chapter presents discussion and results of the research.

CHAPTER SIX: DISCUSSION OF RESULTS

6.1 INTRODUCTION

This thesis has explored the attitudes and experiences of knowledge management based systems amongst project leaders in Nigeria and the UK. The study has illustrated the ways in which knowledge management practices could be implemented and enhanced. The literature search conducted at the outset of the study, established that though there is currently ample of research on knowledge management, not a lot focus on the Niger Delta region. In the first section of this chapter, the qualitative findings of the study are discussed. In the second section, quantitative findings are outlined. The chapter also provides an overview of the implications for theory and practice. The chapter concludes with limitations of the study and provides a way forward for the oil and gas industry.

6.2 OBJECTIVE 1: REVIEW CURRENT PROJECT MANAGEMENT PRACTICE IN NIGERIA AND THE UK

Knowledge management remains an unexplored area in relation to attitudes and experiences of senior project management practitioners managing oil and gas projects in Nigeria. Findings from this study indicate that the oil and gas sector is plagued by severe problems that permeate most aspects of the industry. Participants from Nigeria suggested that they faced challenges when it comes to implementing knowledge management based systems. In addition, the participants highlighted that they had difficulties in implementing modern knowledge management based systems. It was found that in Nigeria senior project management practitioners and indeed managers in general, work in a different context and face different problems from those in the UK. This has led this research to question the applicability of knowledge management tools in Nigeria of the whole range of knowledge management technologies developed in the industrialised world and even their general usefulness in their own context.

Fundamentally, these arguments were found to fall into two groups: one is that cultural factors play a role, which does not admit the practice of managerial skills; and that the environment makes it impossible for senior managers to operate effectively. The first aspect, calls for senior managers working in Nigeria to have skills and sensitivity to

understand the basic characteristics of the culture in which they are operating, most importantly they should be able to modify their project delivery approach. It must be recognised that the second aspect, which is the technology, requires adaptation of approaches derived from developed countries. Technologies are dynamic because they change and change very rapidly. Their unpredictability means that the logical casual relationships on which many industrialised management techniques are founded, cannot be relied on to operate the same way, thus negating the whole basis on which techniques to apply.

A good deal of debate now involves the issue of effective management in a development environment. On the one hand, one approach suggests that practices from the UK have proved themselves successful and effective in their own setting and that attempts should be made to adjust the setting of the oil and gas sector in Nigeria to suit, particularly by cutting down the unpredictability of technology. The significant differences between the UK and Nigeria, suggests this approach lends support to the idea that policy issues are the main ones that face the oil and sector in Nigeria, and that policy reforms will improve knowledge management practices. Findings emerging from this study show that more can be achieved if the Nigerian organisations and the government can eradicate negative practices within the oil and gas sector.

6.3 OBJECTIVE 2: DETERMINE THE IMPORTANCE OF KM BASED SYSTEMS IN DELIVERING SUCCESSFUL PROJECTS IN THE OIL AND GAS SECTOR OF NIGERIA

On the concept of importance of KM based systems in delivering successful projects in the oil and gas sector in Nigeria, an important feature was the identification of what were the participants' perceptions of knowledge management strategies. Participants tended to have tangible and concrete ideas on knowledge management based systems that aligned well with oil and gas projects. Participants suggested that oil and gas project management could be characterised by a two-fold approach: that projects are said to comprise universal characteristics that can be managed with a common approach; however, on the other hand, participants did argue that oil and gas projects are embedded in their technical context and that they need to be managed accordingly.

For instance, the majority of participants from Nigeria and the UK noted that when oil and gas companies have been faced with new technology, outsourcing, new partnerships, and government regulation, their KM teams have provided support through technology and knowledge transfer, as well as asset management. When business issues involved capacity management, cost reduction, and the environment, KM played a part through forecasting/scheduling and process and technique innovation. To improve speed and convenience, KM initiatives have expanded to address point-of-sale technology adoption and procedure effectiveness.

Participants further noted that KM has been proven to increase stock market valuation, assist in growth through acquisition, lead to better-developed products, and encourage intelligent leadership for tenacious early adopters. There was a strongly held belief that the key to knowledge management integration in oil and gas projects is making sure that an organisation or an individual has the ability to adapt, and work with different technologies. Some of the notable differences between participants in Nigeria and the UK were the application of knowledge management practices. Participants in the UK affirmed that a number of oil and gas organisations are fine-tuning their best practices transfer process using content management systems and communities of practice to further minimize downtime at field sites across the globe. However, it is worth noting that the cornerstone of knowledge management is sharing best practices and lessons learned. This suggests that organisations need to institutionalise a knowledge-sharing culture. There was a consensus that the magnitude of content has increased dramatically, but the time to find and understand it has not. As verified by participants from Nigeria and the UK, knowledge management provides context for content management.

A number of participants in Nigeria suggested that content can include databases, audio clips, competitive data, presentations, publications, e-mail virtually any artifact of transactions or dialogue or creative work, inside or outside the organisation. Users can access internal and external content from the same system and with the same queries, yet still know the source of the content. This means that in order for oil and gas organisations in Nigeria to implement the above, a natural starting point would be for the senior managers to formulate innovative knowledge strategies to monitor project performance within the project life cycle. Participants from the UK went on to point out that they have three primary content management initiatives in place:

- **The Knowledge Hub**-as noted in the qualitative findings, a key feature of the Hub is the seamless view it provides to the end user;
- **Real-time News**-is a news-based corporate portal hosted on the Hub. As suggested by participants, clients and employees can search, categorise and customise the data; and
- **The In Touch Knowledge Hub**-provides a single electronic interface for data exchange on oil products and services between the field and its technology centres.

It was found that some of the operational challenges that oil and gas organisations have had to address during the implementation of its content management system involved ensuring connectivity worldwide in a geographically dispersed project team, technology maturity, technology project cycle time, and finding skilled programming resources. Both participants agreed that they have had to handle a number of cultural issues to make the content management evolution a success. Another issue highlighted by participants was the fact that it is a decentralised organisation, where local managers have the tendency to build their own silos. Some of the key lessons drawn from the UK participants that could be utilised by participants in Nigeria are as follows:

- It is important to realise that knowledge management and content management are the tools to help oil and gas organisations reach their business goals, and they are not the solutions in and of themselves;
- Craft a solution that is applicable across the project, and adopt an evolutionary approach as business needs require, rather than assume it will be a one-time technology that can be implemented;
- Putting aside technology and process, fundamentally the people involved in the knowledge and content management effort will really make the difference;
- The cost of initial content migration is substantial-not only will the company have to migrate existing content, but also much of that content will need to be revisited and revised before it is made available to the company population; and
- Time and money will inevitably be wasted due to failed technologies or technologies that don't live up to their promises. The tools to publish content should be very easy to use.

It is worth mentioning that both sets of participants envisaged an ever-increasing range of commercial technology in the future of content management. This will include:

- More automated support for the classification of knowledge objects;
- Extensible mark-up language; and
- Better technology available to provide more support for distributed authorship, editing and publishing.

The majority of participants from Nigeria affirmed that they are planning to introduce open architectures, which enable the application of best-of-breed commercial technology. A notable finding that emerged was the role of KM as a major force changing thinking and management practices among the oil and gas organisations. Not only did all the organisations visited institute KM systems and processes, at most of these companies senior project leaders offered explicit recognition of the importance of knowledge management within corporate management systems as a whole and as a major contributor to performance enhancements.

6.4 OBJECTIVE 3- EXAMINE THE EXTENT TO WHICH KM STRATEGIES CONTRIBUTE TO ADDING VALUE IN OIL AND GAS PROJECTS BEING DELIVERED IN NIGERIA

Most participants agreed that in the oil and gas sector, there are three main components:

- Exploration;
- Refining; and
- Retail.

From the findings, participants suggested that out of three, the exploration aspect is the starting point for the use of knowledge management. For instance, a number of participants from the UK noted that geologists and geophysicists use their knowledge to determine what rock beneath the surface contains oil and gas. Drilling engineers use their knowledge to consider how the distribution of drilling will be achieved at optimum efficiency. This study has elicited a rich array of important information on knowledge

management. One of the most significant and unique findings was that both set of participants felt that once oil and or gas reserves are abundant, oil organisations will spend a lot time, effort and funds to build the required infrastructure. The participants suggested senior project management practitioners need to be able to keep abreast of company and industry design and construction of drilling platforms, in order to control the cost, efficiency and the drilling operations. Secondly, refinery engineers need to quickly access company-related knowledge to be able to resolve any issues within the shortest possible time and minimise duplication of errors. As suggested by both sets of participants, the retail market in the oil gas sector is faced with many challenges and business drivers of different factors.

For instance, the front-end requires a lot of investment and cost. The participants acknowledged that some of the value added techniques used include:

- Community of practice;
- Collection method; and
- Best practice sharing system.

As highlighted by the twenty participants, community of practice is very popular in the exploration area and very effective. With regards to the second method (collection method), it was found that the system is built around work processes and in addition it allows project engineers to remotely login to access a variety of reference materials when delivering oil and gas projects. As shown in this study, a number of organisations use the best practice sharing system. Participants acknowledged that they use internal and external benchmarking to determine what best knowledge practice is when delivering projects. Participants further acknowledged that knowledge management is fundamental in constructing drilling solutions that integrate surface and down-hole equipment, sensor, software and data-communication technologies.

As shown in this theme, the expansion of the electronic world brings with it major challenges-such as computer and information security. Security, confidentiality and protection of proprietary information are vital in the relatively open environment of the internet. There was consensus among the participants that these principles must be honoured because of the immense value of upstream exploration and exploitation data.

A number of participants, from the UK affirmed that the value that knowledge-management technology and a knowledge-sharing culture can reap is being consistently demonstrated throughout the oil field. For example, collaboration tools have opened a new era for rapid and easy access to, and interchange with, technical experts regardless of where they reside. Knowledge-sharing is rapidly becoming an integral part of everyday oilfield operations. It is worth highlighting that effective knowledge management should dramatically reduce costs. Most individuals, project teams and organisations are today continually 'reinventing the wheel'. This is often because they simply do not know that what they are trying to do has already been done elsewhere. They do not know what is already known, or they do not know where to access the knowledge. Continually reinventing the wheel is such a costly and inefficient activity.

A more systematic reuse of knowledge will show substantial cost benefits immediately. Effective knowledge management should dramatically increase speed of response as a direct result of better knowledge access and application. The application of more collective and systematic processes will reduce practitioners' tendency to repeat the same mistakes. There was a consensus among the participants, that effective knowledge management can dramatically improve quality of products or services. As shown in this theme, it is very easy to see how effective knowledge management will greatly contribute to improved excellence, which is to:

- Reduce costs;
- Provide potential to expand and grow;
- Increase value and profitability; and
- Improve operational effectiveness.

6.5 OBJECTIVE 4- IDENTIFY STRATEGIES AND PRACTICES WHICH CONTRIBUTE TO IMPROVED PERFORMANCE, INNOVATION AND CONTINUOUS IMPROVEMENT IN THE OPERATIONS OF THE OIL AND GAS INDUSTRY IN NIGERIA

Strategies and practices which contribute to improved performance, innovation and continuous improvement in the oil and gas sector were explored in Chapter Five: these included databases, software tools, portals, groupware, communities of practice, best practices groups, peer review groups, KM and human resource training. These are summarised below:

6.5.1 Databases

Participants in Nigeria and the UK acknowledged that information technology has facilitated the assembly of databases that can serve as important information including best practices, technical and managerial performance data, supplier and customer information. Participants highlighted that a number of oil and gas organisations rely heavily on the use of IT to create and use directories useful to the management of knowledge. In this sub-theme, participants further acknowledged that a number of organisations have developed databases of best practices like Chevron Texaco's Lessons Learned Database and BP's database of After-Action-Reviews meant to capture positive and negative experiences.

6.5.2 Software tools

Most participants agreed that software tools associated with databases help users navigate, find and apply useful information relatively quickly and at a low cost. For instance, the researcher noted that organisation K uses several databases linked by Oracle's web-based ConText search engine to develop an integrated document management system.

6.5.3 Portals

All participants stated that another important aspect of IT-enabled KM is the ability to provide users a personalised, single point of access for the applications and content they need. For this purpose, internet portals are especially useful. As suggested by the participants, portals can help reduce the inconvenience and inefficiency caused by using multiple applications by integrating a wide range of application programs so that information can be exchanged and shared irrespective of a type of application.

6.5.4 GroupWare

In cultural groupware, a number of participants from Nigeria and the UK agreed that collaboration software and groupware make it possible for groups and teams to interactively share knowledge. It is worth highlighting that groupware helps create a shared space where users can exchange knowledge and manage common tasks and resources. As shown in this sub-theme, various types of groupware have helped the creation of virtual communities to enable the management of knowledge.

6.5.5 Communities of practice

A number of participants from Nigeria and the UK acknowledged that of all the tools of KM used in the oil and gas sector, the most widely and enthusiastically adopted have been communities of practice. Participants asserted that the success of communities of practice resulted in their tendency to extend throughout company-wide reaching both downstream businesses and corporate support functions — health and safety, energy efficiency, process engineering, web application development, retailing to mention a few. It is worth mentioning that they are an integral part of a learning environment, and a catalyst for the deployment of innovative ideas. Through their participation in communities, members seek others who are doing similar things or face similar problems, and who can quickly answer their questions, recommend products and procedures, or become mentors. Community involvement not only allows participants to make a contribution, but it allows them to strengthen and fine-tune their own skills, creating even greater potential value for the organisation.

6.5.6 Best practices groups

In their view about best practices groups, there was a consensus among both set of participants that the opportunities for communication and collaboration made available by information technology and the new thinking about horizontal coordination ushered in by KM led to significant stages in operating practices among several of the organisations. Participants suggested that in the oil and gas sector, business activities are organised into four main areas-upstream, downstream, chemicals and gas and power. As highlighted by the participants:

- Project teams could be more creative and efficient through the sharing of knowledge and best practices; and
- Communities of practice must be formed around areas of expertise to support real operational and strategic business needs.

It is worth mentioning that the communities of practice are naturally occurring groups of project teams who will perform similar work within a project life cycle. As noted by the participants, each community of practice is made up of focal points who represent the community at each phase of the project.

6.5.7 Peer review groups

The twenty acknowledged that, one of the most powerful KM tools for oil and gas organisations has been the “lessons learned” methodology pioneered by the US Army. Both sets of participants, suggested that in order to carry out an in-depth monitoring and peer review of the implementation of knowledge management strategies, senior managers need to develop a knowledge management methodology and detailed terms of reference for a robust, transparent and accelerated knowledge management process.

6.5.8 KM and human resource training

In this theme, a number of the organisations linked training and career management to their KM systems. A number of participants from Nigeria, found training for experienced engineers to be a greater challenge. Participants from Nigeria highlighted that virtual project teamwork initiative requires substantial investments of training and coaching for older and more senior personnel. A major problem for organisations in Nigeria was knowledge loss resulting from employees retiring or leaving the company to join other companies. All the twenty participants acknowledged that the problem of knowledge loss through human resource attrition was a source of concern for the global industry as a whole. As noted in the qualitative findings, it has been conclusively shown that knowledge management objectives are inevitably intertwined with regular functions of the human resource divisions of the petroleum firms.

6.6 OBJECTIVE 5: FRAMEWORK DEVELOPMENT

This study proposed to develop a knowledge management framework which best captures knowledge sharing strategies and practices in the oil and gas sector. As argued in this study, the framework categories are of fundamental importance for adding value in oil and gas projects. Their vital significance lies where knowledge management implementation is not being realised. As suggested by the participants, an effective centralised knowledge management system will help oil and gas organisations accelerate their efforts to backfill their technical capability gaps, recognise and anticipate problems and avoid rein-venting the wheel across multiple projects. Participants stated that the proposed framework should address knowledge sharing issues.

From the validation results, it emerged that the proposed framework can be effective in practice. Reflecting on their personal experience, the participants suggested that the

framework has significance for senior managers who deliver oil and gas projects. For instance, a majority of participants agreed that the framework captured a generic applicability and a foundation to build understanding and an awareness of knowledge management strategies and how these can be managed. While the framework outlined can be valuable for oil and gas project teams, the researcher is aware that the proposed framework would not instantaneously resolve knowledge management issues.

6.7 QUESTIONNAIRE FINDINGS

This section presents a summary of the two main categories that have emerged from the quantitative findings; these include knowledge management technology approaches and knowledge management people approaches. These are recapitulated below.

6.7.1 KNOWLEDGE MANAGEMENT TECHNOLOGY APPROACHES (KMTA)

The survey results suggest that in some organisations the importance of knowledge management technology approaches varied.

6.7.1.1 Theme 1: KMTA

In this theme, the findings indicate that, the factor regarded as most important is “instant messenger”, with a percentage score of 65. This is closely followed by “collaborative technologies”, “intranets”, “records and information management”, “web 2.0 blogs” and “search”, with percentage scores of 59.3, 27.1 and 6 respectively. Overall, participants considered this group of factors as very important. The variation in levels of importance expressed by different participants who at times were involved within the same project was very striking, this suggests that knowledge management strategies should be flexible and a mechanism put in place to monitor continuously the process. In addition, researchers and project experts could face challenges devising a prescriptive method. From the results, the participants emphasised the timely provision of knowledge management tools. It is important in a project based oil organisation that there are sufficient suitable knowledge management technologies, and experienced senior project leaders available to monitor team performance.

6.7.1.2 Theme 2: KMTA

In this theme, participants agreed that if oil and gas project teams are to be effective, they need to have semantic search engines and link machines. In this category, the

significant finding was that there was no different between participants in Nigeria and the UK when it comes to development of information technology. In terms of knowledge management technologies, participants from Niger and the UK rated highly, case-based reasoning systems, web 2.0 social networking, web 2.0-wikis, and tags. The survey results provide more confirmatory evidence that it is the responsibility of project leaders to make sure that the alignment of knowledge management technologies and members of a project team will be pulling together. From the survey results, there are indications that the main aim of developing a set of reciprocated project goals is to utilise knowledge management strategies. Overall, the participants recognised that knowledge is strictly linked and connected to the individual (or group) who creates it, which may cast doubts on the availability of information systems tools to effectively support knowledge management.

6.7.1.3 Theme 3: KMTA

The survey results illustrate that, participants in Nigeria and the UK both considered 'document management system' as very important. One hundred and twenty-four (93.2 per cent) out of one hundred and thirty-two participants agreed that a centralised knowledge management system helps oil and gas organisations accelerate their efforts to backfill their technical capability gaps, recognise and anticipate problems, and avoid reinventing the wheel across multiple projects. A key finding that emerged from this category was that project leaders need to create a common understanding between project teams. Just as Thomas and Thomas (2005) suggested that a structured team selection process should be based on a clear value criteria, it can be argued that the findings from this category reflect the conclusions of the above authors.

It was also found that setting knowledge management goals within a project team is not enough for project performance excellence. The survey results suggest that participants in this study favoured setting collective priorities and project work plans. As earlier discussed, this can be achieved through regular project meetings. The survey results in this category, confirm that when clients or project managers are setting knowledge management strategies, they should ensure that there is an understanding within project teams. This understanding is that not only does each individual project member of the team have a responsibility to complete their knowledge tasks but they also have an obligation to support each other where appropriate in the achievement of the knowledge management objectives.

It was further noted that knowledge management should be holistic, it should include the establishment of institutional mechanisms to capture and disseminate information relevant to project teams. The above findings reveal that the knowledge chain consists of seven links:

- Listing the existing knowledge;
- Determining the required knowledge;
- Developing new knowledge;
- Allocating new and existing knowledge;
- Applying knowledge;
- Maintaining knowledge; and
- Disposing of knowledge.

6.7.2 KNOWLEDGE MANAGEMENT PEOPLE APPROACHES (KMPA)

6.7.2.1 Theme 1: KMPA

In this dimension, the survey results suggest that the process for aligning knowledge management people approaches must be done thoroughly because in oil and gas projects, project team members come from different departments. For instance, seventy-one per cent of the participants stated that to be effective, communities of practice should be formed by senior project leaders who engage in a process of collective project delivery in a shared domain. As shown in this study, the concept has been adopted by oil and gas organisations because of the recognition that knowledge is an essential asset that needs to be managed strategically. For high performing oil and gas project teams, the project director and project manager need to provide a detailed project specification to the team. To certify the whole integrated knowledge management team is pulling in the same direction and to make sure the team is equally supporting each other, it is vital for the project manager to ensure that the seven variables are aligned.

6.7.2.2 Theme 2: KMPA

From the survey results, there are indications that the project manager has to set a tone for the project, which will be conducive to the achievement of knowledge management

objectives. The most commonly identified variable to knowledge management people approaches was leading practice identifying and sharing. As affirmed in this theme, enabling oil and gas organisations to capture, share and apply collective experience and know-how of their project teams is seen as fundamental in the sector. This accords with an earlier observation made in the literature reviewed, which suggested that issues of technology, processes, people and content must be fully aligned (Smith and Farquhar 2000). From the findings, the survey results indicate that in the oil and gas sector, knowledge management happens in the background-in real time. In general, it is done by every project team member as part of the day-to-day job, embedded in the knowledge management lifecycle. In order for the process to be successful, senior managers, need to ensure that people are easily able to obtain the data and knowledge they need to deliver their project tasks.

6.8 IMPLICATIONS FOR THEORY

This study has attempted to clarify the relationship between knowledge management technology approaches and people approaches, and the influence of knowledge management upon project success. The findings of the study highlighted the importance of further theorising about knowledge management based-systems, and empirical investigation of, knowledge management strategies in oil and gas projects. As exploration and production operations in developing and developed nations become more capital-intensive and technically complex, a number of oil organisations are turning to digital solutions as a means of creating and sustaining knowledge management strategies. As shown in this study, properly configured knowledge management strategies allow organisations to leverage technology to holistically manage production, personnel and safety, allowing for reduced operational costs, increased production and more efficient team integration. This research contributes to the body of knowledge by identifying the variables that influence efficient knowledge management technology approaches and people approaches.

The key factors have been discussed in Chapters Four and Five. During the verification and validation exercise, it was established that the key findings identified in Chapters Four and five are inter-connected. As a result, these sub-categories were used within the thesis to propose a framework which best captures knowledge management strategies and practices in the oil and gas sector. This research further contributes to the theory for identifying key strategies that can be utilised to address the gap in knowledge

management practices between Nigeria and developed countries. Understanding how to enhance and create value enhancing practices is a central goal of contemporary knowledge management research. The knowledge management research community will need to advance beyond the mere appeal of knowledge management strategies on oil and gas projects toward a more complete and detailed elucidation of value enhancing knowledge management processes.

6.9 IMPLICATIONS FOR PRACTICE

The majority of oil and gas organisations are now operating in developing and developed countries. As illustrated in this research, oil and gas organisations are now moving resources to almost any worldwide location and have the capacity to work on a global scale. Even organisations without any state of global readiness still maintain a presence overseas by supplying specialist services. The industry has widened its recruitment both locally and abroad. One of the key issues that this research sought to address was to identify challenges faced by senior managers in developing effective knowledge management strategies and practices in oil and gas projects. As highlighted by Mckenna and Wilczynski (2006) knowledge and information management is essential for the oil and gas sector. Economic conditions remain tough, meaning oil and gas organisations will have to explore ways to use their data to maximise operational effectiveness and corporate returns.

This research provides the oil and gas industry with a sense of how important it is to have an effective knowledge management strategy in place. The framework proposed is based on the existing practices. This study illustrated the views of senior project management practitioners to the extent to which knowledge management technology approaches and people approaches can contribute to adding value in oil and gas projects. This gives industry the opportunity to look at their current practices and structure them to enhance their knowledge management strategies. With the exponential growth in technology, there is no excuse for oil and gas organisations of any size to not enhance their knowledge management strategies. This research, therefore, provides good groundwork for understanding the influential knowledge management based systems that enhance operational effectiveness in the global oil and gas sector.

6.10 LIMITATIONS OF THE RESEARCH

This section provides an appraisal on the research contained in this study. The researcher believes the limitations examined do not indicate a fundamental weakness with the research approach adopted and they do not jeopardise the aim and objectives of the study. This research had the following limitations:

- The focus of the research was on senior project leaders' views and did not include junior project workers, however, the influence of junior project workers on the implementation of knowledge management strategies was considered.

- A second issue was that, the qualitative findings were obtained from participants carrying out a variety of project roles relating to different types of oil gas projects. It was found that some participants had a great deal of project management experience and current involvement in the management of oil and gas projects in terms of knowledge management implementation. For example, it was established that participants in the UK proposed better knowledge management solutions which could be applied in both developed and developing countries. However, this provides the basis for a future research recommendation within the Nigerian oil and gas sector. In order to achieve equivalence and comparability across the two countries, the concepts and research technique applied had similar meaning in both countries.

6.11 THE WAY FORWARD

This study has demonstrated the importance of knowledge management in influencing project delivery. Current strategies that are applied on oil and gas projects appear to over-emphasise realisation of maximum value for clients. As established in this research, the oil and gas sector is one of the largest, most complex and most project team concentrated industries. As argued, current strategies need to include modern technology and continuous improvement. From the literature reviewed, it emerged that the way in which knowledge management strategies are implemented can restrict the industry's ability to improve its performance and delivery.

Indeed, as it surfaced in this study the discourse about knowledge sharing strategies within the industry appears to disengage from the broader defining heavy engineering management literature. In addressing the issues relating to knowledge management in

the oil and gas sector, it is vital for the research community to establish a basis to build understanding and awareness of contemporary knowledge management strategies, and in addition, how they may be managed and implemented. Evidence presented in this research, has demonstrated that organisations have found that implementing knowledge management practices in oil and gas projects can be problematic due to cultural factors.

From the findings, it has been highlighted that there is a need for understanding the relationship between knowledge management technology approaches and people approaches. For example, it has been suggested that senior project leaders will implement knowledge management strategies through better understanding of both technology and issues. It was further recognised that to achieve improved performance, innovation and continuous improvement, one has to integrate the variables identified in both qualitative and quantitative findings. As recommended, the application of the proposed framework will assist managers in necessitating a common, generic, and logical structure in knowledge management decision-making. There is considerable evidence presented in this study to illustrate that the framework proposed demarcates key factors influencing knowledge management strategies in the oil and gas sector.

It could be argued that UK knowledge management based systems may be in every respect unsuitable and irrelevant to the Nigeria oil and gas sector. During this research, it emerged that cultures vary from country to country. As a result values at work and social settings between the two countries vary. It has been shown that by understanding knowledge management based systems, senior project management practitioners can determine appropriate modifications to current knowledge management concepts and apply them successfully in different countries and cultures.

In order to manage to implement knowledge management based systems successfully, it will be essential for senior project management practitioners to recognise the cultural context of a country. A natural starting point would be for senior managers to be conscious of a project's social and economic aspects and location and its relationship with the local community. For example, it would be vital for the government in Nigeria to implement policies that would promote efficiency throughout the oil and gas sector to sustain growth within the industry and to ensure that joint ventures between international and local firms are beneficial to the local communities as well. This may seem as a

prerequisite to remedial actions being taken by the industry to improve the way value enhancing can be achieved.

The intricate connection of knowledge management based systems with oil and gas projects must be recognised. As verified in this research, knowledge management based systems on projects are amenable to alterations, modifications, and changes over time. The study may be seen as a fundamental knowledge prerequisite that is required to inform the development of effective and meaningful knowledge management strategies by a strategic forum for the industry. In the meantime, knowledge management practices must be planned and implemented upon a considerably clearer understanding of a project leader's experiences and attitudes.

6.12 CHAPTER SUMMARY

This chapter discussed the content of previous chapters and delineated the most vital results and findings of the research. It has examined the results of the research within the context of the literature, theory, aim, and objectives. The chapter has also summarised the implications for theory and practice and outlined the limitations of the study. Despite the limitations, a way forward for the industry is proposed. A framework is proposed in the following chapter, which lays out the relationships between the key variables identified in Chapters Four and Five. The framework proposed provides a structured approach in implementing knowledge management strategies and practices.

CHAPTER SEVEN: FRAMEWORK DEVELOPMENT AND VERIFICATION

7.1 INTRODUCTION

This chapter focuses on the verification and validation of the framework. The main focus was on the framework practicality, suitability, and effectiveness. In order to address the above, the researcher presented the proposed framework, process, objectives, and results. In addition, participants' accounts of implementing knowledge management practices in oil and gas projects are discussed. The verification and validation exercise was important since it is known that experiences and attitudes are constructed by choices available to individuals.

7.2 THE NEED FOR THE PROPOSED FRAMEWORK

According, to Tomlison (1990, p.11), a framework can be defined as a:

"Means of describing some part of the organisational situation which is of concern to the participants of study".

Fellows and Liu (1997), suggest that a framework should capture the reality being modelled as closely as practical and include the essential features of that reality whilst being reasonably cheap to construct and easy to use. It has been suggested by Bell (1994) and Coxhead and Davis (1992) that the use of a framework in a complex situation assists managers in minimising risk, imposing consistency, and provides a common generic and logical structure in decision making. The framework proposed in this study was used to address the key research questions and the aim posed in this study.

The framework delineates the key variables that influence knowledge management technologies and people approaches and highlights how knowledge management strategies and value enhancing practices can be managed and implemented. The framework was developed from the key variables identified from the qualitative and quantitative analysis. As discussed in the result chapters, the organisational knowledge is one of the most important assets. As suggested by the participants, it guarantees the correct functioning and enhances creativity and innovation. The implementation of

knowledge management based systems is likely to depend on the establishment of a number of identifiable knowledge management technologies and people approaches practices. As illustrated in Table (7.1), these were found to fall within the following categories: KMTA (THEME 1), KMTA (THEME 2), KMTA (THEME 3), KMPA (THEME 1) and KMPA (THEME2).

Table 7.1: Knowledge management technology and people approaches variables

KMTA (THEME 1)	**KMTA (THEME 2)**
• Collaborative technologies • Instant messenger • Intranets • Records and information management • Search • Web 2.0-Blogs	• Web 2.0-Folksonomies and tagging clouds • Web 2.0-Social networking • Web 2.0-Wikis • Case based reasoning systems • Group discussion support system artificial neural networks • Semantic search engines and link machines • Tags
KMTA (THEME 3)	**KMPA (THEME 1)**
• Communication and collaboration systems • Document management system • Content management system • Knowledge mapping tools	• After action review • Community of practice • Embed in organisational HR • Gone well/not gone well exercise • Knowledge audit • Knowledge bank • Knowledge café
KMPA (THEME 2)	**STRATEGIES AND PRACTICES**
• Knowledge centre • Knowledge market place • Leading practice-identifying and sharing • Narrative project case-study • Peer assist	• Databases • Software tools • Portals • Groupware • Communities of practice • Best practices groups • Peer review groups
VALUE ADDED TECHNIQUES BEEN APPLIED	
• Community of practice • Collection method • Best practice sharing system • Minimizing downtime • Results and using past successes for a business rationale	

Conclusions from the two result chapters indicated that knowledge management based systems represents a powerful means for oil and gas organisations to deal with project challenges. It was also established that enabling organisations to capture, share and

apply the collective experience and expertise of their practitioners is seen as fundamental to competing in the global knowledge economy. Participants further suggested that oil and gas organisations must have good enough technology to make progress, especially in the transitional business environment of today. In enhancing the above, there was a need to propose a framework that would:

1. Highlight key knowledge management technology approaches;
2. Highlight knowledge management people approaches; and
3. Knowledge management strategies and value enhancing practices.

Figure 7.1 summarises the main components of the framework that emerged from this study.

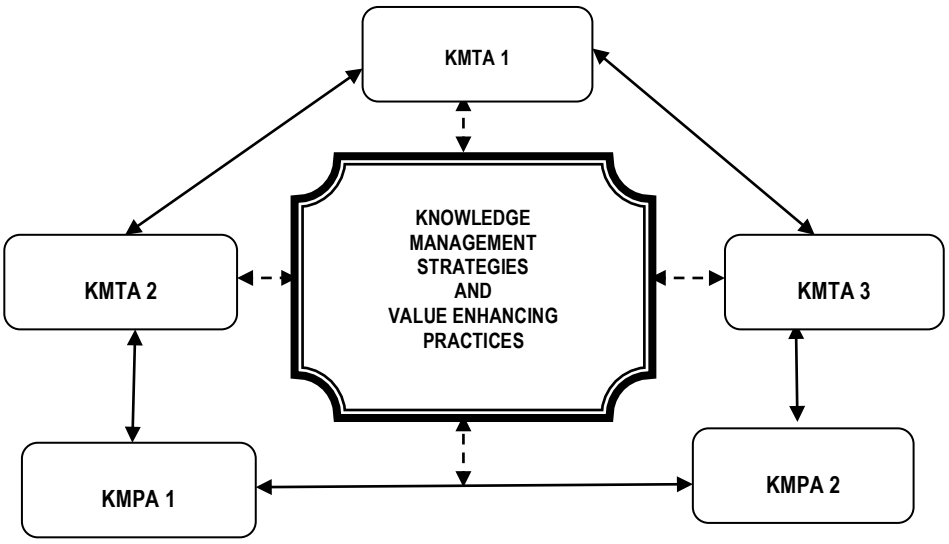


Figure 7.1: Framework components

The findings show that a framework for knowledge management implementation in oil and gas projects in this study needs to draw together:

- Knowledge management technology approaches;
- Knowledge management people approaches; and

- Knowledge management strategies and value enhancing practices.

The three points mentioned have already been discussed in the two results chapters. However, it is essential not to lose sight of what has been learned in the broader sense about the variables associated with knowledge management based systems in oil and gas projects. The analysis carried out in the previous two chapters, allowed the researcher to take a step further and propose a more detailed framework (*see Figure: 7.2*). The results showed that oil and gas organisations must ensure their project workers have access to a library of technical data that comprises of knowledge management technology, people approaches and value enhancing practices.

7.3 VERIFICATION AND VALIDATION OBJECTIVES

Verification and validation was carried out to achieve the following objectives, which follow on from the key research objectives:

1. To present all information compiled throughout both the preliminary and main study stages;

2. To ensure that the proposed framework fulfils the requirements of oil and gas organisations;

3. To validate the applicability of the proposed framework in real life situations;

4. To achieve an agreement on framework requirements to ensure generic applicability;

5. To verify the aims of the framework;

6. To confirm if the framework can only be applied on oil and gas organisations; and

7. To verify the project targeted.

7.4 VERIFICATION AND VALIDATION PROCESS

The verification was carried in phases described below.

7.4.1 Phase 1

An email was sent to participants who were involved with this study, which was then followed by a phone call to explain the purpose of the exercise. The questionnaire was sent out in advance to each organisation for collection during the session.

7.4.2 Phase 2

All knowledge management findings compiled throughout both the preliminary and the main study stages were presented to the senior project management practitioners in Nigeria and the UK. A verification questionnaire assessing the effective factors for knowledge implementation was presented to the main participants of study (see Appendix E). The aim of the questionnaire was to measure their level of agreement on the variables that were identified in the analysis. Verification employed the use of the Likert uni-dimensional scale because it ensured all variables identified from the findings were measured. Participants were asked to indicate the level of agreement on each variable using a scale from 1-5 where 1 indicated 'strongly disagree', 2 'disagree', 3 'fairly agree', 4 'agree' and 5 'strongly agree'. The employment of the questionnaire ensured participants could express their opinions of the proposed framework freely and frankly.

7.4.3 Phase 3: Use of workshops

The session involved a forty-minute presentation by the researcher of the proposed framework; this was followed by a three-hour discussion, review, and critique of the framework. Each session was attended by the participants from the ten organisations selected in Nigeria and the UK.

7.4.4 Respondents

The verification of the framework was accomplished through workshops with participants from the ten organisations selected in Nigeria and the UK. The participants also

participated in interviews carried out in this study. They used questionnaires, which addressed the following issues:

- Knowledge management technology approaches ;
- Knowledge management people approaches; and
- Knowledge management strategies and value enhancing practices.

7.4.5 Phase 4: Use of focus group

The session involved a thirty-minute presentation by the researcher of the proposed framework to a different group of managers not involved with the study. Ten project directors in Nigeria and the UK attended each session. The validation questionnaire assessing the proposed multi-cultural framework was presented to the project directors. The validation questionnaire employed the use of the Likert uni-dimensional scale and participants were asked to indicate the level of agreement on each factor using a scale from 1-5 (see Appendix F). An attitude continuum for each variable in the validation was constructed as described below.

- **Strongly agree** – participants had no doubt on the positivity of question being asked.
- **Agree** – participants generally agreed with the subject or principle underlying the subject being questioned.
- **Uncertain** – participants were not sure but cannot confirm or deny the importance of problem under discussion or being questioned.
- **Disagree** – participants did not agree with the problem or the principle underlining the problem being discussed or questioned.
- **Strongly disagree** – participants were completely aware that the problem under consideration was not possible from his/her perception.

7.4.6 Respondents

The validation of the framework was conducted through a focus group with a different set of managers not involved with the study. They used questionnaires, which addressed the following issues:

- Knowledge management technology approaches ;
- Knowledge management people approaches;
- Knowledge management strategies;
- Knowledge management value enhancing practices; and
- Applicability of the framework.

Details of respondents are provided in Table 7.2 below.

Table 7.2: Details of validation questionnaire respondents

Participants Project directors (UK)	**Profile of company projects**	**Participants** Project directors (Nigeria)	**Profile of company projects**
A, B, C	Oil and gas	K,L,M	Oil and gas
D, E, F	Oil and gas	N, O, P	Oil and gas
G, H, I	Oil and gas	Q,R,S	Oil and gas
J	Oil and gas	T	Oil and gas

7.5 VERIFICATION RESULTS

The results of the two focus groups suggested that there must be an evident commitment from senior project management practitioners . This applies at strategic level, operational level and project level. The participants suggested that without guidance from the top, there is a danger of the project team developing their own working culture within the project environment. There was recognition by the participants that in order to build a knowledge sharing culture, senior managers need to ensure that there is a robust knowledge-management platform. As argued in this study, the growing difficulties with accessing and leveraging technical project knowledge have roots in several ongoing trends, including demographics. As suggested by the

participants about half of Nigerian and UK project engineers are expected to retire over the next 10 years. Participants further noted that this exodus could be viewed as a human resource and knowledge management challenge. It was, therefore, not surprising that the key categories that emerged from the verification process as significant were sorted and grouped within the seven main sub-categories of 'knowledge management people approaches', 'knowledge management technology approaches ', and 'knowledge management strategies and value enhancing practices'. These seven sub-categories were found to be inter-connected and thus were reported together.

7.6 KNOWLEDGE MANAGEMENT TECHNOLOGY APPROACHES (KMTA)

7.6.1 KMTA (Theme 1)

From the verification results, the UK participants' preferences for and reliance upon instant messenger, search, web 2.0-blogs, records and information was evident, whilst a large majority of participants in Nigeria favoured collaborative technologies and intranets. Interestingly, during the discussion with participants B, G, L, M, C, and A, C, E, I, J, R in Nigeria and the UK they acknowledged that knowledge management only generates significant performance benefits when it has become embedded in the project cycle and work practices of project team members. It would seem that participants in Nigeria favoured collaborative technologies and intranets because it allowed them to gain more commitment from the project workers.

Participants in Nigeria noted that collaborative technologies and intranets are easy to use and their national reach has brought about a fundamental shift in delivery of projects in Nigeria. In the UK, participants favoured instant messenger, search, web 2.0-blogs, records and information. Participants in the UK argued that if you apply the three variables it allows project workers to take real-time decisions on projects. It was also suggested by both set of participants that a single source for aggregated technical data, internal and external leads to higher adoption of knowledge management technologies approaches identified in theme one.

7.6.2 KMTA (Theme 2)

During the two meetings, there was a consensus that in order to fully implement knowledge management technologies, organisations need to ensure a healthy balance between the business process and project driven approach. Reflecting on their experiences, both set of participants identified 'web 2.0-folksonomies and tagging clouds' as essential to knowledge management technology approaches. The importance of 'web 2.0-social networking', 'case based reasoning systems and 'web 2.0-wikis' gained the highest score in the verification exercise. In the UK participants suggested, that the use of web 2.0-social networking is the most systematic way of analysing relationships between senior managers and project teams. While there is some increase of web 2.0-social networking in the UK, in Nigeria it was found that group discussion support system has mainly been used.

As a result, participants from Nigeria noted that they have had to face issues to do with system compatibility. Reflecting on their experiences, participants in Nigeria acknowledged that the use of group discussion support system is vital if oil and gas firms in Nigeria are to address the issue of system complexity. What is surprising is that in this particular category there was only a difference of three percent on the average score from both groups. Therefore, this suggests that the Nigerian approach does correspond favourably with the UK manner of case based reasoning system, web 2.0-folksonomies tagging and group discussion support system. In order for senior managers in Nigeria to improve on knowledge management implementation, it is vital for the oil and gas sector to alter how senior managers assess the forces for organisational changes.

7.6.3 KMTA (Theme 3)

A high majority of the participants affirmed that document management system revolves around a centralised repository that can be used to manage the storage of project data that is vital to the organisation. Participants further noted that document management system enhances the likelihood of delivering a project successfully. During the discussions, participants (S, K, F, D, and E) in the UK suggested that compared to non-electronic systems, the document management systems offer reduced operational costs, improved efficiency and speed of retrieval, improved consistency, and more safety (both in terms of file backups and security measures). In Nigeria, it was found that document

management system allows senior managers to exert greater control over production, storage and distribution of project data, yielding greater efficiencies in the ability to reuse project data.

During the workshop, both groups highly rated 'communication and collaboration systems', 'content management system' and 'knowledge mapping tools'. The results suggest that there is a link between the four variables when it comes to the application of knowledge management approaches. Participants from both groups noted that knowledge mapping tools helps you understand the critical success factors, options, and steps involved in implementing a successful knowledge management initiative Therefore, for this particular category senior managers grouped the variables as follows: document management system, knowledge mapping tools, communication and collaboration systems and content management system.

7.7 KNOWLEDGE MANAGEMENT PEOPLE APPROACHES (KMPA)

7.7.1 KMPA (Theme 1)

In this theme, the two groups differed in a number ways, for instance participants in Nigeria highly rated community of practice compared to the UK participants. Whilst reflecting on their personal experiences, it was observed that the national culture from the two countries differed when it came to the application of community of practice. Participants in Nigeria regarded communities of practice as knowledge integrated into the culture, values and language of the community, whilst a few of the participants in the UK believed that the best learning environments are created when there are real consequences to the project team. It is worth noting that, management must understand the advantages, disadvantages and limitations of communities of practice. As established during the discussions with senior managers, there is more than one type of community. These operate in different ways, are different sizes, have different areas of focus, and address knowledge in different levels of maturity. Four types of community identified by participants include:

- Communities of practice – is a community of practitioners within a single discipline of practice working on a project;
- Communities of purpose - here the community (contractors) is funded by an organisation, and in return commit to project deliverables;

- Communities of interest - consist of primary stakeholders who have a direct interest in the project been delivered; and
- Social communities - consist of secondary stakeholders who have an indirect interest in the project being delivered.

It is worth highlighting that community is a wide term, and before senior managers consider introducing any sort of community strategy, they have to be very clear about the sort of community they are dealing with. In this category, four variables received the highest score in the verification questionnaire these were: community of practice, embedding organisational human resource, gone well/not gone well exercise and knowledge audit. There was an equal recognition of the importance of the four variables when it comes to knowledge management people approaches.

The only slight difference highlighted was the use of knowledge bank, knowledge café and after action review. In order to manage this particular category, a high majority of the participants suggested a company wishing to introduce the variables identified in this theme, needs to understand that without good communication, rapid exchange of knowledge and best practice within the organisation will be difficult or impossible. As illustrated by the two groups in this category, the four variables 'community of practice', 'embedding organisational human resource', 'gone well/not gone well exercise' and 'knowledge audit' are relevant to both the connecting and collecting aspects of knowledge sharing.

7.7.2 KMPA (Theme 2)

In this theme, almost all the twenty participants agreed that knowledge centre, knowledge market place and leading practice-identifying and sharing is essential when it comes to knowledge management people approaches. It was not surprising to see that when participants from both UK and Nigeria reflected on their personal experiences they associated the three variables with effective knowledge management people approaches. The factors emerging from this category indicate that the framework needs to address collective working processes. Combining these requirements with operational considerations, participants (A, C, D, E, F, I, J, K, R and S) in the UK suggested that knowledge management requires a managerial approach to mistakes which is healthy and balanced, and which encourages project workers to take certain risks and to be honest about the consequences and their actions.

Participants (B, G, H, L, M, N, O, P, Q and T) in Nigeria further noted that knowledge sharing and learning is about a two-way communication that should take place in a simple and effective manner. For instance, both set of participants agreed that peer assist and narrative project case study encourages participatory learning. To make sure that essential project knowledge is retained by an organisation, a range of techniques from traditional information management tools and modern tools need to be used. In doing this, the effective team working can be achieved at many levels in the project environment. The following diagram is a representation of the knowledge management framework proposed in this study.

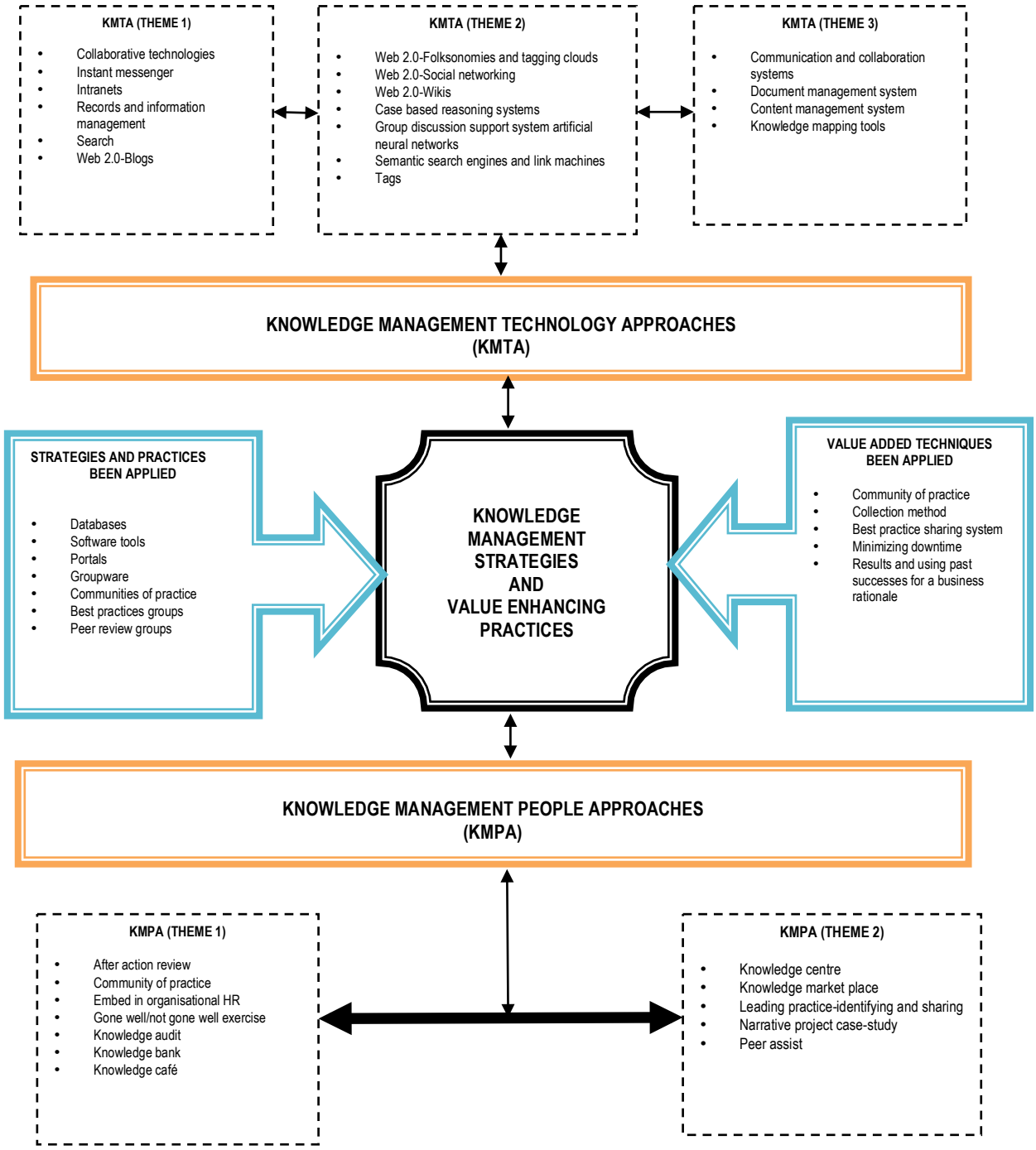


Figure 7.2: Framework for knowledge management implementation in oil and gas projects

7.8 VALIDATION RESULTS

The following two tables are a representation of the assessment of the proposed knowledge management framework by participants in the UK and Nigeria.

Table 7.3: Respondents assessment of knowledge management framework

KNOWLEDGE MANAGEMENT FRAMEWORK MODEL ASSESSMENT (KMTA VARIABLES)													
	Question Implementation of KMTA is likely to fall within the following categories:-	**Respondents score (1 Strongly disagree and 5 Strongly agree)** **PARTICIPANTS** **K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**Score**	**Percentage %**
1	Collaborative technologies	5	5	5	5	5	5	5	5	5	5	5	100
2	Instant messenger	5	5	5	4	5	4	4	5	5	5	4.7	94
3	Intranets	3	4	4	5	3	3	4	3	3	3	3.5	70
4	Records and information management	5	5	4	4	4	5	5	4	4	4	4.4	88
5	Search	5	5	5	5	5	5	5	5	5	5	5	100
6	Web 2.0-Blogs	3	3	3	4	3	4	3	3	3	4	3.3	66
7	Web 2.0-Folksonomies and tagging clouds	3	3	4	3	3	3	4	4	3	3	3.3	66
8	Web 2.0-Social networking	4	4	3	3	4	5	5	4	3	5	4.5	90
9	Web 2.0-Wikis	3	3	3	2	2	3	2	2	3	3	2.6	52
10	Case based reasoning systems	4	4	4	3	4	4	5	4	4	4	4.0	80
11	Group discussion support system artificial neural networks	5	5	4	4	4	5	5	4	4	4	4.4	88
12	Semantic search engines and link machines	3	3	4	3	3	3	4	4	3	3	3.3	66
13	Tags	3	3	4	3	3	3	4	4	3	3	3.3	66
14	Communication and collaboration systems	5	5	5	5	5	5	5	5	5	5	5	100
15	Document management system	5	5	5	5	5	5	5	5	5	5	5	100
16	Content management system	5	5	5	5	5	5	5	5	5	5	5	100
17	Knowledge mapping tools	5	5	5	5	5	5	5	5	5	5	5	100

Table 7.4: Respondents assessment of knowledge management framework

	Question	Respondents score (1 Strongly disagree and 5 Strongly agree) PARTICIPANTS										Score	Percentage %
KNOWLEDGE MANAGEMENT FRAMEWORK MODEL ASSESSMENT (KMPA VARIABLES)													
	Implementation of KMPA is likely to fall within the following categories:-	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**		
1	After action review	4	4	4	3	4	4	5	4	4	4	4.0	80
2	Community of practice	5	5	5	5	5	5	5	5	5	5	5	94
3	Embedding organisational HR	3	4	4	5	3	3	4	3	3	3	3.5	70
4	Gone well/not gone well exercise	5	5	4	4	4	5	5	4	4	4	4.4	88
5	Knowledge audit	5	5	4	4	4	5	5	4	4	4	4.0	80
6	Knowledge bank	5	5	5	5	5	5	5	5	5	5	5	100
7	Knowledge café	5	5	4	4	4	5	5	4	4	4	4.4	88
8	Knowledge centre	4	4	3	3	4	5	5	4	3	5	4.5	90
9	Knowledge market place	5	5	4	4	4	5	5	4	4	4	4.4	88
10	Leading practice-identifying and sharing	4	4	4	3	4	4	5	4	4	4	4.0	80
11	Narrative project-study	5	5	4	4	4	5	5	4	4	4	4.4	88
12	Peer assist	3	3	4	3	3	3	4	4	3	3	3.3	66

The knowledge management framework describes how project leaders from Nigeria and the UK perceive importance of knowledge management, strategies and practices, which contribute to improved performance, innovation and continuous improvement in the oil and gas sector. From the above two Tables 7.3 and 7.4, it can be observed that participants felt that the framework highlighted the key factors of knowledge management technology and people approaches that have to be considered to ensure successful delivery of projects in the oil and gas sector. However, participants (K, L, M, N, O, P, Q, R, S and T) in Nigeria were of the view that though the framework presented useful tools and techniques, training and cultural change would be needed before its full implementation.

Participants suggested that a positive cultural change could be created by implementing a series of organisational systems and processes that enhance innovation. Participants from Nigeria acknowledged that the main challenge of knowledge management implementation in Nigeria is getting buy-in from project workers. As established from the qualitative findings, no knowledge management system can work unless senior project workers and project team members fully understand the benefits. In order to weave knowledge sharing and reuse into the everyday workflow of projects in the case of Nigeria, a significant cultural change is necessary. In their opinion, the framework provided a generic application and established a basis for building understanding, and awareness of knowledge management.

Reflecting on their personal experience, a majority of participants (A, B, C, D, E, F, G, H, I and J) in the UK agreed that the proposed framework, which could be generally applied, took account of knowledge management technology approaches, people approaches, strategies and value enhancing practices. Participants from UK suggested that a combination of intranet, software, organisational systems and processes forms a successful Knowledge Hub. Results revealed by the verification and validation exercise, suggest that it is essential that researchers in heavy engineering management advance beyond the mere appeal of knowledge sharing studies towards a more complete and detailed explication of knowledge management and organisational processes.

7.9 FRAMEWORK IMPLICATIONS

The growing trend in achieving knowledge economy status is giving rise to a need for the development of knowledge management based systems. As established in this study, oil and gas organisations in Niger Delta have recognised that one prerequisite for realising knowledge economy is that they need to invest in modern knowledge management based systems. Hence, the aim of this framework was to enable senior project management practitioners to implement knowledge management technology and people approaches. This framework comprises of:

- Knowledge management technology approaches;
- Knowledge management people approaches;
- Value enhancing practices;

- Strategies and practices.

On knowledge management technology approaches, senior managers must ensure that project workers have access to KMTA (Theme 1), KMTA (Theme 2) and KMTA (Theme 3) (*see Figure 7.2*). Senior managers must also ensure that their knowledge teams have access to a library of technical information that is aligned to processes and systems. In terms of knowledge management people approaches, a comprehensive collection of variables identified in KMPA (Theme 1) and KMPA (Theme 2) should include workflows that automate ideation and problem-solving approaches. These workflows will help senior managers and other project workers to define and analyse both soft and hard knowledge issues. This will depend on how senior managers integrate the tools and techniques identified in Figure 7.2. The variables outlined in Figure 7.2 a framework for how project leaders can think about the return on investment and maximising operational effectiveness.

As proposed in this study, this requires the integration of thinking and practice related to knowledge management. As suggested by the participants much can be achieved by embedding a systematic knowledge management platform, which includes technology and people, approaches. In applying the above, participants affirmed that best knowledge sharing practices can be captured at strategic, operational and project level. The proposed framework in this study has implications for senior project management practitioners who work with project teams and who are committed to enhancing knowledge management practices and productivity. The utilisation of the proposed framework would not instantly transform oil organisations in Nigeria into high performing ones; however, it does identify four key knowledge dimensions that need to be considered. From the above, it is hopefully, evident that in order to develop a culture that is supportive of knowledge management it is necessary for organisations to create awareness, invest in technology, human resource and develop expectation across the three levels of the organisation (strategic, operational and project).

7.10 FRAMEWORK IMPLEMENTATION AND BARRIERS

As established in this study, senior managers need to be aware of the benefits of knowledge management and give it a priority. During the validation, project leaders affirmed that successful organisations are typically those that have a clear vision,

leadership and appreciate the contribution of knowledge to business performance. To ensure the framework is implemented successfully, there has to be:

- A clear knowledge management strategy within the organisation;
- Awareness of knowledge management;
- Awareness of organisational culture;
- Standard work processes;
- Sufficient funding;
- Application of technology and knowledge management tools.

The above six variables can also be viewed as barriers, hence senior managers need to have effective mitigation processes in place.

7.11 CHAPTER SUMMARY

This chapter presented the results obtained from a validation exercise of the framework for knowledge management based systems in oil and gas organisations. The aim of the verification and validation was to measure the extent to which the proposed framework is valuable, complete, practical, and adequate. The proposed framework is intended to provide project leaders with an understanding and awareness of knowledge management strategies and practices. As illustrated in the verification and validation results, the two groups expressed willingness and a capacity to incorporate the framework into their organisations. Project directors from Nigeria and the UK attested to the importance of the framework and the belief that it will enhance their practices. In conclusion, it was revealed that the proposed framework provides a clear context for strategies and practices which contributes to improved performance, innovation and continuous improvement in the oil and gas sector. In the next chapter, recommendations and further research work are presented.

CHAPTER EIGHT: RESEARCH CONCLUSIONS AND RECOMMENDATIONS

8.1 INTRODUCTION

The aim of the research was to propose an integrated framework for managing knowledge repository in oil and gas projects. The resulting framework comprised of strategies and practices that could be used to address operational issues in Nigeria, and also promote effectiveness in managing knowledge based management systems. The research objectives were developed in Chapter One in order to achieve the aim of the research. The preceding chapter discussed the results of the research within the context of the objectives, literature, and theory. This chapter briefly highlights the key findings and draws conclusions from these. Finally, the chapter provides recommendations to industry and suggests areas for further research work based on the literature, findings, and discussion.

8.2 CONCLUSIONS OF THE STUDY

The research focussed on the experiences of project leaders in Nigeria and the UK. A number of significant issues have been identified that have not previously been discussed in the literature. The issues that have been identified relate to knowledge management based systems on oil and gas projects. The evidence from this research shows that there is an emerging trend in the development of knowledge management approaches as a research domain. The discipline is increasingly being informed by the experiences of senior project management practitioners across the world. On a fundamental level, it was confirmed that senior managers in Nigeria and the UK face similar threats. These threats manifest themselves differently depending on project context. As noted in this study, knowledge management based systems exist because project work in oil and gas projects is increasingly information intensive.

This research further established that the value that knowledge management technology and a knowledge-sharing culture can reap is being consistently demonstrated throughout the oil and gas sector in Nigeria and the UK. The researcher noted that collaboration tools in the UK have opened a new era for rapid and easy access to, and interchange with, senior project management practitioners and project workers regardless of where they reside. For example, oil and gas organisations in the UK,

expect suppliers to deliver electronic inventories of their products and services as a basis for improving their global operations.

Today's wide variety of oilfield electronic initiatives, some simple and others highly sophisticated, span activities from procurement, as just described, to the acquisition and divestiture of oil and gas assets. Concerning current practice in Nigeria and the UK, the research established that knowledge management based systems remains an unexplored area in Nigeria. It was found that project leaders in Nigeria face different problems from those in the UK. It is worth noting that project leaders in Nigeria face considerable cross-cultural challenges when implementing knowledge management technologies. The most formidable problems senior project management practitioners face in modifying project management to local needs include procedures, knowledge, and process. As discussed in the validation exercise, if a proper cultural strategy is implemented and managed by properly trained senior project management practitioners these difficulties can be overcome. The accruing benefits will extend to all the stakeholders involved with oil and gas project delivery in Nigeria. As identified in this research, policy issues are the main ones that face the oil and gas sector in Nigeria, and that policy reforms will improve knowledge management practices. In order to enhance knowledge management practices, oil and gas local organisations in Nigeria and the government need to work closely.

In relation to the importance of knowledge management based systems in delivering successful projects in the oil and gas industry of Nigeria, it was established that oil and gas project management could be characterised by a two-fold approach: that projects are said to comprise universal characteristics that can be managed with a common approach. Interestingly, there was a strongly held belief that the key to knowledge management based systems integration in oil and gas projects is making sure that organisations or an individual have the ability to adapt, and work with different technologies. Some of the notable differences between participants in Nigeria and the UK were the application of knowledge management practices. The qualitative findings showed that senior project management practitioners from UK have three primary content management initiatives in place:

- **The Knowledge Hub** - a key feature of the Hub is the seamless view it provides to the end user;

- **Real-time News** - is a news-based corporate portal hosted on the Hub. As suggested by participants, clients and employees can search, categorise and customise the data; and
- **The In Touch Knowledge Hub** - provides a single electronic interface for data exchange on oil products and services between the field and its technology centres.

Even though there were some differences between participants in Nigeria and the UK, the findings showed that some of the key lessons drawn from UK participants that could be utilised by participants in Nigeria are as follows:

- It is important to realise that knowledge management based systems and content management are the tools to help oil and gas organisations reach their business goals, and they are not the solutions in and of themselves;
- Craft a solution that is applicable across the project, and adopt an evolutionary approach as business needs require, rather than assume it will be a one-time technology that can be implemented;
- Putting aside technology and process, fundamentally the people involved in the knowledge and content management effort will really make the difference;
- The cost of initial content migration is substantial - not only will the company have to migrate existing content, but also much of that content will need to be revisited and revised before it is made available to the company population; and
- Time and money will inevitably be wasted due to failed technologies or technologies that don't live up to their promises. The tools to publish content should be very easy to use.

Concerning the extent to which knowledge management strategies contribute to adding value in oil and gas projects being delivered in Nigeria, it was established that some of the value added techniques used include: community of practice, collection method and best practice sharing system. It is essential for senior project management practitioners to ensure that they use internal and external benchmarking to determine what best knowledge practice is when delivering projects. As previously pointed out, the expansion of the electronic world brings with it major challenges such as computer and information security. What needs to be well understood is that security, confidentiality and protection

of proprietary information are vital in the relatively open environment of the Internet. These principles must be honoured because of the immense value of upstream exploration and exploitation data. The research also revealed that effective knowledge management based systems should dramatically increase speed of response as a direct result of better knowledge access and application. The application of more collective and systematic processes will reduce a practitioner's tendency to repeat the same mistakes.

In relation to strategies and practices which contribute to improved performance, innovation and continuous improvement in the operations of the oil and gas industry in Nigeria, the research identified the main categories that are central to improved performance, innovation and continuous improvement. These are databases, software tools, portals, groupware, communities of practice, best practices groups, peer review groups, knowledge management and human resource training. There is no doubt that knowledge management has constituted substantially to the success of UK organisations. Despite the enthusiasm with which organisations in Nigeria have embraced IT-based knowledge management systems to increase value and efficiency, implementing such systems has proven difficult. As shown in this study, successful knowledge management based systems requires the aligning of business strategy, technology for knowledge management, project management strategy with an enterprise-knowledge sharing culture. Such sharing requires managing the behaviour of project workers such that knowledge transfer becomes part of the organisation's norm.

Being familiar with organisational culture empowers organisations with the requisite knowledge for improving the efficiency of delivering projects. It is worth noting that although the scope of this research was restricted to projects in Nigeria and the UK, the geographical focus of this research does not invalidate these results with respect to other countries. The fact is that the oil and gas sector globally shares some common fundamental characteristics. Nigeria and the UK were simply used as case studies to examine broader issues and problems of the industry. Furthermore participants from the UK have shown that knowledge management infrastructure can be a cost-effective means of addressing new and/or increasingly pertinent operational issues in the oil and gas sector. If anything, the Nigerian and the UK cases represent an exceptional and a particularly convincing example because they constitute participants from a developed and developing environment.

In general, terms, there are similarities in the fundamental characteristics of practice of project management in the oil and gas sector in both Nigeria and the UK. Consequently, there are number of additional factors to be considered. The implementation of knowledge management based systems requires deliberate planning and action to create the conditions for success and put in place the strategy, leadership, goals, process, skills, systems, issue resolution, and structure to direct and exploit the dynamic nature of project work.

The strategies proposed in this research cannot be expected to resolve all knowledge management issues in the oil and gas sector in Nigeria. However, their use defines an approach that is superior to the traditional approaches typically adopted and consequently merits far wider application. However, what does this mean for senior managers in Nigeria? The engagement of employees will require the reformulation of perceptions and expectations about job responsibilities and performance such that knowledge-related activities are accepted as a normal part of the job. In aligning knowledge management strategies with business strategies, senior managers need to identify the following:

- What types of knowledge management based systems are necessary for the organisation viability; and
- What data is to be used;
- They need to prioritise and filter their knowledge management based systems depending on how much; the technology would contribute to realising their goals.

It is worth noting that knowledge accumulation and sharing will occur voluntarily and cannot be conscripted. Knowledge management based systems are only used when knowledge sharing activities are supported by trust and appropriate tools. The knowledge management framework comprises of seven well-defined stages. All these steps emerged as being related; they are comprised of independent variables. These steps were found to comprise of knowledge management technology approaches, knowledge management people approaches, knowledge management strategies and value enhancing practices. The research verified that these steps define a model for project leaders to use in content management. As established in this research, content management systems of people, processes and technology provide meaningful and timely information to project teams by creating processes that identify, collect, categorise and refresh content using a common taxonomy across the project life cycle. The

framework was considered useful for oil and gas organisations in Nigeria since it addressed most of the requirements that are necessary for organisations to achieve operational effectiveness. In summary, the proposed framework presents a better way of optimising the performance of project-based operations thus enabling oil and gas organisations in Nigeria to reform their poor performance on projects and empower them to better manage emerging cultural challenges in their future projects.

8.3 CONTRIBUTION TO THE RESEARCH

The research has established that when implementing knowledge management based systems project teams and project leaders need to take into account the influence of innovation, behaviour, values, beliefs, and cultural background of individuals. There is a need to pursue new directions in knowledge management in oil and gas projects given that with globalisation, technological issues in oil and gas have become more complex than ever before. Content in the oil and gas sector is growing uncontrollably. Taxonomies, coupled with auto-classification can help with classification of data. Without taxonomy, the very basic task of search becomes the weakest link in deriving knowledge because information that cannot be found cannot be used. If it cannot be used it has no value. Content represents corporate memory, without the ability to access these content assets, the corporate memory is eroded and forgotten. With the rise, albeit slow adoption by end users, of business social applications, the opportunity exists more than ever before to capture the knowledge of an often aging workforce, to provide the intersection between content assets and knowledge assets. Collaboration, loosely tied to social, can also be transformed into knowledge. All of these functions can be tied back to the taxonomy, or taxonomies, to essentially maintain and refine corporate memory so it becomes a highly usable tool for knowledge management.

8.4 RECOMMENDATIONS TO THE INDUSTRY

Following an analysis of the findings, a number of recommendations can be formulated which need to be addressed by the industry if energy demands continues to grow on a global basis. These are:

- It would be essential for oil and gas companies to join organisations across all industries in seeking ways to improve overall operational efficiency. As established in this study, communities of practice are the next step in the evolution of the modern, knowledge-based approach to process and productivity improvement;

- In order to realise and enhance knowledge management practices in Nigeria, the government should commit itself to leading by example in works it commissions as the client. This can be effected through the Federal Ministry of Petroleum Resources. The Government will need to appoint an independent project management body to lead in implementing recommendations. Getting the right people with the right skills should be a priority for the industry. In addition, there should be an emphasis on modernising and enhancing the existing skills and management abilities of its existing staff;

- As the main regulatory body in Nigeria, it is essential for the government to ensure that oil and gas organisations deliver value for money to clients. It should ensure that the existing laws and codes allow project teams to develop new ways of working more efficiently on projects. To achieve the above, the Nigerian government will need to intensify the existing efforts aimed at eradicating corrupt practices within the industry.

8.5 RECOMMENDATIONS FOR FURTHER RESEARCH

The study has achieved its aim of developing a knowledge management framework for oil and gas projects. Although the findings have universal applicability, it will be important to conduct follow-up research validating the potential for using the results of this study to establish frameworks for knowledge and information management in different organisations and contexts. This will provide not only data about the validity of the framework in generic terms but will also generate additional data on the application of knowledge management strategy. There are some issues that were not covered in-depth but have been identified as themes for subsequent research. These issues have been outlined as very specific recommendations for further research below:

- There is a need for the oil and gas industry to develop further its appreciation of the different cultural factors that influence the application of knowledge management strategies. This calls for comprehensive research into value enhancing practices, including the unique features of oil and gas projects, technological characteristics of projects, and socio-cultural differences. The practice of knowledge management within the oil and gas sector will greatly benefit from such studies especially if they not only identify the influencing factors but also establish if any co-dependencies exist among these factors;

- It was established that knowledge based systems have different tolerances for uncertainty. Such considerations need to be taken into account in further research focussing on examining factors that can be used to manage knowledge-based systems' uncertainty in oil and gas projects;

- Although there has been significant research into decision support systems in Western economies, there has been little done to address this theme in developing countries. The focus of existing studies has been on the use of customer relationship management. This highlights the need for research work examining the application of decision support systems and group support systems in the oil and gas sector in developing countries;

- There is a growing demand for geographic information systems and knowledge based systems to help senior project management practitioners working in emerging economies to deal with large and complex oil and gas projects. Further studies in this area will help the managers to process and analyse large data;

- Gender representation has emerged as an important aspect of increasing team productivity through diversity. The oil and gas industry still needs to attract and retain female employees. It has been established that women in non-traditional occupations face unique challenges which if not adequately addressed will undermine any organisation's existing team integration efforts. In order to address properly the gender specific challenges, there should be further studies focussing on such issues. Such studies should explore the national, social, cultural, and economic factors, which perpetuate the stereotypical masculine image of the oil and gas industry.

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APPENDICES

APPENDIX A-QUESTIONNAIRE COVERING LETTER

The School of Built Environment
Liverpool John Moores University
Byrom Street
Liverpool
L3 3AF
Email: O.Ovbagbedia@2012.ljmu.ac.uk

Company Address

Dear……..,

I am currently undertaking a PhD entitled 'Framework for knowledge management in oil and gas projects'. My research focuses on knowledge management strategies. The first stage of the work necessitates a survey of Nigerian and the UK senior managers so as to establish the importance of knowledge management tools and techniques.

The main research objective focuses on identifying strategies and practices which contribute to improved performance, innovation and continuous improvement in the oil and gas sector. It is my belief that ascertaining the knowledge management success criteria from senior managers who are directly involved with projects, will greatly assist in the provision of the most appropriate knowledge management framework. The decision to choose your organisation was based on the excellent background your company has had on project management.

I would be very grateful if you could kindly assist me in arranging the participation of your senior managers in this study. The questionnaire (please see attached postal questionnaire) should take no longer than **30** minutes to complete and will provide, as I have mentioned, vital information for my research. You are assured of confidentiality and that any identifying information will be destroyed at the data processing stage of the research. Please be assured that the identity of your senior managers and your organisation shall remain strictly confidential.

Hopefully the research will provide a comprehensive review of success factors of knowledge management on oil and gas projects and reveal some factors that influence value enhancing practices. If you would like a summary of the research findings I should be pleased to forward a copy on completion of the survey.

Given the constraint of time it would be helpful if the questionnaires were ready by the end of March. If you have any further questions or would like a discussion with me please contact me on **[deleted]** or leave a message to call you back as soon as possible.

Your assistance and co-operation in this research will be welcome and gratefully received; I hope you will be able to assist in furthering my research studies. Once again if you have any queries please do not hesitate to contact me.

Yours sincerely,

Marho Ovbagbedia
PhD research student

APPENDIX B-QUESTIONNAIRE

SURVEY QUESTIONNAIRE ON KNOWLEDGE MANAGEMENT

United Kingdom Return Address
Marho Ovbagbedia
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Nigerian Return Address
Marho Ovbagbedia
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Notes about the Questionnaire:

As is the case with many questionnaire surveys there may be some questions that appear, irrelevant or impertinent. However, it is necessary in this research that all questions are answered, as the questionnaire is designed to achieve particular research objectives, and it is hoped not to offend participants in any way. If there are any questions, which you are unwilling or unable to answer, then it is my wish that you continue to answer the remainder of the questionnaire. **Remember that both your identity and that of the company you work for will remain strictly confidential.**

A. Background Information: Please put a tick in one box only and fill in where necessary.

1. Are your organisations' operations focused solely on oil and gas activities?

Yes [ ] No [ ] Other [ ] please specify

2. Please state your current job title.
Project director [ ] Project manager [ ] Project Planner [ ] Client [ ] Other [ ] (please specify)

3. How long have you worked within this sector?
Less than a year [ ] 1-5 years [ ] 6-10 years [ ] 11-15 years [ ] Over 15 years [ ]

4. What is your gender: Male [ ] or Female[ ]

Knowledge Management: there is real difficulty in retaining relevant knowledge (Tacit and Explicit) within an organization Please indicate to what extent you agree or disagree with the following definition, by circling **(O)** the appropriate number.

Strongly Agree	Agree	Disagree	Strongly Disagree
1	**2**	**3**	**4**

SECTION 2: KNOWLEDGE MANAGEMENT TECHNOLOGY VARIABLES

SECTION 2A: The following is a list of factors which are associated with knowledge management technology approaches. Please indicate (i.e. tick **(√)**) the extent of level of importance on each factor using a scale from 1 to 5 where: **1** indicates 'very important'; **2** 'important'; **3** 'fairly important'; **4** 'slightly important 'and **5** 'not important'.

Level of importance	**VI**	**I**	**FI**	**SI**	**NI**
Knowledge management technology approaches (KMTA)					
THEME 1: KMTA					
Collaborative technologies					
Instant messenger					
Intranets					
Records and information management					
Search					
Web 2.0-Blogs					
THEME 2: KMTA					
Web 2.0-Folksonomies and tagging clouds					
Web 2.0-Social networking					
Web 2.0-Wikis					
Case based reasoning systems					
Group discussion support system Artificial neural networks					
Semantic search engines and link machines					
Tags					
THEME 3: KMTA					
Communication and collaboration systems					
Document management system					
Content management system					
Knowledge mapping tools					

SECTION 2B: The following is a list of factors which are associated with knowledge management people approaches. Please indicate (i.e. tick **(√)**) the extent of level of importance on each factor using a scale from 1 to 5 where: **1** indicates 'very important'; **2** 'important'; **3** 'fairly important'; **4** 'slightly important 'and **5** 'not important'.

Level of importance	**VI**	**I**	**FI**	**SI**	**NI**
Knowledge management people approaches					
THEME 1: KPMA					
After action review					
Community of practice					
Embed in organisational HR					
Gone well/not gone well exercise					
Knowledge audit					
Knowledge bank					
Knowledge café					
THEME 2: KMPA					
Knowledge centre					
Knowledge market place					
Leading practice-identifying and sharing					
Narrative project case study					
Peer assist					
UK=66, Nigeria=66 **Total**=132					
Measuring instrument: Very important **(VI)**, Slightly important **(SI)**, Not important **(NI)**, Important (I), Fairly important **(FI)**					

SECTION 3: How **satisfied** are you that your organisation can successfully implement knowledge management tools? Please circle **(O)** the appropriate number.

	Very satisfied	**Satisfied**	**Fairly satisfied**	**Not satisfied**
Knowledge management tools	1	2	3	4

If there was one thing that you feel is not working properly and you would like to change, what would it be?

Thank you very much for taking part in this survey. If you would like a summary of the results, please enter your name and contact address below.

Name: **Contact Address:**

APPENDIX C-SEMI-STRUCTURED INTERVIEW QUESTIONS TO PARTICIPANTS

Background:
This research is part of a PhD study conducted in order to increase understanding in the area of knowledge management, and to define best practices that organisations use in knowledge management and how it influence projects. Information gathered is for a university study and will not be used for any other reason. Please be aware that your responses will be confidential. All personal information obtained through this research will remain confidential

1. Brief background:

(i) Describe your role and responsibility in the organisation?

(ii) What type of project do you work on?

(iii) What are key problems you face when implementing knowledge management strategies?

2. What are the key stages when implementing knowledge management tools and techniques?

3. Does your organisation encourage knowledge management in any form?

4. What are the main steps in achieving a widespread commitment on knowledge management?

5. What are the barriers you've encountered in achieving a widespread commitment?

6. What are the technical aspects, cultural complexity, procedure, difficulties, aims and objectives of integration on your projects?

7. Does your organisation have an existing knowledge management repository?
How successful / beneficial is it?

8. Does the knowledge management repository add value or improve project delivery?

9. How satisfied are you that your organisation can use contemporary knowledge management tools?

10. If there was one thing that you feel is not working properly and you would like to change, what would it be?

APPENDIX D-CONSENT LETTER TO CHIEF PROJECT MANAGERS

The School of Built Environment
Liverpool John Moores University
Byrom Street
Liverpool
L3 3AF
Email: O.Ovbagbedia@2012.ljmu.ac.uk

Chief Project Manager
Company Address

Dear……,

I am currently undertaking a PhD entitled 'Framework for knowledge management in oil and gas projects'. My research focuses on knowledge management strategies. The first stage of the work necessitates a survey of Nigerian and the UK senior managers so as to establish the importance of knowledge management tools and techniques.

The main research objective focuses on identifying strategies and practices which contribute to improved performance, innovation and continuous improvement in the oil and gas sector. It is my belief that ascertaining the knowledge management success criteria from senior managers who are directly involved with projects, will greatly assist in the provision of the most appropriate knowledge management framework. The decision to choose your organisation was based on the excellent background your company has had on project management.

As a PhD research student at Liverpool John Moores University, I have a growing interest in finding out how senior managers have successfully implemented knowledge management tools in oil and gas projects and avoided the pitfalls and difficulties.

Your senior manager's participation in this project will eventually help to enhance the understanding of value enhancing practices in oil and gas projects. You are assured of confidentiality and that any identifying information will be destroyed at the data processing stage of the research. Please be assured that the identity of your senior managers and organisation shall remain strictly confidential.

Hopefully the research will provide a comprehensive review of success factors of knowledge management on oil and gas projects and reveal some factors that influence value enhancing practices. If you would like a summary of the research findings I should be pleased to forward a copy on completion of the survey.

If you have any further questions or would like a discussion with me prior to making up your mind please contact me on **[deleted]** or leave a message to call you back as soon as possible. Your assistance and co-operation in this research will be welcome and gratefully received; I hope you will be able to assist in furthering my research studies.

Yours sincerely,

Marho Ovbagbedia
PhD research student

I hereby agree/not agree for my organisation to participate in this study. I understand that all information gathered during the study will be treated as strictly confidential.

Name: ----------

Date: ----------

Telephone: ----------

Address: ----------

If you do not wish to participate in the study, I would be grateful if you would sign above and please feel free to write down the reasons for refusing.

APPENDIX E- VERIFICATION QUESTIONNAIRE

KNOWLEDGE MANAGEMENT TECHNOLOGY APPROACHES

The following is a list of factors which are associated with knowledge management technology approaches. Please indicate (i.e. tick (√)) the extent of level of importance on each factor using a scale from 1 to 5 where: **1** indicates 'very important'; **2** 'important'; **3** 'fairly important'; **4** 'slightly important 'and **5** 'not important'.

Level of importance	**VI**	**I**	**FI**	**SI**	**NI**
Knowledge management technology approaches (KMTA)					
THEME 1: KMTA					
Collaborative technologies					
Instant messenger					
Intranets					
Records and information management					
Search					
Web 2.0-Blogs					
THEME 2: KMTA					
Web 2.0-Folksonomies and tagging clouds					
Web 2.0-Social networking					
Web 2.0-Wikis					
Case based reasoning systems					
Group discussion support system Artificial neural networks					
Semantic search engines and link machines					
Tags					
THEME 3: KMTA					
Communication and collaboration systems					
Document management system					
Content management system					
Knowledge mapping tools					

The following is a list of factors which are associated with knowledge management people approaches. Please indicate (i.e. tick (√)) the extent of level of importance on each factor using a scale from 1 to 5 where: **1** indicates 'very important'; **2** 'important'; **3** 'fairly important'; **4** 'slightly important 'and **5** 'not important'.

Level of importance	**VI**	**I**	**FI**	**SI**	**NI**
Knowledge management people approaches					
THEME 1: KPMA					
After action review					
Community of practice					
Embed in organisational HR					
Gone well/not gone well exercise					
Knowledge audit					
Knowledge bank					
Knowledge café					
THEME 2: KMPA					
Knowledge centre					
Knowledge market place					
Leading practice-identifying and sharing					
Narrative project case study					
Peer assist					
UK=66, Nigeria=66 **Total**=132					
Measuring instrument: Very important **(VI)**, Slightly important **(SI)**, Not important **(NI)**, Important (I), Fairly important **(FI)**					

APPENDIX F-VALIDATION QUESTIONNAIRE

The following is a list of factors which are associated with knowledge management framework proposed in this study. Please indicate (i.e. tick **(√)**) the extent of level of agreement on each variable using a scale from 1 to 5 where: **1** indicates 'strongly agree'; **2** 'agree'; **3** 'uncertain'; **4** 'disagree' and **5** 'strongly disagree'.

Level of agreement	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
Knowledge management technology approaches (KMTA)					
THEME 1: KMTA					
Collaborative technologies					
Instant messenger					
Intranets					
Records and information management					
Search					
Web 2.0-Blogs					
THEME 2: KMTA					
Web 2.0-Folksonomies and tagging clouds					
Web 2.0-Social networking					
Web 2.0-Wikis					
Case based reasoning systems					
Group discussion support system Artificial neural networks					
Semantic search engines and link machines					
Tags					
THEME 3: KMTA					
Communication and collaboration systems					
Document management system					
Content management system					
Knowledge mapping tools					

The following is a list of factors which are associated with knowledge management framework proposed in this study. Please indicate (i.e. tick **(√)**) the extent of level of agreement on each variable using a scale from 1 to 5 where: **1** indicates 'strongly agree'; **2** 'agree'; **3** 'uncertain'; **4** 'disagree' and **5** 'strongly disagree'.

Level of agreement	**Strongly agree**	**Agree**	**Uncertain**	**Disagree**	**Strongly disagree**
Knowledge management people approaches					
THEME 1: KPMA					
After action review					
Community of practice					
Embed in organisational HR					
Gone well/not gone well exercise					
Knowledge audit					
Knowledge bank					
Knowledge café					
THEME 2: KMPA					
Knowledge centre					
Knowledge market place					
Leading practice-identifying and sharing					
Narrative project case study					
Peer assist					
UK=66, Nigeria=66 **Total=**132					
Measuring instrument: Very important **(VI)**, Slightly important **(SI)**, Not important **(NI)**, Important (I), Fairly important **(FI)**					

12. Please comment on how the model can be improved if any.
