Evaluation of Information Systems Deployment in Libyan Oil Companies:

Towards an Assessment Framework

HOSIAN AKEEL

A thesis submitted to
the University of Gloucestershire
in accordance with the requirements of the degree of
Doctor of Philosophy
in the Faculty of Media, Arts and Technology

September 2013

ABSTRACT

This research work provides an explorative study of information systems deployment in two oil companies in Libya, one domestic and one foreign. It focuses on evaluation, review and assessment methodologies for information system deployment in oil companies in Libya. It also takes into consideration related issues such as information systems strategies and strategic business alignment with information systems.

The study begins with an overview of information systems deployment in Libyan-based oil companies. The study thereafter reviews Libya as a business environment and provides a literature review on information systems deployment, information systems strategies and existing assessment models for information systems deployment. A case study of each company is then presented.

The research investigates information systems deployment along with associated business functions in the Libyan-based oil companies chosen as case studies. Detailed analysis of information systems deployed in the company has been carried out, following a comprehensive information gathering process from the case study companies. The analysis was done using existing scholarly models which include process mapping, system portfolio analysis, Nolan's model, Zuboff's model, the CPIT model and the MacFarlan-Peppard model. Earl's model and Gottschalk's model have also been reviewed in the literature and used to provide insightful analysis of the information system strategies of the case study companies.

In the concluding section of this research work, a framework is established for the assessment of information systems deployment in similar business contexts - starting from the basis of process analysis and the information systems used, considering interfaces and linkages of the information systems and the suitability of the information systems in similar business contexts. The developed framework builds on the foundation of the existing assessment models for information systems deployment. This newly developed framework presented in this study is the contribution of this research work to knowledge. The developed framework is suited to assessing information systems deployment in oil companies in Libya and can be adapted to other oil companies in developing countries.

DECLARATION

I declare that the work in this thesis has been carried out in accordance with the regulations of the University of Gloucestershire and it is original except where indicated by specific reference in the text. No part of this thesis has been submitted as part of any other academic award. The thesis has not been presented to any other education institution in the United Kingdom or overseas.

Any views expressed in this thesis are those of the author and in no way represent those of the university.

Signature: Date: 31/03/2014

ACKNOWLEDGEMENTS

DEDICATION

I dedicate this research work to:

- The memory of my mother who passed away while I was studying for my PhD: Salima Ali.

- My wife and baby: Safia Agil and Salma Akeel.

- My entire family and friends.

Table of Contents

List of Figures

List of Tables

CHAPTER ONE - INTRODUCTION

The Libyan economy remains largely state controlled and completely dependent on the revenues from the export of crude oil and natural gas. At the same time, oil and gas revenues depend heavily on the scale of activities of foreign oil companies. Since 2003, the Libyan Government has permitted foreign oil companies to restart and resume oil production and businesses in Libya (Blanchard, 2008, p. 4). Ever since the issuance of this permission, the Libyan oil industry has developed significantly until the beginning of the Libyan war in 2011 when Libyan oil production suffered and almost came to an end. However, Libyan oil production rebounded from a near-stoppage to more than 1 million barrels of oil per day in the months following the death of Libyan leader Moammar Gadhafi in October, 2011 and this has continued more recently (Mikail, 2012, p. 6). It is thus interesting to explore if there is any difference or similarity between the deployment of information systems and information systems strategies in both foreign oil companies and domestic oil companies in the country.

Ever since the lifting of the sanctions in 2003, Libya has changed in many dimensions, mainly on the economic front. However, information technology is still a relatively new concept in the country and its use in Libya is minimal; for example, there does not appear to be a strategy for information technology deployment within Libyan society (Al-Mabrouk and Soar, 2009, p. 109). Currently, studies on the operational deployment of information systems and their underlying information systems strategies is of high importance in Libya, as the level of information technology in the country is growing and developing (Windsor and Kessler, 2007, p. 4). Not only will the oil industry in Libya benefit from this work, but many other types of businesses and organisations in the country are also potential beneficiaries, as they will be able to find a guide to assessing and improving their information system deployment and information system strategy.

Van Akkeren and Cavaye (1999) explained that an information system is a system which allows man, machine and material to interface, using information and communication technology resources, all coming together to produce specific products or services which satisfy the customers' needs. According to Alter (2006), an information system is a work system whose activities are devoted to processing (capturing, transmitting, storing, retrieving, manipulating and displaying) information. Studies have revealed that appropriate deployment of information systems and their proper usage has provided immense support and given increased successes to different businesses (van Akkeren and Cavaye, 1999, p. 36). Hence,

the appropriate deployment and proper assessment of the deployed information systems in Libyan based oil companies will provide significant business support for companies and also increase their business successes.

This chapter consists of five sections (Section 1.1 to 1.5). Section 1.1 discusses the purpose of this research work. Section 1.2 and 1.3 discuss the research objectives and research ethics respectively. Section 1.4 presents the structure of the entire thesis while Section 1.5 gives a summary of Chapter One.

1.1   Purpose of the Research

In developed countries of the world, the development of society including information technology, mostly takes place gradually and in harmony with the environment. Nearly all technological tools are invented and developed at a similar speed, so there is some sort of balance in the progress of technology in developed countries. However, in a developing country such as Libya, such balance may not exist, so some fields may develop more quickly than others. In Libya, information technology is a fast growing area and the concept of the deployment of information systems and information systems strategy has been recently introduced. However, there are several imbalances in the growth of different areas of information technology in Libya, and there are many issues that need addressing in any successful deployment of information systems in companies in the country. Some of the issues include: lack of organizational readiness for the information systems deployment; inadequate support for the needed change as a result of the deployed information systems; lack of standards for business alignment with strategic changes that are required with the assessment outcome of the deployed information systems; inadequate top-management support and user involvement in the deployed information systems; and unrealistic expectations from the deployed information systems (Twati, 2008, p. 8).

The purpose of this research is to develop a comprehensive framework with which deployed information systems in Libyan based oil companies can be assessed. The new framework will be built on the existing standard models in the field of computing, for assessing information system deployment. The main reason for choosing the oil companies as the basis of this research is because the main source of income and the main driver of the Libyan economy is oil (New Nations, 2006, p. 1) and 95% of Libyan revenue in recent times has been generated from the export of oil (Net News Publishers, 2008, p. 1). The motivation for conducting this research and the importance of this study arose from the need to introduce

and develop a new framework that is more specific for the needs of Libyan based oil companies, and as a tool to assess the deployed information systems in line with adopted information system strategies in the oil companies. This new framework will provide a guide for Libyan based companies whenever there is need for:

1. New deployment of information systems in Libyan based companies.
2. New adoption of information system strategies in Libyan based companies.
3. Changes in the deployed information systems of Libyan based companies.
4. Changes in information system strategies adopted by Libyan based companies.
5. Review and assessment of deployed information systems in Libyan based companies.

As stated in the two earlier paragraphs above, the purpose behind this research is to investigate information systems and information system strategies in oil companies in Libya. This investigation will be carried out with a focus on creating a new framework for assessing the deployment of information systems in Libyan based oil companies. The main reason for choosing the oil companies as the basis of this research is because, in Libya, the main source of income and the main driver of the national economy is oil industry (Encyclopaedia of the Nations, 2009, p. 2; Rivlin, 2011) and 95% of revenue of the Libya comes from the export of crude oil (Net News Publisher, 2008; Rivlin, 2011, p. 5). Hence, the outcome of this research will be of immense importance for oil companies in the country. This study also investigates the deployment of information systems and implementation of information systems strategies in a domestic and a foreign oil company in Libya.

In addition, the study looks into methods used by the companies for their information system strategies, the main factors and elements affecting the ways information systems are deployed and implemented. In addition, it identifies a set of differences and similarities in the two companies' information systems deployment. The study gathers data and information on the information systems deployment in the companies and on all other related matters such as information system strategy, process flows, and information system usages. This is achieved by means of questionnaires and semi-structured interviews that are used to gather data from employees of the oil companies in Libya. Detailed accounts of the participants, methodology and strategy applied for the completion of this study have been provided in the following sections.

1.2   Research Objectives

The overall aim of this thesis is to investigate and analyse the way that information system strategies are adopted and information systems are deployed in Libyan oil companies with consideration given to both domestic and foreign oil companies in the country. This will be done by:

1. Investigating the currently deployed information systems and adopted information system strategies in both the domestic and foreign oil companies in Libya.

2. Investigating if there is any significant difference or similarity between the information systems and information system strategy implemented in these two types of oil companies.

3. Assessing information system deployment in two case study companies against mainstream conceptual models assessed in a literature review.

4. Developing an empirically based framework for assessing information system deployment in Libyan based oil companies. The framework will serve as a model and guide to support any new oil company in Libya in their new information systems and information system strategy implementation. The framework will also help existing oil companies in the country to evaluate their information systems and information system strategy for possible strategic or tactical improvements and upgrades.

1.3   Research Ethics

In this study, the main data and information are taken from resources and materials of the chosen Libyan based oil companies. The data was gathered with the consent of the companies and their staff who participated in completing the questionnaire and granting interviews. The data gathered will only be used for the academic purposes. All the required work that is part of this research has been conducted according to the ethical regulations of the University of Gloucestershire, United Kingdom. Without the approval of the appropriate authorities from the case study companies, the data and information provided in this research work cannot be used or copied in any form. The names of all personnel involved in interviews and questionnaire responses have been coded to ensure anonymity.

1.4   Thesis Structure

This thesis is divided into seven chapters. Chapter One is the introductory chapter which introduces the purpose and objectives of the research work. The case study companies for this research work are oil companies in Libya. Hence, Chapter Two gives an overview of

the oil companies in Libya. Chapter Three contains the review of literature that is related to the research area of this study – information systems deployment and their assessment. It also specifies the research questions, which are based on original research objectives and the analysis of existing literature. Chapter Four presents the research methodology as well as the actual case study companies where the research was carried out. The gathered data and findings from the case study companies are presented in Chapter Five. Building on the previous chapters, the collected data in this research work are analysed and discussed in Chapter Six. The final chapter, contains the conclusions and recommendations of the research work based on the gathered data that have been analysed and discussed in Chapter Six. Chapter Seven is followed by the section of references and appendices.

1.5   Summary

This chapter has presented the foundation elements of this research work. A general overview of Libya and its oil industry was given followed by a brief discussion on the information system usage in the companies in the Libyan oil industry. Next, the purpose and strategies in both the domestic and foreign oil companies in Libya were discussed. Also presented in this chapter are the research objectives, which include, but are not limited to: investigating if there is any significant difference or similarity between the information systems and information system strategies implemented in these two types of oil companies, and assessing the information system deployment in two case study companies against mainstream conceptual models assessed in the literature review. The ethical standards complied with in this study as well as the structure of the entire thesis report is presented. Chapter Two gives a more detailed survey of oil companies in Libya, economic background, political background and other relevant related issues with Libyan oil companies. Chapter Two further discusses the two case study companies where the study presented in this research work has been carried out.

CHAPTER TWO – AN OVERVIEW OF OIL COMPANIES IN LIBYA

This chapter discusses the relevant information about the oil and gas industries in Libya, in relation to the political, economic and cultural dimensions of the country that affect the oil and gas sectors. This chapter will also examine the deployment of information systems in Libyan companies as part of the backdrop to the Libyan oil sector, as well as seeking to provide an understanding of the influential political, economic and cultural factors that are important for the deployment of information systems in the country. The two chosen case studies of oil companies in Libya are also presented in section 4.8 of chapter four. The reasons for the choice of the two case study companies were also explained. In order to understand the factors that influence the implementation of information systems in Libya, a detailed explanation of the business culture in Libyan organisation – especially in the oil industry - has also been provided.

2.1   General Overview of Libya

Libya is the fourth largest country in the African Union, covering a geographical area of 1,774,440 square kilometres (Terterov and Wallace, 2002, p. 57). The Mediterranean Sea flanks it in the North, in the east it is bordered by Egypt and Sudan, in the south by Niger, Chad and Sudan and in the west by Tunisia and Algeria. Within Libya, 90% of the land is made up of desert or semi-desert. The climate of Libya is hot in the South, as it is dominated by the Sahara desert, and moderate along the coast of the Mediterranean Sea (Infoplease, 2010, p. 2).

Terterov and Wallace (2002) estimated the population of Libya to be 5.5 million; this number includes foreigners residing in the country. The Libyan population is growing rapidly; indeed, it has the highest growth rate in the world, growing at a rate of 3.5 percent per annum. In Libya, 5% of the population is under 20 years of age, making it a country of young people. 86% live in urban areas. This is the highest urbanisation rate in the world (Terterov and Wallace, 2002, pp. 65 - 78).

Libya is a member of the Organization of Petroleum Exporting Countries (OPEC) and it is known to hold the largest oil reserves in Africa and it is also the largest supplier of oil in North Africa to Europe (Frynas and Paulo, 2007, p. 233). The proximity of North Africa to Europe means that supplies to Europe from this source are both cost effective and can be speedily delivered. The 2008 BP Statistical Energy Survey states that in 2007 Libya was producing, on average, 1847.7 thousand barrels of crude oil per day, which was around 2.2%

of the world's total crude oil production per day in 2006 (Frynas and Paulo, 2007, p. 236). Libya has an oil-based economy which supplies between 75% and 90% of the revenues of the state of Libya (Frynas and Paulo, 2007, p. 242).

The Libyan economy has little in common with its North African neighbours but can, more readily, be compared with those Persian Gulf states that export oil which, although small, gain a considerable income from their export of oil, as does Libya, which has an extensive territory but relatively small population, totalling only 5.6 million at the time of the 2006 census (Central Intelligence Agency, 2009, p. 1). By far, the largest producer of oil in Libya is the National Oil Corporation (NOC), which is owned by the state and which, together with its smaller subsidiaries, produces approximately 60% of the oil output of Libya. Of this company's subsidiaries, the Waha Oil Company is the predominant upstream producer of its crude oil (Fattouh and Darbouche, 2010, p. 1125).

There has been continual discovery of crude oil in Libya up to the present date (2013). In 2009, hydrocarbon deposits were found in the Ghadames Basin in Libya by Verenex Energy, a Canadian company, and Woodside Petroleum, an Australian oil company, providing a further boost to the Libyan oil and gas industry. In addition, together with the Arabian Gulf Oil Company, the National Oil Corporation of the oil and gas industry of Libya discovered resources of oil and gas in 2008, again in a part of the Ghadames Basin. The Libyan oil and gas industry has been vital for the economic growth of Libya, generating massive investment which has been the foundation of infrastructural development in Libya. Work has been undertaken to develop the capacity of Libya's oil and gas industry, and there are plans to increase the oil output per day in Libya (Economy Watch, 2010, p. 2).

Taking into account these frenetic activities in the oil and gas sector, it is clear that there is an urgent need for a solid foundation for the mammoth task of information management in Libya. This study makes an attempt to support the enormous requirements needed to fill this need, created by the requirement for proper deployment of information systems to cater for the emerging and growing industries in the Libyan oil and gas sector.

2.1.1   Political Background to Libya

It was on the 1st of September 1969 that Colonel Muammar Gaddafi and a group of army officers overthrew the then existing royal government and started a new epoch in the history of Libya. In 1976, Muammar Gaddafi, Libya's leader brought in a plan to restructure Libya. This plan was to ensure that Libya would henceforth be governed by a new delegate body known as the General People's Congress - GPC, and to then establish the Socialist

People's Libyan Arab Jamahiriya - SPLAJ (Ham, 2002, p. 27). In 1977, the GPC was established as the highest legislative and executive authority in Libya (Encyclopaedia of the Nations, 2009, p. 6). Hence, the supreme governing power in Libya was vested in the GPC. The GPC had 11 Secretariats of State, each one headed by a Secretary of State (Minister). The 11 Secretariats were Foreign Affairs, Finance, Economy/Foreign Trade, Culture, Manpower/Training, Power, Planning, Sport, Youth, Energy, Justice, General Security and Tourism (Encyclopaedia of the Nations, 2009, p. 8).

The Libyan crisis which began in February 2011 led to the killing of Muammar Gaddafi, and the political leadership of the country changed afterwards and now resides in an interim administration – National Transitional Council (NTC). The NTC Chairman is Mustafa Abdul Jalil and the NTC Prime Minister is Abdurrahim El-Keib. The NTC is very weak as a central control body for political activities in the post-crisis Libya. This has resulted in most oil companies not functioning at their normal capacity, thereby having some negative effects on the continuous data gathering process for this research work (Lacher, 2012, p. 39). In another research work, St. John (2012) notes that the NTC has been unable or unwilling to use all of the political and economic tools at its disposal to disband the militias. The competing revolutionary narratives of the militias, many of whom profess exaggerated roles in the revolution and offer contrasting versions of legitimacy, are central to the current dilemma (St. John, 2012, p. 11). This unbalanced political climate has not allowed the oil companies in Libya to function at their normal capacity. This has a direct bearing on the information systems deployment and usage in the country as some of the infrastructure is sometimes destroyed causing disruptions in the functionalities of the deployed information systems.

2.1.2 Economic Background

The Libya that exists today, which is one of the countries producing the largest amount of oil in the world, has grown out of one of the poorest countries in the world. At the time that Libya gained its independence in 1951, it was largely an agrarian society with more than 70% of the population working on the land in order to supply about 30% of Libya's GDP. The discovery of oil changed Libya from being one of the poorest countries in the world to one where there is substantial social and economic development (Terterov and Wallace, 2002, p. 47). Unlike most of Libya's North African neighbours, the country has the advantage of possessing natural resources to build a bright future. However, the guidelines

for fundamental economic reform, key for the country's future, must still be defined. At present, in addition to the economic challenges, the political situation in Libya is complicated enough to jeopardise the country's economic reconstruction following the Libyan war which started in February, 2011 and yet to be completely ended (Mikail, 2012, p. 12). Unlike the comparatively ethnically homogenous Tunisia, Libyan society is a complex web of tribes, clans and ethnicities. The potential for tensions and divergences created by this social mix constitutes an additional challenge to the construction of a peaceful, unified and economically viable country. Despite the complexity of Libya's economic challenges, the NTC, supported by a determined international community, can face them successfully if no further time is wasted (Mikail, 2012, p. 14).
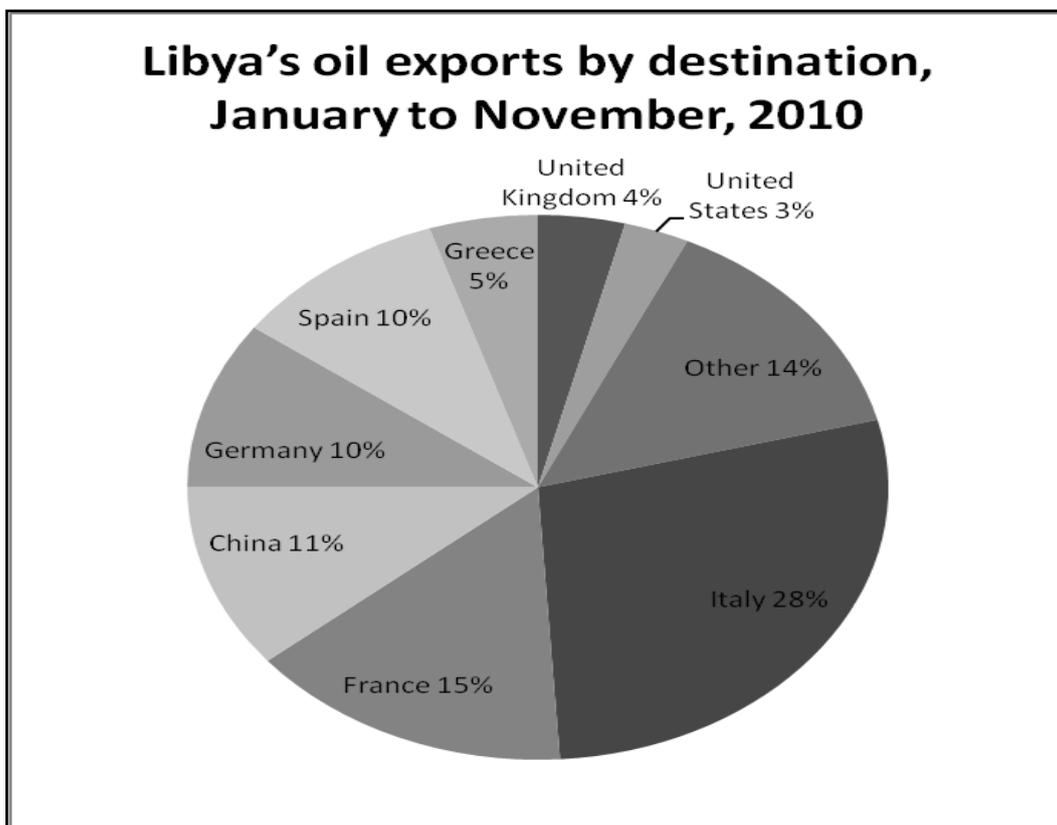
<div align="right">(Source: Energy Information Administration, 2011)</div>

Figure 2.1: Libya's oil exports by destination, January to November, 2010

2.2 The Business Culture within Libya

The work culture in Libya is similar to that which exists in other Arab countries and there are substantial differences between it and the work culture that exists in Europe. For instance meetings will always be prefaced by small talk, usually while food is being taken, and only after this is the first point on the agenda addressed. Short-term strategy takes

precedence over long-term planning, and it is only when projects on a larger scale are being considered that there is any strategic planning. Libyans tend to act within existing small groups where trust and reliability are highly valued. This means that business often follows friendships and what is important is creating new groups of friends with business subsequently following Hawedi, et al, 2011, p. 145).

The Libyan people are widely known for their hard negotiating skills. In business, these are often used as a way of gaining honour and respect from counterparts. A considerable amount of time should be allocated for such negotiations. When talks are finally overthere may be no formal written contract of agreement since it is common for such agreements to be solidified by a handshake or spoken decision. However, written contracts are becoming more common within the Libyan business world, especially when large businesses are involved. If these are provided, there should be two copies of the contract; one in Arabic and the other in English or your own preferred language. This will ensure that all parties involved understand the formal agreement which has been made (Hawedi, et al., 2011, p. 146).

On the whole, Libya is a vast country with a wealth of business opportunities for those who are willing to adapt to the cultures and ideologies of the nation. The most important part of doing business in Libya is allowing enough time to develop a solid business relationship, upon which trust and reputation are of paramount importance. Should this be recognised, both the relationship and market should expect to (Hawedi, et al., 2011, p. 146).

2.3   Oil Companies In Libya

The discovery of oil in Libya in the late 1950s by foreign oil companies (FOCs) was to turn the economic fortunes of the country around, taking Libya from being one of the poorest countries in the world into becoming one of the richest in terms of per capita GDP. The oil sector is the main source of national income and foreign exchange in Libya. Oil is considered to be the principal source of power in the world. It contributes greatly to the national income of the oil producing countries. The members of the Organization of the Petroleum Exporting Countries (OPEC) collectively supply the majority of the world's proven crude oil output and process more than three-quarters of the world's total proven crude oil reserves (Organisation of Petroleum Exporting Countries, 2005, p. 2).

Table 2.1: The world's energy fuel shares (%)

Year	Crude Oil	Gas	Solids	Hydro/Nuclear	% Total
1998	41.3	22.2	26.2	10.3	100
2000	41.3	22.4	26.1	10.2	100
2010	40.3	24.1	26.3	9.3	100
2020	39.2	26.6	25.8	8.4	100

(Source: Perez-Barahona and Zou, 2004)

The above table shows a breakdown of the world's energy-producing fuel usage (in percentages). With this in mind, Libya is considered to have the largest proven oil reserves in Africa, and holds 3.3% of the world's oil reserves (Central Intelligence Agency, 2011, p 3). The publically owned Corporation for Oil was established by law number 25 in 1955. After the Al-Fatah Revolution, the Revolutionary Command Council issued a new law, number 24, in March 1970. This law involved the establishment of the National Oil Corporation (NOC) which took over all search and discovery activities, as well as the production and export activities of inshore and offshore oil throughout the country. The potential for further discoveries in Libyan territory is very high, as illustrated by the table below, which ranks countries by their potential for oil deposit discovery.

Table 2.2: Countries with the Greatest Potential for Oil Exploration

Rank	Countries
1	Libya
2	Iran
3	UK
4	Australia
5	Algeria
6	Iraq
7	Indonesia
8	Angola
9	Brazil
10	Egypt

(Source: Arab.Net, 2011, p. 1)

The total crude oil production in Libya as of 2010 was approximately 1.8 million barrels per day (b/d). Libya holds about 46.4 billion barrels of oil reserves, which is the largest amount in Africa, as well as having almost 55 trillion cubic feet (tcf) of natural gas reserves (Energy Information Administration, 2011, p. 2). The Libyan government is planning an expansion of its oil reserves as well as further development of the gas sector, to take place over the medium term, with the continuing recovery of the country from the US and international sanctions which were in place for more than a decade. Out of the crude oil produced, Libya produces all its own energy needs from oil and gas extracted in the country. The pie diagram below in figure 2.2 illustrates Libya's energy consumption in 2009, showing 72% of energy demand being provided by oil and 28% by natural gas.
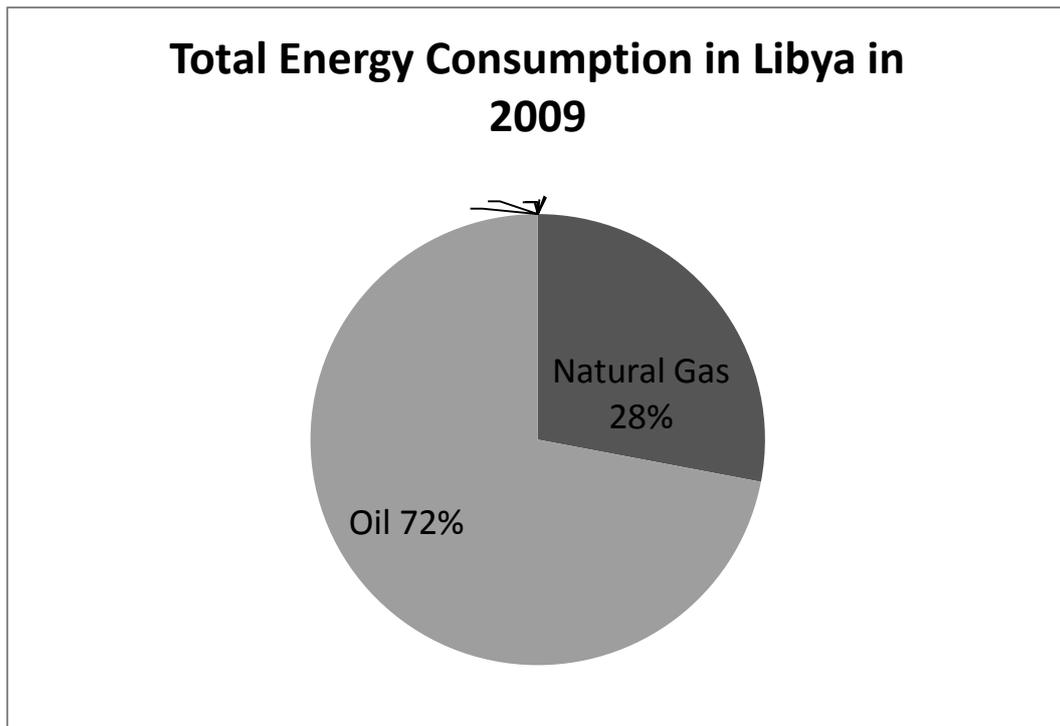
Total Energy Consumption in Libya in 2009

Figure 2.2: Total Energy Consumption in Libya in 2009.

2.4   Information Systems Adoption

In the late 1990s and the early 2000s, several organisations across the world acquired information systems for the management of their business information, and this has led to this period being called the 'information technology era' (Zain, et al., 2004, p. 834; Al-Ashban and Burney, 2001, p. 194). This adoption of up-to-date technology and information systems was made by organisations to increase their competitive advantage (Caldeira and Ward, 2002, p. 126). Substantial sums of money are being spent by organisations to enable them to put in place and manage the latest information systems that allow them to integrate their activities and so provide better services and products. Governments also have spent billions of dollars in improving their infrastructure in this way so that they are able to transfer information reliably and utilise it efficiently (Al-Mabrouk and Soar, 2009, p. 112). Where new technology is adopted in an organisation, especially when done for reasons associated with the business information and communication of the company, it is likely that the business processes of the company will change. Such changes are often quite fundamental, so that the whole of the system dealing with human activity, specifically that dealing with an organisation's information system, will have to be remodelled to enable the technology to be embedded. It is not possible to separate out information system and information technology when they are

embraced as a new system, and their importance in allowing organisations to fulfil their potential and build success and economic strength has been recognised.

However, while it is generally seen as desirable for developing countries to adopt new information systems, this is often a slow process, and yet the use of information system does not equal the level achieved in developed countries (Danowitz, Nassef and Goodman, 1995, p. 26). The gap that exists between developing and developed countries in part stems from the substantial cost of building and then implementing an information system, but this is not a sufficient explanation. A considerable amount of independent and descriptive evidence is available detailing failure where the financial barriers have in fact been overcome. For Libya, with its relative wealth, finance is not an issue, rather it is the case that it has underused its computing capability (Ghnia, Iles and Li-Hua, 2004, p. 3; Al-Mabrouk and Soar, 2009, p. 110).

2.4.1   Current Level of Information System Adoption in Libya

At present, Libya can be said to be one of the wealthiest countries in Africa, but it still makes little use of technology. The adoption of information systems in Libya appears to have only recently begun and there is little information available about it in the existing literature. However, internal economic competition across a number of organisations within the country has led to a rise in the use of information system as well as some other information technologies, since many organisations are seeking to acquire a competitive edge over their competitors and this they hope they can achieve through putting in place suitable information systems and information system strategies. Haag, Cummings and McCubbrey (2004) discuss the advantages of information systems to organisations in enabling them to have an advantage over their competitors thus: there are many examples of ways that organizations have used and are using information technology in creative ways to give themselves a competitive advantage. A company gains a competitive advantage by providing a product or service in a way that customers value more than what the competition is able to do (Haag, Cummings, and McCubbrey, 2004, pp. 43 - 51). Among the newly adopted information systems currently in Libya are enterprise resource planning systems, a system to manage e-payment, and a system to manage on-line sales, as well as other e-commerce systems, including "searching for products, services and information, advertising, and the buying, selling and paying for products and/or services"(van Akkeren and Cavaye, 1999, p. 41).

Currently there is a growing awareness in Libya of the competitive advantages that can accrue as a result of information technology enabling an organisation to out-perform its competitors, and therefore it is being increasingly adopted. This has brought about an improvement in the capacity of organisations as well as improving performance and the efficiency of operations in Libya generally, so that some businesses now have a global presence. A lack of information technology infrastructure and platforms that are needed together with minimal competition within a range of industries in Libya has meant that there has been little stimulus to encourage the use and therefore the growth of the internet in Libya. It would certainly be advantageous if the Libyan government acknowledged the advantages that information technology can bring and, therefore, invest in it. For example, "Internet services in Libya are in the early growth stages. Libya has one of the lowest penetration rates and one of the lowest percentages of Internet users in the Arab region" (Internet World Stats, 2012, p. 1).

2.4.2 Adoption of Information Systems and Information System Strategies in Libyan Oil Companies

The deployment of information systems and adoption of information system strategies in Libyan oil companies requires them to be ready to make significant change. There are a number of issues that must be considered in the country before the oil companies can adopt their chosen information systems and information system strategies, among which are: the technical expertise that is accessible to the company; the availability of technological infrastructures to the company: staff readiness to accept the change that will come with the deployed information systems and implemented information system strategies. Stewart et al., (2000) explain that more effective local technical skills are needed if information systems are to be adopted fully in Libyan oil companies. For this to happen, there will have to be more social and organisational changes, and also strategic change should be undertaken. Hence the Libyan oil companies require experts in the field of change management.

There have been two main hierarchical conflicts of interest within different organisations in the oil and gas sector in Libya that have impacted on the deployment of information systems in Libya. One is the difference between the old and new generations of staff, and the other is the issue of change management. The latter should be considered when deploying new information systems, as the necessity of allaying the fears of the company staff on the changes that come with deployment of information systems is very important.

Most employees belong to an older generation and they lag behind in their understanding of the latest computing developments. Many new employees are much more skilled in terms of technological expertise, but the older employees have traditionally organised the workplace. The new generation is keen to learn about new technology and how to utilise it, but the organisations they work for continue to lag behind with the implementation of such technology because of a lack of relevant educational skills and uncertainty about the effects of implementation (Lacher, 2012, p. 46).

Research on the adopted information systems and implemented information systems in Libyan based oil companies appear to be limited and the information available in the literature is not comprehensive or sufficiently specific to Libyan oil companies.

2.5   Summary

In order to study the assessment of deployed information systems and associated strategies in Libyan oil companies, there is a need to clearly understand the Libyan environment where the oil companies carry out their businesses. This chapter (Chapter Two) has given a broad overview of Libyan crude oil business activities and Libya as a nation. It provides a brief history of the country and has shown how important the economic and political background of Libya, is to all oil companies based in the country. The challenges of implementing information systems in Libya were discussed. The chapter also discussed the level of adoption of information systems across the world along with the level of information systems that are generally available among the oil companies in Libya at present. The challenges faced during and after implementation of information systems by the oil companies were also outlined.

In addition, this chapter reviewed some other factors that may have an impact on information systems deployment and information system strategy implementation in Libyan based oil companies.

Chapter Three - presents the review of relevant literature in this field. Relevant literature was reviewed for data, information, knowledge, information systems (components, types, deployment, etc), and information system strategy. Models for assessing information system deployment and research questions that this study attempts to address are also presented in Chapter Three.

CHAPTER THREE – LITERATURE REVIEW

3.1 Introduction

3.1.1 General Introduction into Information Systems Deployment

Deployment of information systems in business organisations is usually carried out for the purpose of improving the effectiveness and efficiency of business processes in the organization. "Capabilities of the information system and characteristics of the organization, its work systems, its people, and its development and implementation methodologies together determine the extent to which that purpose is achieved." (Hevner, *et al.,* 2004, p. 82). According to Chan (2005), "It is incumbent upon researchers in the Information Systems (IS) discipline to further knowledge that aids in the productive application of information technology to human organizations and their management." The benefits offered by the effective deployment and assessment of information systems for organisational use is enormous and Libyan oil companies have a lot to gain form proper deployment of information systems in the organisations.

3.1.2 Introduction to the Components of Information Systems: Data, Information and Knowledge

Researchers in Information Technology (IT) have defined data as raw and unprocessed facts, while information can be defined as "data converted into something valuable and usable for certain users" (O'Brien, 1993, p. 42). Data can also be defined as raw facts that contain factual elements that describe something, while information represents data that has been processed to provide more insights (Bocij et al., 2006, p. 10 - 19). From these definitions, it can be deduced that: Information refers to sets of processed data that together offer new knowledge to the owners of the data. For example, the volumes of crude oil purchased by a particular customer in a particular month are data, but for professional forecasting in the oil industry, the data can be used together with historical data of the customer's previous purchases to predict the volume that the customer will buy in a similar month of the upcoming year. It is therefore important for information to be available at the time that it is needed: It should also be reliable and well-presented so as to be interpreted correctly.

Information can be viewed and interpreted in various different meaningful ways depending on its application. However, information is seen from several viewpoints, among which there are:

Information as Communication: While presenting views on information, the nature of the data assumes utmost importance. Information can take its form only when it is communicated and understood.

Information as reduction of uncertainty: Situations which are lacking in clarity often occur when either the available information is wrong or it is not there at all. Accuracy of information is vital, as accurate information helps in taking decisions in different situations and it often helps control the situations.

Information as possession of power: Information is an empowerment tool. This aspect makes it a desirable commodity or resource and often there emerges a trade for the control, possession or even the act of withholding information. Practical designs of an information system have to take into account this important factor. This will be elaborated in the next section along with the particular importance of the information system strategies that firms employ to store, maintain, use and update their information systems.

The collections of "data" are of primary importance to the success of this research, the collected data are processed and called "information". The information is subsequently analysed to provide "knowledge" which in the case of this project, will provide a guiding direction for the case study companies in the deployment of their information systems and information system strategies. The knowledge is used for effective communication both within and outside the company. The knowledge also helps in reducing uncertainty and it serves as an empowerment tool for management of businesses in the Libyan oil companies. When data are collected, analysed and interpreted with appropriate deployment of information systems along with progressive business strategies, the Libyan oil companies cannot but improve their business activities.

3.2   The Concept of Information Systems

3.2.1   Introduction to Information Systems
A system can be defined as "a group of elements that are integrated with the common purpose of achieving an objective" (Bocij et al., 2006, p. 43). Hence, the elements of a system must be mutually connected and work together for a common goal. In a similar vein, all components of information systems are mutually connected and work together to perform the role of informing. In similitude, the business process of Libyan oil companies which include both upstream and downstream sectors of the oil and gas business in Libyan constitutes a

system, which entails the crude oil mining up to refining and the delivery of different components of the crude oil to the end users.

Information system has been defined in different ways. Businesses around the world use information systems, as a standard tool or environment and no longer as a resource, and Libyan oil companies should not be an exception in this current trend. Since information systems are critical to the core of a business, organisations devote significant attention to aligning them with the firm's overall business strategy and operations. The definition of information system varies with industry, business and the nature of processes. Thus, efforts have been made to have a more comprehensive definition of information system, based on drivers such as effectiveness of the overall information system design, the discipline to deliver the information system solutions, comprehensively designed training material for different users from varied backgrounds to successfully use the deployed information system, and major impacts of the information system on the organisational and political growth. The Libyan oil companies stand to gain significantly from a properly deployed information system.

Lee (1999), in his work on Management Information Systems, defined information system as an instantiation of information technology, with the special attribute of having the same information technology working in multiple ways. His approach to defining an information system is primarily based on the way technology should be managed, maintained and upgraded to be able to respond well to organisational processes (Lee, 1999, p. 31). In another scholarly work, Laudon and Laudon (2005) wrote that "an information system can be defined technically as set of inter-related components that collect, process, store, and distribute information to support decision making and control in an organisation." The UK Academy of Information Systems consider IS as a means of utilising technology to gather, process, store, use and disseminate information (Ward and Peppard, 2002, p. 29). Bocij, et al. (2006) takes a slightly deeper approach and defines an information system in accordance with its usefulness. Hence, an information system is defined as a group of interrelated components that work collectively to carry out input, processing, output, storage and control actions in order to convert data into information products that can be used to support forecasting, planning, control, co-ordination, decision-making and operational activities in an organisation (Bocij, et al., 2006, pp. 28 - 35).

It can be concluded from these definitions that the main purpose of an information system is that it is a vital business tool for conversion of data to information, and it helps in

subsequent storage and management of the information, as well as the presentation of the information in a precise, well structured, accurate and consistent format for making short-term and long-term decisions by managers in a business environment. Therefore, processes of getting information include input, processing, output, storage and control. These processes of getting information are of immense importance in managing the affairs of business organisations which include the Libyan oil companies. The Libyan oil companies have much to benefit from efficient management of their data and information via the deployment of information system.

Hence, an information system is a very critical tool that should be part of the core of a business; organisations need to pay appropriate attention into aligning it with their overall business strategy and operations (Caglio, 2003, p. 124). According to Carmona (2003), there are several reasons for firms to align their information systems with their operations. The first and most important reason is to support itself, which essentially means that the firm should make efforts to develop its information system in such a way that it results in an increase in operational efficiency and the overall performance of the company. Papp (1999) explains that firms also need to develop, implement and establish a link between their businesses, deployed information systems and adopted information system strategies. If this is adopted by Libyan oil companies, deployment of information systems will improve the operational efficiency and support the business activities of the companies by giving them competitive advantages over their contemporaries in the Libyan oil and gas industry.

The second reason for aligning IS with the firm's overall business strategy is to increase the firm's profitability (Carmona, 2003, p. 219). This can be accomplished through a new avenue of business management provided by the deployed information systems and adopted information system strategies. This new avenue of business management leverages the existing optimisation techniques in the organisation and provides important reports for guiding the resource allocation of the organisation. The key objective of strategic alignment is to completely understand how information systems and associated technologies are expected to positively affect the overall corporate business strategy of a company, and how well they can fit into the existing business structure and culture in the organisation under consideration. In addition, Papp (1999) explains that it indicates how to ensure that the new information system deployed fits and agrees with the existing IT infrastructure of the company, and how to achieve proper functional integration of all appropriate components to ensure the success of the organisation's business.

3.2.2 Types of Business Information Systems

According to Beynon-Davies (2004), business information systems have been put into use in order to control the overall management of an organisation, apart from focusing on some individual aspects such as operations, transaction processing, business strategies, etc. Information systems in the business world can be broadly divided into three types (Beynon-Davies, 2004, pp. 10 - 15). The three types of business information systems are described below:

1. **Operations Information Systems (OIS):** These are concerned with the business processes control, transaction processing, communication both within the organisation and externally, and productivity. These are required for the day-to-day activities of a business.

2. **Management Information Systems (MIS):** These support managerial decision making such as the costing of a product or service. These systems are increasingly being used by large corporations and the software service sector for their proven capability to help manage data globally, and to provide feedback on organisational activities.

3. **Decision Support Systems (DSS):** These are software-based systems intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems. In its primal form, it can be said to be a type of MIS.

According to Beynon-Davies (2004), it has to be noted that the traditional division of IS into two types - Operational and Management information systems, although useful for the managerial cadre, does not necessarily reflect the reality of information systems in a firm. However, it will go a long way to guide deployment of information systems in Libyan oil companies. It will also provide an avenue for assessment of the deployed information system.

3.2.3 E-business Systems

E-business, as referred to in this research work, refers to all internet and online facilities made available to support business transactions of the surveyed oil companies. E-business systems cut across operational, management and decision support information systems to provide more closely coupled platforms (Prananto, McKay and Marshall, 2003, p. 73). The systems, along with adopted information system strategies, can be the right tools and techniques for better productivity, resource management and utilisation of proper resources to

give any company its required competitive edge in any chosen industry (Beynon-Davies, 2004, p. 16).

As rightly put by Van der Veen (2004), there are various definitions for e-business (electronic business) and each definition appears to reflect the views on the e-business phenomenon as observed by its author. In his words, Van der Veen (2004) observed that "definitions have evolved according to the shifting locus of attention, especially with policy makers. For example, early definitions dealt with e-commerce, narrowly defined as selling and buying products and services on the internet." However, recent definitions refer to the term e-business as the utilisation of Information and Communication Technology to maximize efficiency in business operations, with respect to internal and external processes. More simply, e-Business can be defined as "doing business electronically in support of organisational goals" (Van der Veen, 2004, p. 31). Gloor (2000) also explains that e-business covers the application of internet technology in all aspects of the business world (Gloor, 2000, p. 61). According to Beynon-Davies (2004), e-business can be considered either as an entity or as the set of activities associated with a commercial organisation using the internet facilities to carry out any of its business activities (Beynon-Davies, 2004, p. 22). E-business helps in streamlining business processes, improves productivity and efficiency, thus enabling companies that use them to communicate easily, using web technology, with partners, vendors, and customers to connect to back-end database systems and make transactions (Beynon-Davies, 2004, p. 34).

Hence, the internet provides the platform from which the concept of e-business has emerged. In turn, e-business has become the world's major distribution channel for goods and services in business; it is also a platform for international cooperation among business entities and partners. On the business front, e-business has changed several issues, among which are industry structures, economical plans, marketing modes, products and services delivery, and customers' management. Therefore, this research work agrees with Van der Veen (2004) on his examples of companies' business activities that can be referred to as e-business. The examples include when a company:

1. Communicates electronically with its business partners, customers and suppliers.
2. Communicates electronically with other enterprises to order products and services.
3. Sells products or services via a website.
4. Uses the web to find information, such as prices and reviews of products.

5. Uses the web for research, such as the latest industry trends.

6. Uses a website to provide information about its products and services.

7. Uses the internet for online banking and for paying its bills.

The Concept of B2B

B2B is an abbreviation of "Business to Business". It is a concept of e-business procedure which indicates business transactions made by a particular business company to other companies. According to Goodchild, Herring and Milosevic (2000), B2B includes the area of online exchange of information between trading partners. They suggest that some examples of B2B include:

1. Trading partner integration between enterprises, forming supply and value chains and allowing automated coordination of business operations (e.g. order management, invoicing, shipping and government procurement).

2. Business process integration, integration of commerce sites, enterprise resource planning systems and legacy systems.

3. Business-to-business portals enabling formation of trading communities, electronic catalogue management, content syndication, and post-sale customer management.

Hence, B2B sales often take the form of one company carrying out business transactions with customer-companies. Some of the examples of established e-business information systems that use the concept of B2B include the following:

1. e-Procurement: This refers to B2B sale and purchase of products and/or services and their supplies, using e-business procedures. Thoben, et al. (2002) explain that e-procurement facilitates purchasing needs via a single web-enabled access point, and that e-Procurement - sometimes referred to as 'electronic supplier exchange' - allows qualified, registered and authorised companies to transact businesses on the supply of products among themselves. Business transactions can be initiated and completed online. A properly implemented e-Procurement information system can connect companies and their business processes directly with customers and also manage all interaction between them. This includes management of communication, bids, pricing activities, and answering questions. In Libyan oil companies, this section of e-business offers fast and strategic inter-company business relationships. With e-

procurement, the Libyan oil companies in the downstream oil sector can transact business with the Libyan oil companies in the upstream sector with ease. The crude oil products can be traded seamless via the internet. The entire sales request, bargaining and the eventual delivery of products can be initiated and completed online with the e-procurement functionality in e-business (Daniel, Wilson and Myers, 2002, p. 259).

2. <u>e-SCM:</u> Supply chain management (SCM) is the entire movement process of products, data/information and finance from a supplier company to a customer company. The SCM has an integrated e-business procedure which is referred to as e-SCM. The IS/IT services integrated in the B2B can be SCM activities. This e-SCM system can support all procurement activities including purchase, request, ordering, and delivery between sellers and buyers (Chong, et al. 2011, p. 18). The Libyan oil companies would be able to use this e-business procedure to facilitate their businesses with their customer companies. In the upstream sector of the oil industry, there is the crude oil supply chain which can be efficiently managed with the e-SCM. This is an e-business area which, when deployed as an information system in the Libyan oil companies, will be of immense benefit to the running of businesses in the Libyan oil companies.

3. <u>e-CRM:</u> This is the component of e-business systems that manages the Customer Relationship Management. e-CRM entails using IS/IT communication technologies such as web-based e-mail and data mining/warehousing to maximise benefits for both sellers and buyers, and encourages customer retention (Chong et al., 2011, p. 23). e-CRM has been proved as an e-business functionality that improves the loyalty of customer companies. Hence, its adoption is highly likely to contribute positively to the business growth of the Libyan based oil companies. Daniel, Wilson and Myers (2002) mentioned that the e-CRM provides a fast, efficient and cost-effective ways for business firms to reach out and manage their customers. Hence Libyan oil companies can benefit from the usage of e-CRM to manage their customers efficiently in a cost-effective manner.

3.2.4 Enterprise Resource Planning

Traditionally, the integration of several business related services, partners and products has been achieved by effective planning and management of information and communication technology but more recently, many firms have chosen to buy large suites of information systems with inbuilt integration and these packages are called Enterprise Resource Planning (ERP) packages or mega-packages (Davenport, 2000, p. 169). ERP is an enterprise-wide information system that integrates and controls all the business processes in the entire organisation. According to Nah, Lau and Kuang (2001), ERP is a packaged business software system that enables a company to manage the efficient and effective use of resources (materials, human resources, finance, etc.) by providing a total, integrated solution for the organisation's information-processing needs.

Al-Fawaz, Al-Salti and Eldabi (2008) note that ERP system, if properly implemented, facilitates the integration of all the functional information flows across the organisation into a single package with a common database. Therefore, "it allows easy and immediate access to information regarding inventory, product or customer data, and prior history information" (Al-Fawaz, Al-Salti and Eldabi, 2008, p. 5). The Figure 3.3 below shows an ERP system which has different functions of production, distribution, sales, finance, human resource management, etc and they are customised according to the needs of the company after purchase. This will leads to a better understanding between the company and the customer. ERP systems provide improvement, development and growth among oil companies (Bendoly and Jacobs, 2005, p. 12).
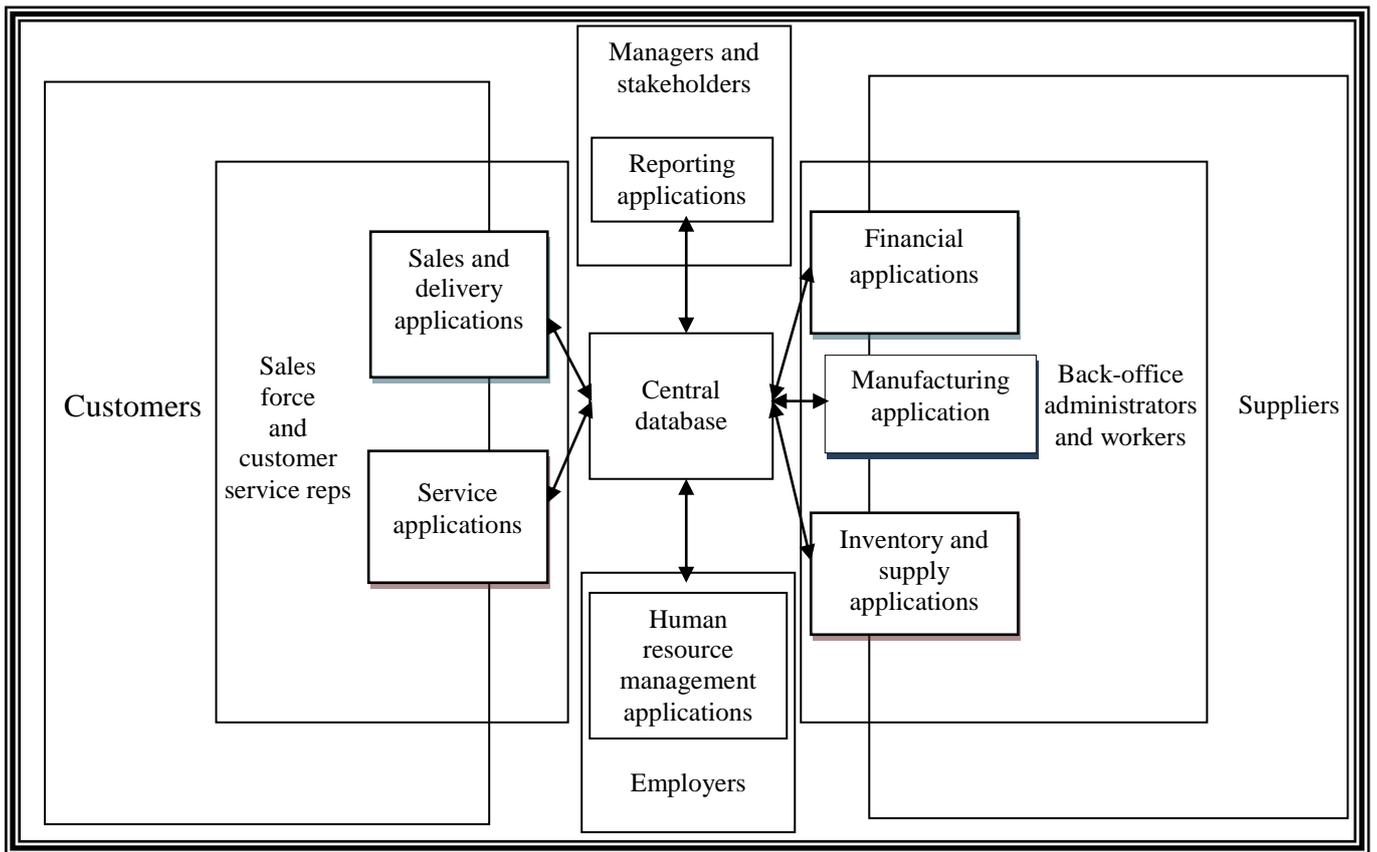
Figure 3.3: Davenport's ERP System Illustration

In various emerging markets (such as Libya, China, India, Brazil), there has been an increasing demand ERP systems, and there appears to be more interest in the system by the top management echelon of some companies (Bendoly and Jacobs, 2005, pp. 21 - 22). Before elaborating on some of the pervasive effects of the ERP system, it has to be understood that there is a necessity in understanding the inherent differences in the methodologies followed when differentiating between products delivered by an ERP system and the processes followed by it. Examples of these potentially pervasive and ubiquitous enabling capabilities are explained as shown in the Table 3.1 below:

Table 3.1: ERP Product vs Process Benefits

ERP Product vs Process Benefits		
Parameter	Product Effects	Process Effects
Variability Reduction	Elimination of redundancy and multisystem data conflicts	Better certainty as to how a transaction will be executed
	Reduction of variance in Human-Computer and Computer-computer time	Reduced variation in interpretation of micro level corporate goals, operational priorities, etc.
Bottleneck Elimination	Simplified identification and mitigation process for probable bottlenecks as central system handles transactions	Fewer processes that can potentially create bottlenecks
Parameter	Product effects	Process effects
Waste reduction	Monitoring various forms of waste (time, energy and resources) and prioritization	More workers have the ability to recognisze waste and waste generating processes because of enhanced transparency of processes

(Source: Bendoly and Kaefer, 2004, p. 399)

Based on the aforementioned review of the ERP system, it would be advantageous for Libyan oil companies to implement the ERP system to run the business affairs of the companies. However, Allen (2005) explains that although ERP is a good information system, it does have its shortcomings. Allen (2005) mentions that ERP, being a centralised information technology system, its technological scope becomes highly important and when it is depended upon solely by a firm as its information system, it is essential to minimise its possible downtime. Amoako-Gyampah, K. (2007) explains that an increase in the downtime of an ERP system when it is the sole information system in an organisation can impact negatively on the goals and targets of the organisation. Hence, Addo-Tenkorang and Helo (2011) explained that although "The field of ERP will certainly continue to mature", it is important to ensure that there is no downtime in its running so that the company using it can

have no loss of business. Based on the advantages offered by the ERP system, it will be good for use at the oil companies in Libya. However, all possible downtime of the ERP system must be minimised or preferably eliminated to ensure that the Libyan oil companies can derive the maximum benefit from the use of the system as explained by Addo-Tenkorang and Helo (2011), Amoako-Gyampah, K. (2007) and Allen (2005).

3.3   Information System Strategy

Having discussed the concept of Information Systems (IS) in section 3.2 above, it is now imperative to discuss the strategies adopted for handling IS. Strategy in business is defined as a "definition of future direction and actions of a company specified as approaches taken to achieve specific objectives" (Bocij et al., 2006, p. 119). Information System Strategy (ISS) consists of a specification of the information systems needed to support and improve organisational activity in the areas of collection, dissemination and use of information (Beynon-Davies, 2004, p. 54). ISS is distinguished from general business strategy through being specifically concerned with strategy related to interpretation surrounding information technologies. In classic models of formation, the ideal of perfect alignment between organisational strategy, business strategy and information strategy is attempted. In developing an effective ISS, it is important to focus on the information needed to run the business rather than the technology that will be used to hold the business information. Technology issues are, of course, important but they need to be addressed as part of an overall ISS rather than as an end in themselves (Al-Aboud, 2011, p. 187). Furthermore, owing to the improvements in the field of information technology, the computer and the internet are playing a pivotal role in establishing strategies to be put into effect in various business organisations. Therefore, Information System Strategy can be developed through a process in which a working relationship between the organisational context and the business process environment are aligned, along with the internal structure and features required in sustaining the relationship (Al-Aboud, 2011, p. 189).

According to Rosenkranz and Holten (2007), a closer look at setting up measurement and modelling for ISS and deployed information systems may be essential, depending on whether the business organisation is in a developing country or a developed country. The main reason for this is as follows: if a comparison is made between a developed country and a developing country, such as Libya, in terms of IS strategies, it can be observed that in a developed country, the development of everything, including IT, takes place gradually, in

parallel and in harmony. Nearly all the technological tools are invented and developed at a similar speed, so there is some sort of balance in developed countries. However, in a developing country such balance may not exist, so some fields may develop much more quickly than others (Rosenkranz and Holten, 2007, pp. 20 - 31).

In Libya, IT and related tools have been introduced more quickly than many other important information system support, such as the required local manpower, local technological skills etc. that are needed to drive the introduced IT and related technologies; therefore, there is an imbalance. The information system deployment and ISS implementation requires that planning must be taken more seriously and all changes that come with their adoption must be well managed in every business organisation that seeks to use their deployed information systems successfully. Therefore, this research work will be of immense importance to Libyan organisations that have deployed information systems or are planning for future deployment of information systems. This research work gathers the salient components of deployed information systems and existing information system strategies in Libya based oil companies, thereafter the gathered data are used to provide a framework more specific to the Libyan situation for assessing deployed information systems in oil companies in Libya.

3.4   Components of Information System Strategy

Identifying the components of an ISS paves the way for its implementation, and subsequently the choice of information systems and their deployment in an organisation. For any firm planning to operate a successful oil business in a growing oil and gas industry and market like that which obtains in the Libyan oil and gas industry represents, there is a need to have a suitable tool for assessing its deployed information system. This will help in ensuring that the information systems in use in the Libyan oil companies are good enough to meet the business challenges in the current oil and gas market in the country. According to Teo and Ang (1999), the importance of information system deployment planning has been one of the top ten issues for senior executives of oil companies in recent years, with a key aspect being the coordination of business plans and information system usage to drive the planned business in order to align the two so that maximum results are obtained (Teo and Ang, 1999, p. 178).

It has been established that many business firms have made decisions on information system deployment and information system strategies on the basis of what the top

management believes, or suggestions by IT suppliers or professional associates from other companies (Bechor, et al., 2009, p. 18). Such decisions might not help the business as expected because when making decisions on deployment of information systems and implementation of information system strategies, it is important to consider the specific organisational strategy and business strategy of the company in question, along with available options of information system strategies. The top management needs will be of importance in the information system deployment in Libyan oil companies because the level of IT is still poor in the country and there is need for effective change management strategy to be observed when the company is deploying an information system. The support of the top management at the Libyan oil companies in driving and adopting the changes that comes with the information systems deployment in Libyan oil and gas companies will be vital to the success of the newly deployed information systems in the Libyan oil companies.

According to Gutierrez, Orozco and Serrano (2009), in order to ensure successful deployment of information systems along with adopted information systems strategies, alignment of organisational strategy, business strategy and information systems strategy is highly important. Hence, the Libyan oil companies need to align their information systems strategy, business strategy and organisational strategy to achieve a successful information systems deployment and associated assessments (Gutierrez, Orozco and Serrano, 2009, p. 2). In effect, the aims of a standard information system strategy plan warrant a well organised approach to implement the functionalities that information systems will offer after deployment. The foundation of this strategic planning process is that the business direction and business requirements drive the information systems to be deployed and the computing architecture to be acquired by a company. Therefore, the Libyan oil companies can initiate a strategic planning process to drive its information system deployment for the maximum benefit of their businesses.

3.5 Deployment of Information Systems and Implementation of Information Systems Strategies

Adequate planning is very important for the success of information system deployment and implementation of information system strategy. Well-structured planning steps are extremely essential to ensure that business strategy, organisational structure and adopted information system strategy are well synchronised in a complementary relationship. Necessary assessments which might be internal and external need to be considered and the expected overall function of information systems within the organisation must be determined.

Expenses that will be incurred during the information systems deployment and implementation of information system strategy also need to be considered. Above all, there is a need to consider if the business plan of a company will accommodate the information systems deployment and implementation of the information systems strategy. The planning is a very complex process, especially in the big oil companies where there are several business functional activities. There is no planning approach to information system deployment and the implementation of information system strategy that can be said to be the best approach; it is all about the information system' needs of the company, its financial capabilities, and available technologies, among other factors. The fact that there is no single best methodology for information system deployment and implementation of information system strategy can be observed from the reality that many organisations make use of a combination of approaches.

Johnson and Scholes (1999) defined strategy as the direction and scope of an organisation over the long term: ideally one which matches its resources to its changing environment and in particular its markets, customers or clients so as to meet stakeholder's expectations. Every business organisation requires adequate strategic planning to enable it to plan successfully for its information system deployment and implementation of information system strategy. Johnson and Scholes (1999) also suggest that the strategic planning process should include analysis, choice and implementation. The analysis should involve the external environment, considering opportunities and threats and their impact. The planning at this stage will also involve a corporate appraisal of internal strengths/weaknesses. The company must also formulate its mission statement, organisational values and ensure it has a set of smart objectives.

The choice stage of planning will identify and evaluate the strategic options available to the company. The evaluation needs to be in terms of both financial and non-financial factors, considering suitability, acceptability and feasibility. Finally there is the implementation stage, which will involve plans for management of change, business culture, performance evaluation and balanced scorecard exercises. This is the formalised rational approach to strategic planning. Cassidy and Guggenberger (2001) suggest that before information system deployment and implementation of information system strategy, corporations with a business plan pursue the four phase process as shown below in Figure 3.4:

46

Conceptual Business Level	• Establish planning process • Document high level business direction • Customer and supplier requirement • Environmental factors – strengths and weaknesses
Detailed Business Analysis	• Detailed business direction • Information needs • Competitor analysis • Investment prediction
Conceptual IS Plan	• Initial internal and external IS situation • Forecast IS direction and depth of automation • Mission and vision conceptualization with detailed annual objectives
Detailed IS Recommendation	• Determination of gap from current process to the future • Determination of recommendations (cost, time resources, bench marking, etc) • Business application assessment

(Source: Cassidy and Guggenberger, 2001, p. 43)

Figure 3.4: Outline of the ISS process plan

The planning process which precludes a solid information system deployment and implementation of information system strategy will now be elaborated in detail. This process plays a very important and pivotal role in the success of business organisations. Porter (1980) suggests a strategic planning approach for information system deployment and implementation of information system strategy. The approach comprises five steps which are outlined below and have significant potential for any firm to obtain a sustainable competitive advantage with its information systems and information system strategies:

1. Evaluating intensity and the complexity involved in information flow across the organisation so that the information systems can be configured accordingly. For an

intensely complex information flow, equally sophisticated information systems capable of supporting existing operations seamlessly would be required.

2. Determination of the role required of the information systems in the chosen industry where they will be used and to understand areas where information systems can bring in significant operational efficiency. This will help the organisation to benchmark its existing processes and to improve process efficiency which will result in long term performance improvement of the organisation.

3. Assessment of the information systems may help the organisation create sustainable competitive advantage in both the short and long term. Once the organisation understands and properly assesses the information systems, areas where it can significantly differentiate itself from the industry competition purely on the basis of superior information technology and systems can be considered.

4. A procedure to identify whether the information systems can help the organisation create any new business: products or services. Having understood the first three points, the organisation can comfortably think of new products and services which can further bridge the technology gap within the industry.

5. A strategic plan to leverage the information systems to achieve strength against the industry competition for a chosen business. This is the last step in the process and it involves senior management sitting together with a technology team and vendors (if applicable) to create a plan for the deployment of information systems and implementation of information system strategies.

3.6   Information Systems and Information System Strategy Deployment in a Firm

Understanding the company's business needs and purpose of deploying information systems, goes a long way in deciding the overall course of action to take on strategising and deploying information systems. The following steps can be said to be important:

1. The purpose and goals of the information system strategy being planned have to be documented with the executive management of the company and an agreement has to be reached. The constraints on the strategy by the executive management on the total expenditure, resource usage, etc that is available has to be clear and lucid in the agreement.

2. An information system strategy steering committee should be instituted to handle the establishment of the scope of the steps that will be needed and the committee will

communicate this to the executive management. Questions such as whether the scope includes particular departments and divisions of the company are answered.

3. The committee has to come up with a Plan Document which gives all the necessary details about the Business Process Objectives, resources in terms of hardware, skill set required, time lines, deployment plans, etc. The detailed document will have specific topics which clear the air about various customary topics such as the Mission Statement, Vision Statement, Business goals, Management Overview and Strategic Objectives along with Risk Analysis and Mitigation Plan, Return-on-Investment Analysis and such. Examples of the Mission statements, vision statements, etc. for the Information System are collated at the end of this document. A detailed application portfolio should consist of the identification of the application, the technologies used, the hardware platform, functional descriptions, data requirements, interfaces, usage, and other relevant statistics.

4. A decision on whether the information systems to be deployed will be in phases across different departments or not, and if there are timed expectations for particular modules have to be incorporated into the strategy.

While technology is a key factor in any information system strategy, it is a means to an end. An effective IS strategy must be driven by clear and simple organisational goals that can sustain the change of technologies and their scale over time. Aligning information technology strategy with business strategy is critical (Kearns and Lederer, 2001, p. 4). Information system strategies need also to take into consideration an integrated view of information and business processes across the extended enterprise, the vendors/suppliers and all departments involved. The following factors should be carefully considered while deploying information systems and setting up information system strategies for a firm:

A. <u>Management Overview</u>: The Management Overview is a succinct summary document of what aspects of the information systems package must change and adapt to the newer work process, how much this change will cost in terms of time and resources, and how long it will take to deploy the whole package across the organisation (Cassidy and Guggenberger, 2001, p. 46). This will depend on the size of the organisation and the extent of automation planned. The document will contain the framework that will be followed for various processes.

B. <u>Risk Management</u>: Risk management is also important in information system deployment and implementation of information system strategy, especially in the information system authorization, security control monitoring and security control assessment (Elky, 2007, p. 2). Behnia, AbdRashid, and Chaudhry (2012), in a work on risk management in information systems deployment, write that "risk management is the process of understanding and responding to factors that may lead to a failure in the confidentiality, integrity or availability of an information system. IT security risk is the harm to a process or the related information resulting from some purposeful or accidental event that negatively impacts the process or the related information." (Behnia, et al, 2012, p. 82).

Risk Management is the process of identifying risk, assessing risk, and taking steps to reduce risk to an acceptable level. The ultimate goal of risk management is to enable the organisation to manage IT-related risks through the following:

1. By better securing the deployed information systems.
2. By enabling the top management team of a company to make well-informed risk management decisions to justify expenditure that is part of an IT budget.
3. By assisting management in authorising or accrediting the IT systems on the basis of the supporting documentation resulting from the performance of risk management.

3.7   Strategic Information System Alignment

It is universally understood that information is important for the success of businesses in today's world. Information systems help oil companies and all other companies to improve efficiencies in all aspects of their operations and services but the information systems may not necessarily be completely in tune with the existing organisational business processes and procedures in the oil companies. Hence there are times that it is important to strategically place information systems and associated technologies within an organisation. This implies that information system strategy should be synthesised with the business strategy of the oil companies with appropriate Strategic Information Systems Alignment (SISA) techniques. This is supported by Issa-Salwe et al. (2010, p. 124) who say, "To integrate into a smoothly working business system and improve productivity, managers ought to align their Information Systems with the business strategy. The purpose of Strategic Information Systems Alignment (SISA) is to help implement information systems to integrate with its

business strategy. It assists in transforming information into a usable form for coordinating the workflow within the organisation, and helps in decision making and solving other problems.

Alignment of the information system strategy with the business strategy is defined as is "the capacity to demonstrate a positive relationship between information systems and the accepted financial measures of performance." (Strassmann, 1998, p.7). Henderson and Venkatraman (1999) proposed a multidimensional model for strategic alignment; this model is one of the most extensively used models of strategic alignment. The model (Figure 3.5) identifies the internal and external dimensions and how these can be functionally integrated with the organisational business strategy.
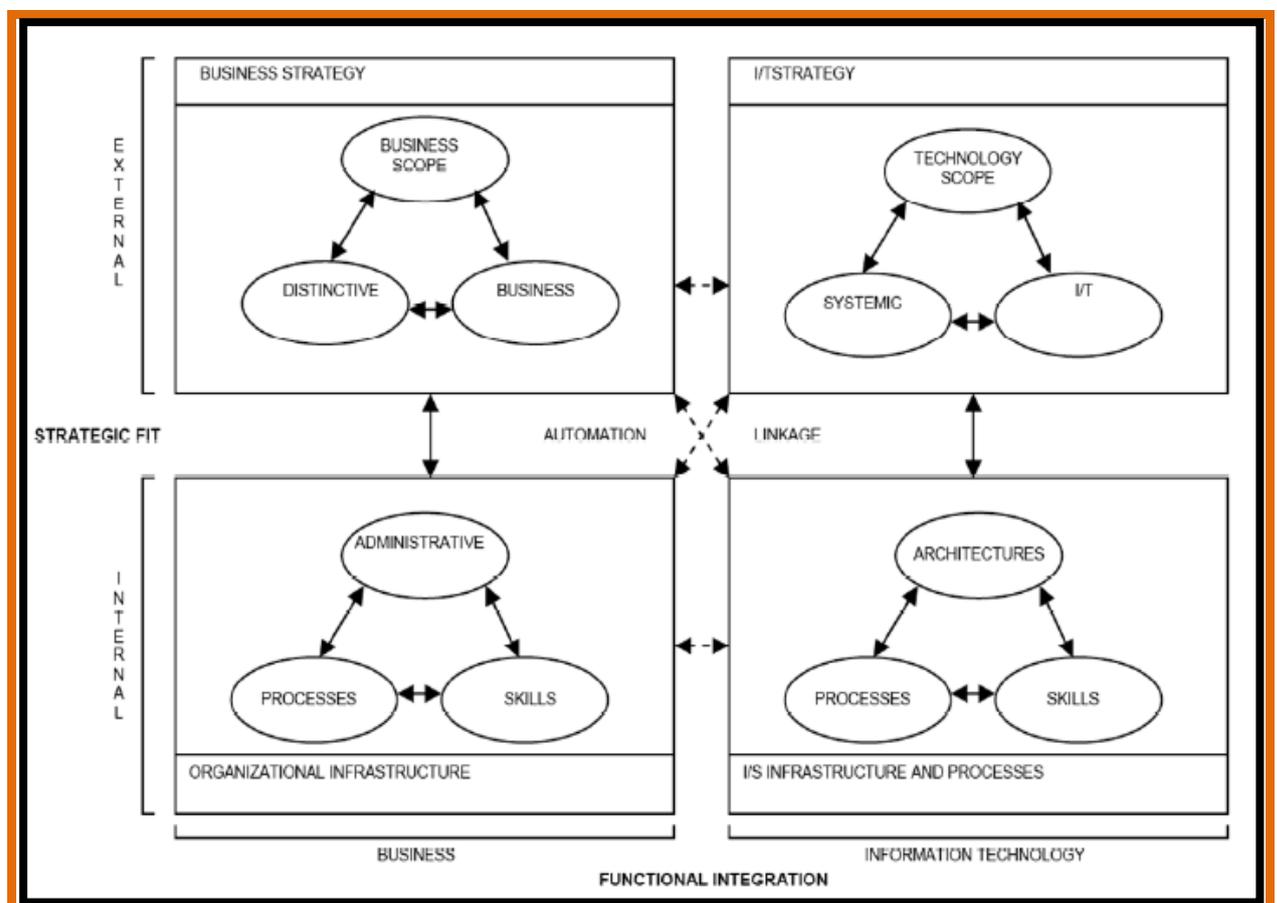
(Source: Henderson and Venkatraman, 1999, p. 8)

Figure 3.5: Multidimensional Model for Strategic Alignment

There are other alignment models that are structured based on the type of organisation under consideration and their business objectives. The basic advantage offered by strategic alignment is its successful application based on a chosen mode. Henderson and Venkatraman, (1999, p. 9) says it results in "organisational capability to leverage IT/IS resources on a continuous basis to support competitive advantage in the marketplace." The Libyan oil

companies can use strategic alignment to manage their functional integration of different processes in the companies.

3.8   Models for Assessing Information Systems Deployment

Scholars and researchers have developed several models and techniques to assess information system deployment and explain what makes it successful. "Davis's (1989) Technology Acceptance Model (TAM) used the Theory of Reasoned Action and Theory of Planned Behaviour (Fishbein and Ajzen, 1975) to explain why some IS are more readily accepted by users than others" (Petter, DeLone and McLean, 2008, p. 244). However, acceptance is not necessarily equivalent to success, although, acceptance of an information system is a necessary precondition to success (Gelderman, 2002, p. 595).

Early attempts to define information system success were ill-defined due to the complex, interdependent, and multi-dimensional nature of IS success (Petter, DeLone and McLean, 2008, pp. 244 - 249). To resolve this problem, DeLone and McLean (1992) reviewed the research published during the period of 1981 to 1987, and created a nomenclature of information system success based upon this review. In their 1992 paper, they identified six variables or components of IS success: system quality, information quality, use, user satisfaction, individual impact, and organisational impact (DeLone and McLean, 1992, pp. 67 - 68). Established models for assessing the success of deployed information systems are discussed below.

3.8.1   Earl's Model

Earl's 'three-pronged' model for information system strategy formulation and delivery is one of the models that are used for analysis in developing information system strategy. It serves as the overarching framework for understanding how the companies developed their strategies. Although Earl (1989) identified three possible strategies that are seen as alternatives, he argued that all three can be used parallel to each other and that different strategies are used in different business contexts. This depends on a number of factors including the nature of the basic IT infrastructure, the structure of the organisation and the level of development of the organisation's main business systems.

Earl (1989) suggests that a combination of strategy approaches is necessary, because in practice, senior management have three issues to address in the management of information systems. These are:

1. The clarification of top management business needs and their translation into information systems' requirements, hence, a top down approach.
2. The evaluation of current information systems' provisions and the operational needs, hence, a bottom up approach.
3. The identification of innovative uses and opportunities afforded by IT/IS, hence, an inside out approach.

The top down approach is driven by a formal attempt to match companies' IS investment with their business needs. It identifies the business plans and goals and applies an analytical approach to identify IS' requirements. It ensures business managers are involved in IS strategy formulation, which is thus driven top down. The bottom up approach is an evaluation of the capabilities of information systems that are currently in place. As Earl (1989, p. 13) rightly puts it, "IS strategies are rarely developed from a green field site, but have to recognise the strengths and weaknesses of the current applications portfolio." This may establish that some of the existing systems could be better exploited for strategic advantage or be improved upon to produce several significant added values.

The inside out approach attempts to identify opportunities afforded by IT/IS which may yield competitive advantage or may create strategic options. Earl (1989) argues that although top down and bottom up approaches can give indications of how IT/IS can provide competitive advantage, they will not provide the entire picture. A third approach is necessary, and Earl (1989) suggests a number of ways in which this can be pursued for spotting and implementing strategic advantage of IT/IS opportunities. This advantage includes such things as harnessing the perspectives and knowledge of sales and purchasing managers who may be field based and thereby see opportunities through their interface with customers and suppliers, and the recruitment of bright spark staff that have had exposure to the latest IT/IS innovations and recent thinking on related concepts. The aforementioned approaches when adopted in Libyan oil companies may be beneficial to the information system deployment in the companies.

3.8.2 The Stage of Growth Theory (Nolan's Model)

The stage of growth theory was coined by Richard Nolan in 1979. This theory states that like all other products, IT systems also have a life cycle. According to this theory, there is a general model which presents the role of IT systems in an organisation. This model presents six stages of growth in the functions and usage of IT/IS systems in an organisation

(Nolan, 1979, pp. 116 -123). The following figure (Figure 3.6) presents the six stages of the Stage of Growth Theory (Nolan's Model).
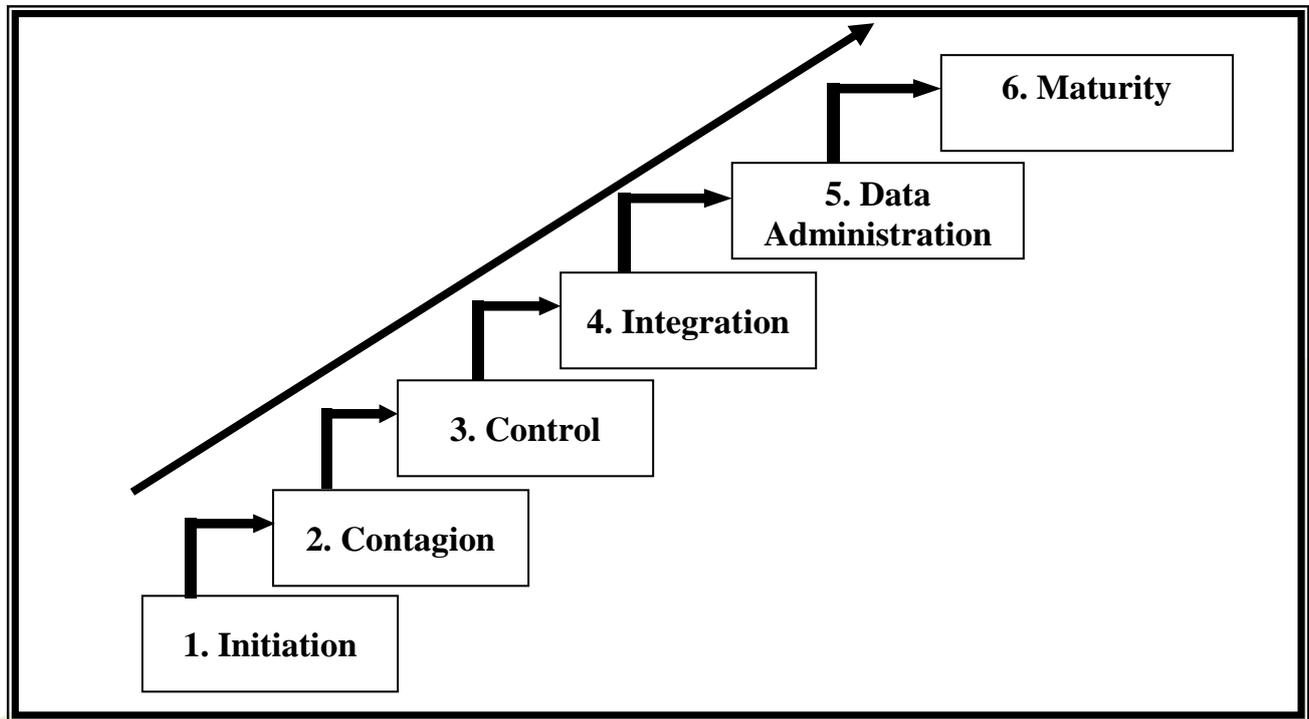
Figure 3.6: Nolan's model of the evolution of the IT/IS function

Stage 1 – Initiation

Stage 2 – Contagion

Stage 3 – Control

Stage 4 – Integration

Stage 5 – Data Adminstration

Stage 6 – Maturity

At the initiation stage, systems are first introduced to the organisation and the technology is established. This is done through the efforts of a few trained and open-minded professionals who recognise the potential for the use of information systems in any organisation. At this stage the IS are closely supervised and are introduced only to a small number of departments (Sadagopan, 2004, p. 34). The IS is usually introduced in organisations to increase operational efficiencies, reduce expenses over the long term and thereby increase profitability (Sadagopan, 2004, p. 38).

At the contagion stage, there is a rapid expansion in the applications of the IS within the organisation. Here users are enthusiastic about using IT applications and information systems to solve their work related problems. At this stage, there is less rigour and strictness in management control of the information systems (Nolan, 1979, p. 17). If many of the information systems put in place at the initiation stage lack scalability and flexibility of interfacing with other systems or have an excessive control measure, there will be a number of chaotic situations as there is expansion in the usage of information systems at this stage (Sadagopan, 2004, p. 23).

At the control stage, the management avoids the frustrations that can come with the use of technology by recognising the importance of employees' training in order to see positive growth and maximise their return on investment in the information ststems. The management also put in place, a centralised control over the information systems (Swanson, 2009, p. 132). Usually, there is no going back for the mangement on the introduction of the information systems. Rather than stopping the use of the information system, the management of the company would rather bring in measures such as authorisation, standardisation, documentation and interfacing (Sadagopan, 2004, p. 135).

The recognised need for standardisation and interfacing usually brings the need for integration at all levels in hardware, software, support and general operational activities (Sadagopan, 2004, p. 138). This brings about the integration stage. At this stage there is an increased demand for a well centralised communication across different information systems that are used in different functional areas. This is usually made possible with proper control and formal planning (Nolan, 1979, p. 29).

The next stage is the data adminstration stage. At the data administration stage, there is a recognised need to adminster data and information as a corporate resource (Sadagopan, 2004, p. 141). The data and information are then used for managing and taking decisions on the company activities. Issues of data security and access priviledges are of vital importance at this stage. Although issues of responsibility and duties of the various departments and how they are supposed to handle the information systems are recognised here, there is an acknowledgement of the information systems' ability to store and manage business activities of different functional areas.(Swanson, 2009, p. 74).

At the maturity stage, the information systems have been integrated and well incorporated into the company's business activities. The stage presents a level in which the company now looks for new uses of tecnology and new means to advance technology

(Paradzayi and Ruther, 2002, pp. 73 - 74). During this stage, the company is certain that the information systems deployed are successful already, efforts are mainly geared towards achieving additional functionalities that information systems can still offer the business.

Richard Nolan's Stage of growth Model showed the stages of growth of information systems within an organisation. According to this model, organisational goals are defined through the technological changes (Paradzayi and Ruther, 2002, p. 75). Moreover, Nolan's 'Stages of Growth model' formed the basis of academic debate and research over many years before its acceptance (Earl, 1983, p. 43). However, Galliers and Sutherland (1994) mention that it is now widely adopted and accepted by academics and practitioners, particularly following the development of further models in this area (Galliers and Sutherland, 1994, p. 924). Many organisations can be at many levels of an evolutionary growth cycle, with different applications, at different times. This area is so inextricably linked with strategy that it is imperative. SMEs lack any emphasis on strategy, a framework that enables them to position themselves on the evolutionary 'ladder' aids them in also deciding where they want to be.

Although Richard Nolan's Stage of Growth Model is generally accepted by the aforementioned scholarly works as being good in the evaluating of deployed information systems and it will be good to use it in the assessment of deployed information systems in Libyan oil companies, it is very important to mention that there are series of debates among scholars on the validity and viability of the stages concept in information systems (Prananto, McKay and Marshall, 2003, p. 13). King and Kraemer (1987) in his critique of Richard Nolan's Stage of Growth Model mentions that although it is regarded as an attractive model to explain the progression of IT in organisations, it raises great concerns as it lacks empirical validation of each stage (King and Kraemer, 1987, p. 131). In the critique of Benbasat, Dexter and Mantha (1980), it is mentioned that further research based on Richard Nolan's Stage of Growth Model has resulted in some inconsistencies in the evaluation of information system deployment because stages in the growth of information systems may not be crystal clear. However, Benbasat, Dexter and Mantha (1980), King and Kraemer (1987) and (Prananto, McKay and Marshall (2003) agreed that Richard Nolan's Stage of Growth Model is a good tool for assessing deployment of information systems. Hence, it is a good model for assessment of deployed information systems in Libyan oil companies.

3.8.3 Zuboff's 'automate-informate-transformate' model

Ever since the first use of computers there has been a growing interest by managers in the success of information systems within an organisation. The world of business has seen significant changes since the implementation and application of computing in businesses. The use of computers in the business world can be attributed to the increasing use of computers in everyday life and the falling cost of computing devices. With the increased dependence on computers, there is growth in the investment of computers and technologies in organisations (Hart et al, 2004, p. 52). This has resulted in some concerns for managers who have to justify the costs associated with information system deployment, and thus questions pertaining to its success and the evaluation of its benefits (Hart, et al, 2004, p. 53).

In understanding the impact of deployed information systems on the business of a particular company for which the information systems are deployed, researchers have come up with different models. In order to understand the impact on deployed information systems in businesses and how these impacts have evolved into success, a model that is worthy of being considered is the Zuboff's 'automate – informate – transformate' model (Gomez and Pather, 2010, p. 3). The three phases of Zuboff's model - automate, informate and transformate, have been described by Laudon and Laudon (2002), and Zuboff (1988) describes the three phases as follows.

According to Chatterjee, Richardson and Zmud (2001), the first phase is the automate phase which is explained as the phase where the technical aspects of IT and information systems are given a considerable amount of attention. Hence, the main focus is on the role of IT and information systems replacing human labour in organisations, with the use of appropriate technological devices and technological processes (Chatterjee, Richardson and Zmud, 2001, pp. 45 - 47). In the informate phase, there is an empowerment of the business by the deployed information systems and the IT devices. At this level, new jobs are created which require skilled workers in information system usage. There is a clear breakdown of duties expected of different employees, thus empowering the workers. The informate phase presents an avenue to derive meaningful reports from the deployed information systems, which influence important decisions taken in the company and create an evaluation capability for the functionalities covered by the information systems (Zuboff, 1988, p. 21). In the transformate phase, the traditional ways of handling business activities at different functional areas of the company's business are transformed into sophisticated business processes that are of great importance to the business. This is because the transformation is of immense

business benefit. The introduction of the internet into business information systems in recent times is helping many businesses go through major transformations (Chatterjee, Richardson and Zmud, 2001, p. 51).

The following table presents the three phases – automate, informate and transformate, as well as the evaluation of information system deployment in businesses. It presents the benefits of information systems at various stages.

Table 3.2: The three phases - automate, informate and transformate: The evaluation of information systems deployment in business.

Phases of Impact evaluation (of the deployed information systems).	Phases (based on Zuboff, 1988)	Development in the business.
Early: Quantifiable, tangible outputs.	**Automate:** Measure technical aspects of IT (rate of information flow, accuracy, timeliness)	**Euphoria:** quantifiable outputs (number of computers, number of users, rate of bandwidth consumption; tele-density; e-literacy rate; etc
Intermediate: Measurable, mostly tangible outcomes.	**Informate:** IT production and project implementation	**Instrumental:** economic outcomes (income generation, business opportunities, etc)
Mature: Unquantifiable, intangible aspects.	**Transformate:** Service perspective, intangible benefits (trust, loyalty, brand, etc)	**Intangibles:** aspirational outcomes (empowerment, self-esteem and self-worth; social cohesion and social fabric); citizen empowerment (relationship with governments); Individualised motivator factors. (Achievement, recognition).

(Source: Gomez and Pather, 2010, p 9)

Gomez and Pather (2010) extoll the advantages of Zuboff's model as being useful in the assessment of not only the stages of information system deployment but also the functionalities offered by the deployed information systems. This model therefore provides for further in-depth assessment of deployed information systems and will be useful in the assessment of deployed information systems in Libyan oil companies.

3.8.4   CPIT Model of e-Business adoption

The acronym CPIT stands for Connect, Publish, Interact and Transform:

1. Connect: This has to do with proper linking and joining of different individual business components with basic internet technologies such as "... the internet for information gathering" (Department of Trade and Industry (DTI), 2001).

2. Publish: This has to do with making information available using online technologies. This information is made available only in one direction, that is; the viewers can receive information about the organisation but cannot give feedback to the organisation.

3. Interact: This entails making information available in a two way and opposite direction using online technologies. A process "whereby a business allows its customers, suppliers or employees to interact with them online." (DTI, 2001).

4. Transform: Efficient, goal-oriented and timely interactions in business activities bring positive transformation into the business processes of a company. The transformation may be with aligning the business processes in a way that they will conform to online technologies, or completely overhauling the entire business processes in conformity with online technologies.

CPIT model of e-business adoption clearly define two elements:

1. The Connect, Publish, Interact and Transform (CPIT) axis which classifies how e-business technologies can be used in a company.

2. The business processes or activities that the e-business technologies can be applied to, in a company.

The CPIT model shows the integration between business processes with the use of a series of expanding arrows to replicate how business processes interact and overlap. It does not view business processes as isolated stand-alone events. The model reveals that e-business technologies can be applied not only to some business activities but to all business activities

of an organisation. Business activities such as Logistics, Finance, Marketing, Sales and Trading, Supply Chain management, Transportation and Distribution can all adopt e-business technologies.

The CPIT model has been effectively used with successful outcomes in some company studies in the United Kingdom to access the level of e-Business across an organisation (Taylor and Murphy, 2004, p. 321). Taylor and Murphy (2004) are of the opinion that CPIT model allows better interpretation of e-business adoption by SMEs. With the success of usage of CPIT model in assessing the deployed e-business information systems in the United Kingdom, it will be good to critically look into how it will aid the evaluation of e-business information system deployment in the Libyan oil companies. Shown below is the CPIT model demonstrating the progression from Connecting and Publishing, through Interact to transform for six core business processes.
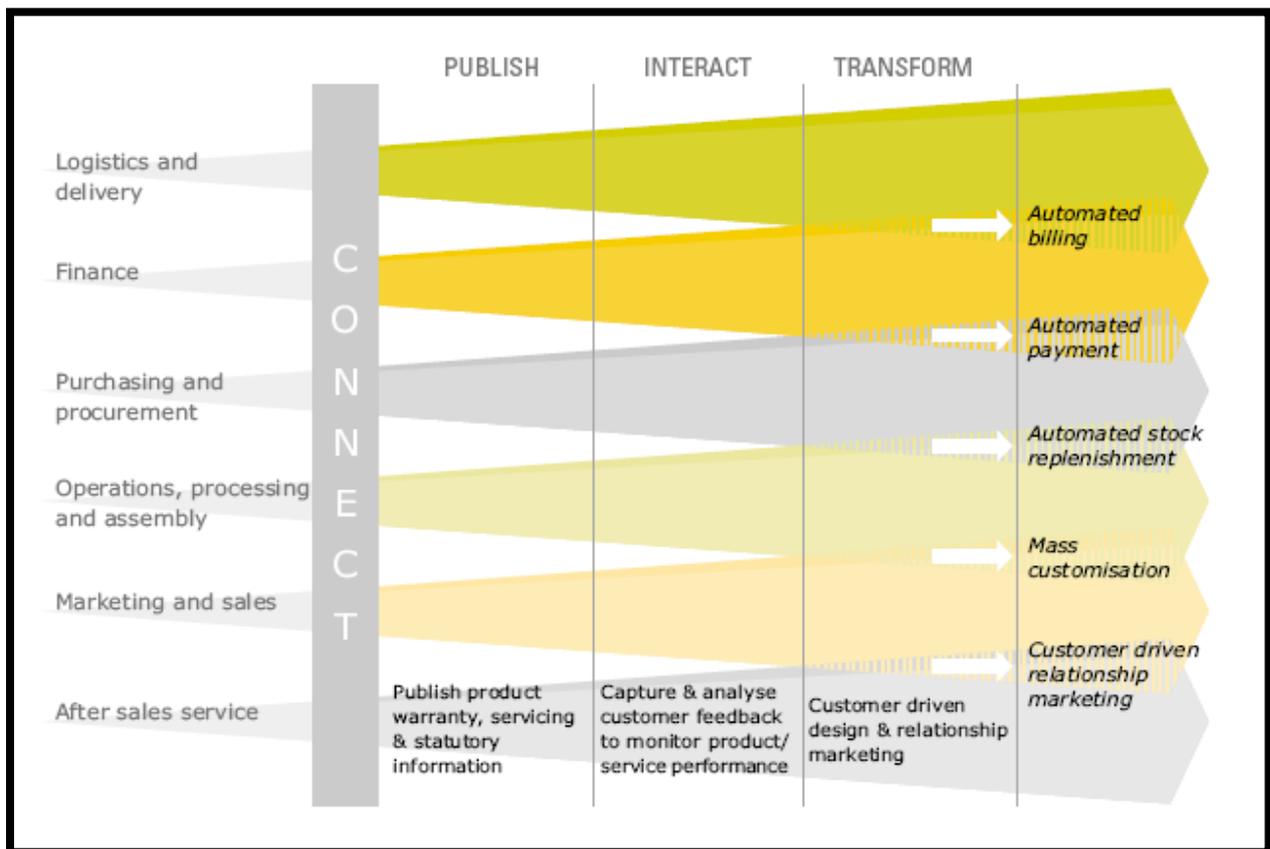
(Source: DTI, 2001)

Figure 3.7: The CPIT model demonstrating the progression from Connecting and Publishing, through Interact to Transform for six core business processes.

3.8.5   Process Mapping

The process mapping technique provides another method of assessing information system deployment. The process mapping technique presents a sequence of maps that are used in identifying the information systems that are used in defined business functional areas in the form of a diagram. Hence it can be stated that process mapping is a method that can provide a clearer view of functionalities of the deployed information systems in a company for proper assessment (CPS Activity Based Costings Team, 2011). A process map describes the flow of the information; it presents the different tasks within the process; it indicates the kind of decisions to be made; and it presents the strengths and weaknesses of the steps and presents to the researcher the interdependence of the different process steps on one another (CPS Activity Based Costings Team, 2011).

In the development of information systems within an organisation, it is crucial to first research the various processes and systems in the company. Before embarking on developing a business process map, a researcher has to understand the mission and objectives of the company in question, while also trying to gain an understanding of its goals for some years to come. While the process mapping system is used as a framework to identify the business processes, it is also used as a point of reference for improving or changing the business process. It is used to assess the shortcomings of the information systems of the company, in matters of what is missing in the information systems, what is needed in the information systems to be replaced, or even where there is a need for complete replacement of the entire information system (Wynn, et al, 2009).

In line with the usage of top-level mapping of some case studies on the system status of SMEs in the UK by Wynn et al, (2009), process function maps have been used in this study to show the deployment of information systems along with associated sub-processes and implementation of ISS in the case study oil companies' business activities. This has helped in resolving research questions on the assessment of information system deployment and existing ISS implementation in Libyan based oil companies. The main business processes and sub-processes of the oil companies are identified, deployed information systems and ISS implemented on processes in different oil companies are shown, and subsequently some positive approaches to ensure the success of deployed information systems and ISS components have been reviewed.

3.8.6 McFarlan Strategic Grid Model

The McFarlan Strategic Grid Model is a model in which subjective estimates on the importance of current and future applications of deployed information systems are used to categorise the current and envisaged information systems into a quadrant grid. The importance of both current and future usage of the information systems are estimated with two factors: The strategic importance of existing information systems in the current environment; and strategic importance of the information system in the predicted or future environment (Nolan and McFarlan, 2005, p. 100). The scale used for measuring the factors is a two-way scale of either low or high. Hence, information systems are classified into one of the four possible sections in the quadrant grid, as proposed by McFarlan. The four sections in the quadrant are named by him as: 'factory, strategic, turnaround and support.' The sections are discussed below:

1. Factory

   Information systems in this category are the information systems in the organisation that are currently in use and are crucial for the company's success in surviving and keeping their fundamental processes running. Removal of this information system or its associated functionalities from the firm will result in a major breakdown in the daily business of the organisation. However, the information systems may not have a high value for the company's future information system plan.

2. Support

   The support section refers to information systems that do not have critical impact in running the business processes of the organisation and are not expected to have critical impact on the future of the company's business. For example, the payroll system is not the core work in the oil company business and if it is removed, the company's business can still survive and in the future, an automated online staff payment system may replace it.

3. Strategy

   The information systems in this section currently have a very high business value at present and are also crucial for the success of the company. For example, in the upstream oil companies, the information systems that manage oil production and its trading are critical for the companies' major business activities. Removal of these

information systems might shut down the oil companies' operations. These information systems are also needed in the future.

4. Turnaround

In every organisation, there are usually information system projects that are not given enough attention and are somehow abandoned. This may be because there is not enough budget allocation for them or the projects are not immediately needed. However, they might be an important factor in the company's future business success. Such information systems have high potential opportunity; require improved planning, and strategic support.

Presented below in Figure 3.8 is the McFarlan strategic grid model:

	DEFENSIVE	OFFENSIVE
High	**Factory Mode** • If systems fail for a minute or more, there's an immediate loss of business. • Decrease in response time beyond one second has serious consequences for both internal and external users. • Most core business activities are online. • Systems work is mostly maintenance. • Systems work provides little strategic differentiation or dramatic cost reduction	**Strategic Mode** • If systems fail for a minute or more, there's an immediate loss of business. • Decrease in response time beyond one second has serious consequences for both internal and external users. • New systems promise major process and service transformations. • New systems promise major cost reduction • New systems will close significant cost, service, or process performance gap with competitors.
Low	**Factory Mode** • Even with repeated service interruptions of up to 12 hours, there are no serious consequences. • User response time can take up to five seconds with online transactions. • Internal systems are almost invisible to suppliers and customers. There's little need for extranet capability. • Company can quickly revert to manual procedures for 80% of value transactions. • Systems work is mostly maintenance.	**Strategic Mode** • New systems promise major process and service transformations. • New systems promise major cost reductions. • New systems will close significant cost, service, or process performance gap with competitors. • IT constitutes more than 50% of capital spending. • IT makes up more than 15% of total corporate expenses.

Low to High need for new information technology

(Source: Nolan and McFarlan, 2005, p. 3)

Figure 3.8: The McFarlan Strategic Grid Model

3.8.7 McFarlan-Peppard Model - Quadrant grid of IS applications portfolio

Information systems and information system strategies are adopted by business-oriented organisations because of potential benefits in terms of business process' effectiveness and beneficial data cum information management that comes with their adoption. These potential benefits are used as strategic tools to drive the business strategy to achieve desired business values for the companies that adopted the information systems and the information system strategies. The McFarlan-Peppard Model was established on the basis that the prospects from investments on information systems are not homogeneous because information systems differ in the way that they are used, the level to which they align with the business strategic goals of organisations, and the business value they provide for investments in them (Ives and Learmonth, 1984, p. 1199). Hence, the IS applications portfolios are categorised into a quadrant as shown in Figure 3.9 below.

The strategic grid takes cognisance of the fact that information systems and the adopted strategy is critical to the smooth running of business operations. Also the grid reveals that there are some adopted information systems and information system strategies that have direct bearing on the overall business strategy of the company in question. Hence, the strategic grid categorises the information systems along strategic lines based on:

1. The strategic importance in the current environment (Low or High).
2. The strategic importance in the predicted environment (Low or High).

Shown below in Figure 3.9 is a further clarification of the McFarlan-Peppard quadrant grid:
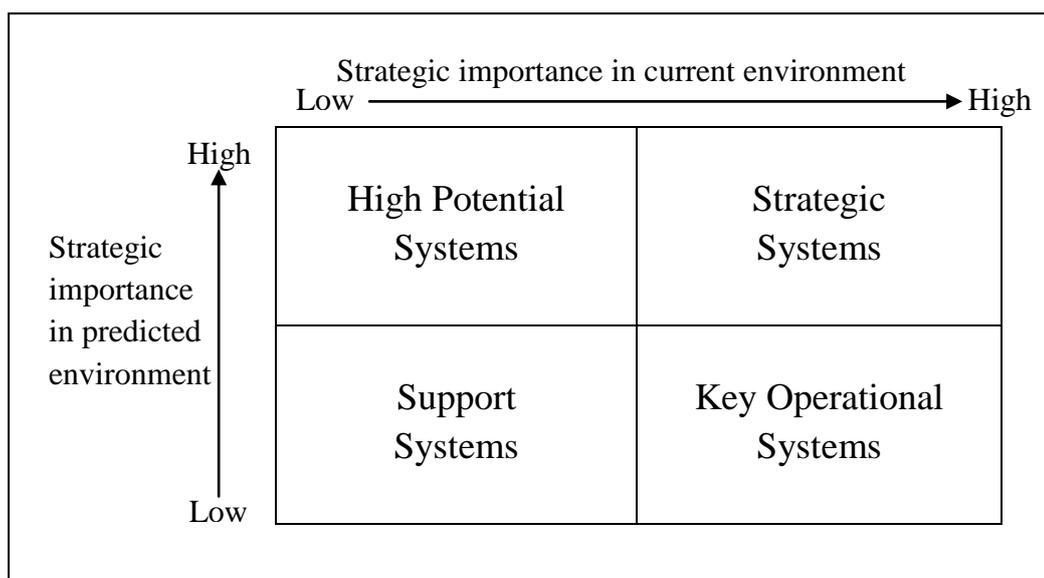
Figure 3.9: Explanation of McFarlan-Peppard Model - Quandrant grid of IS applications portfolio

This mode of analysis with strategic grid is useful because it enables an assessment of how well information system deployment and implemented information system strategies are aligned with a company's business strategic goals. Furthermore, it makes available another approach for assessing and organising deployed information systems and information system strategy implementation. The model considers the contribution of information systems to the business at present and also considers the future contribution of information systems based on their industry impact. The model as illustrated above proposes an analysis of all information systems in the company, irrespective of their category, weather already existing in the company, or planned to be used in the company in the future.

As elucidated by Ward and Griffiths (1996), the information systems of the oil companies can be categorised into any of the illustrated four groups in figure 3.9 above, depending on their contributions to the current or anticipated business success. High potential systems are information systems that are crucial to derive future business success, but they are not of great use in the present. The information systems that are of high strategic importance in the present and also promise to be of great importance in the future are referred to as strategic systems. Such information systems are flexible and can be easily adapted to manage the ever evolving business needs of business organisations. Therefore, the company strategically believes that success will continue. The information systems that are considered as key operational systems are those the company considered as being important at present but not really relevant in the future for the success of its business. The support systems include information systems that shore up the business functions in the company but are not strategically highly important at present or in the future.

3.8.8 Gottschalk's "Stages of Growth" Model

Gottschalk (2002) developed a model that can be used to comprehend how information systems can support the management of knowledge in organisations. The model is referred to as Gottschalk's "Stages of Growth" model. This model assesses the growth of information systems over a particular period of time with the knowledge management contributions of the information systems to the business organisation where it is being used. The evaluation of information systems with this model assists companies:

1. To be able to understand the current state of the information systems in a business organisation in terms of a specific stage (The stages are as defined in the Gottschalk's "Stages of Growth" model).

2. To be able to guide the company in developing strategies to move their information systems to a higher stage in the future (The stages are as defined in the Gottschalk's "Stages of Growth" model).

Gottschalk (2002) specified four stages in the model. The stages were named: Stage I, II, III and IV accordingly. Shown below in Figure 3.10 is the illustration of Gottschalk's "Stages of Growth" model.
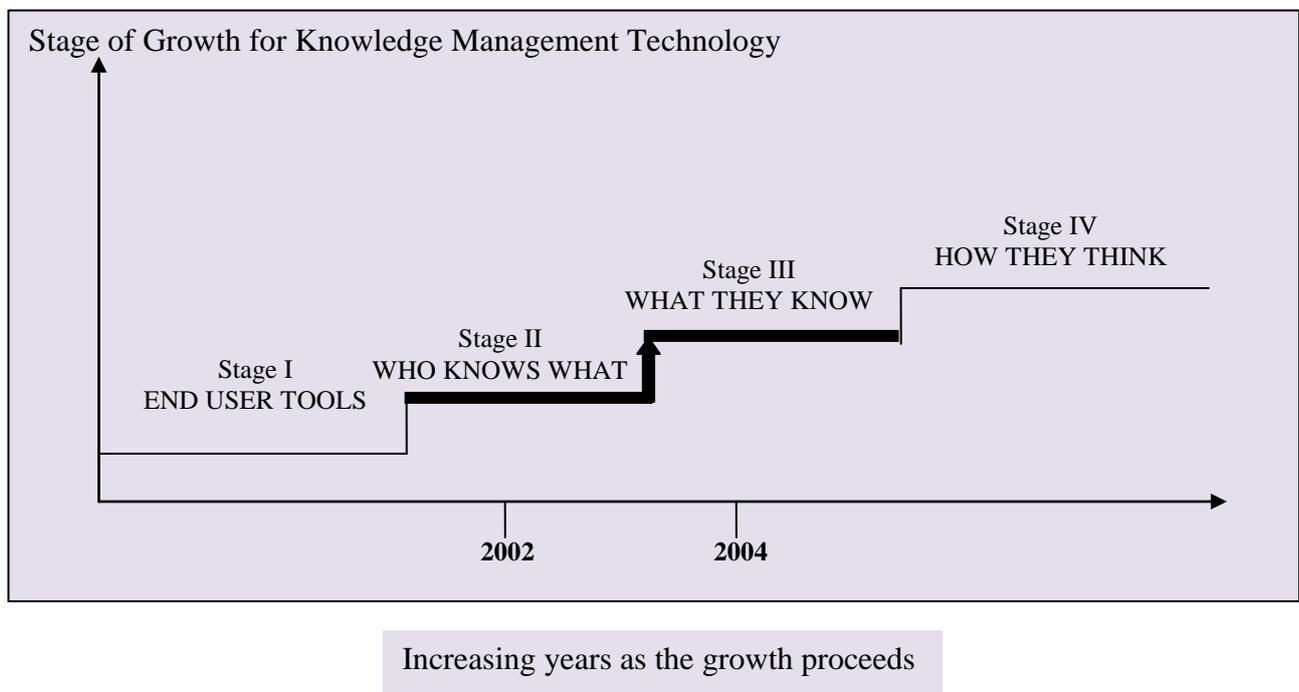
Figure 3.10: The Gottschalk's "Stages of Growth" model for Knowledge Management Technology

At stage I, the information systems provide basic support for the staff of the company. The basic support includes word processing facilities, spreadsheet capabilities, and email communication. At stage II, the information systems store information on different sources of knowledge from within and outside the firm. This includes customers' information, suppliers' information, companies' information, and employees' information. At the third stage, the information from the information systems represents knowledge. Hence, there is sufficient

information in the database to generate required reports and outputs to drive the general business activities of the company. The final stage is the stage in which the information systems provide efficient processing of information as required. In evaluating information systems, understanding the stages of information systems' beneficial support to the business is useful to manage the information systems.

3.9   Resources that support Information Systems Deployment

IS typically relies on the combination of all of the following resources:

1. People: People develop, maintain and also use the resources and in turn, the deployed information systems. This is an important resource, as the success of IS depends on sufficient development of the IS and its acceptance by the users (Boddy, Boonstra, and Kennedy, 2005, pp. 313 - 334) discuss the Technology Acceptance Model (TAM) and Theories of Human Need along with some other factors to show that people are a vital resource that support deployed information systems, and have significant effects on their successes.

2. Hardware: All kinds of physical machines and infrastructure on which the deployed information systems operate including, but not limited to, CPU, monitors, keyboards, mouse, fax machines, telephones, copiers, etc.

3. Software: This term is not limited to computer software that is built into the computer system, but also includes the automated procedures and processes the other resources (people, for instance) follow. Company policies, instructions to new entrants, health and safety procedure, etc. also fall into this category as long as they are automated.

4. Communication Infrastructure: This includes networks and protocols used to transfer data and information between different resources and across different information systems.

5. Data: This is the building block which forms the main part or the body of the business reports. Data are organised meticulously and properly processed to form information.

Although all of the above resources have their own value and are indispensable for the successful functioning of any deployed information system, it must be pointed out that in recent times the people and the computers (hardware and software) have become the most crucial aspect of the information system deployment in organisations when business processes have to be maintained and streamlined for trouble-free operations. This warrants the Work Centred Analysis (WCA) framework which is based on the idea that business

professionals analyse deployed information systems by focussing on the work being done with the deployment (Alter, 2006, p. 54).

This WCA framework defines six elements, based on studies in Total Quality Management, Systems Theory and Business Process Reengineering. They are:

1. The customers, internal or external, of the business process.
2. The products generated by the business process.
3. The steps in the business process.
4. The participants.
5. The information.
6. The technology.

These are used to formulate a paradigm where the business process is the heart of the deployed information systems.

As can be observed, there is always a two-way link between all the elements in the framework, which implies that a balance is required between the elements, and that the system becomes fully functional when there is mutual exchange of data between the different elements. Planning for information systems, as for any other system, begins with the identification of requirements. In order to be productive, deployment of any type of information system should be a response to business need - whether at the transaction processing level or at the more complex information and strategic operation levels. Such planning for information systems is much like strategic planning in management. Objectives, priorities, targets and authorisation for information systems need to be formalised. King (1995) stated that strategic capability architecture of deployed information systems - a flexible and continuously improving information systems based on organisational business needs – is the basis for a company's sustainable competitive advantage in any industry.

3.10   Research Questions

When discussing IS in the developing world, Gomez and Pather (2012) observe that there is lack of literature and evaluation studies on IS. Akeel, Wynn and Zhang (2013) while citing Batchelor et al (2003) pointed out that the World Bank believes that "analysts and decision makers are still struggling to make sense of the mixed experience of information technologies in developing countries." Nevertheless, Avgerou (2008) has observed that there has been a significant effort of engagement with IS development and management in all organizational fields of developing countries.

Within this context, and in accordance with the research aims and objectives given above, this research addresses the following questions:

1. What are the current information system strategies used in the oil companies in Libya?
2. How effective are current information system strategies in supporting business strategy and business operations in the Libyan oil companies?
3. How are the Libyan oil companies embracing e-business processes and procedures in Libya?
4. How can information system deployment in Libyan oil companies be assessed using existing models and can these be developed into a comprehensive framework for assessing information system deployment in Libyan oil companies?

3.11   Summary

This research work investigates the deployment of Information Systems (IS) and Information System Strategies (ISS) by domestic and foreign oil companies in Libya. It looks into factors associated with the implementation and deployment of the IS and ISS in the two types of oil companies, and identifies the differences in such deployment In addition, ISS development and implementation is considered, and thereafter a new framework as a tool for assessing deployment of information systems and ISS implementation in Libya based oil companies is instituted.

This chapter has presented a detailed review of important literature that is relevant to the main research area of this study. Data, information, information system, information system strategy and strategic information system alignment have been discussed in relation to how they bring improvements into the operations of different business organisations among which are the crude oil companies. In this chapter, the e-business information system and ERP information system have been reviewed. e-business has been discussed in relation to the important usage of internet technologies to drive business processes. Components of information system strategy, associated implementation and the expected integration into organisational business strategy have been looked into, with consideration given to works such as Cassidy and Guggenberger (2001), Mateus, et al. (1996), Kent (2004), Pearlson and Saunders (2010) and Johnson and Scholes (1999).

Risks that come with deployment of information systems and information system strategy implementation, especially in the aspects of information system authorisation,

security control monitoring and security control assessment have been considered in this chapter. Relevant and established models for assessing deployed information systems and information system strategy implementation in Libyan based oil companies and the evaluation of the effect on process change have all been discussed in this chapter. The first model reviewed was "The Stage of Growth Theory" model by Richard Nolan that can be used to measure progress of information system deployment based on their functional usages. Other models discussed include the Zuboff 'automate-informate-transformate' model to access the level of information system application to the businesses of the oil companies, and the CPIT model of e-business adoption to investigate how the Libyan oil companies are embracing e-business procedure. The multidimensional model of Henderson and Venkatraman (1999) on strategic information system alignment which looks into detailed integration of business strategy with information system strategy was reviewed. In addition, the McFarlan Strategic Grid and McFarlan-Peppard model of assessing information systems and adopted information systems strategies were critically looked into with associated quadrant groupings.

A review on the Earl's "three pronged" model on the companies' information system strategies has also been carried out. The concepts of process mapping and information system application portfolio were introduced with clear analysis. Gottschalk's "Stages of Growth" model was presented in this chapter and the four stages of the Gottschalk's model have been discussed. This chapter took a closer look at the essentiality of setting up assessment models for information system deployment and information system strategy implementation in a developing country such as Libya. It has reviewed previous studies on different types of business information systems. Moreover, envisaged factors that can affect deployment of information systems and implementation of information systems strategy in Libya have been reviewed. The following chapter of this thesis - Chapter Four - presents the research methodology adopted while carrying out this research. It also provides a more detailed view of the case study companies. It states the fundamental focus of this research and describes the research strategy adopted to achieve the stated aim and objectives of the research.

CHAPTER FOUR – RESEARCH METHODOLOGY AND OVERVIEW OF CASE STUDIES

4.1   Introduction

Research can be defined as the exploration for new knowledge with an open mind through a systematic investigation to institute relevant fresh facts that solve existing or newly discovered problems (Dawson, 2002, p. 12). Research Methodology has been defined in different ways by various authors, among them Dawson (2002), Kothari (1985) and Kumar (2005); however, there are convergent points in the definitions of the authors. Research can be carried out in many different ways, however these ways can be broadly categorised into two main approaches: qualitative approach and quantitative approach. Qualitative approach has to do with studies based on words and meanings, with the objective of capturing the complexity and vastness of human experience. On the other hand, quantitative approach entails studies that are carried out with records of information gathered from research participants in forms that are suitable for statistical analysis of the findings, and the generalisation of discoveries on a wider scale. There has been considerable debate in the past about which of the two approaches is superior (Salomon, 1991, p. 13; Bryman, 1984, p. 81). However, in the modern research environment, it is agreed that both approaches are valid and have their advantages and disadvantages. For this reason, many researchers adopt a pragmatic approach, simply using whichever method is best suited to answering their research questions, and which might even involve a combination of both approaches within the same study.

In order to understand the real causes behind natural phenomena and events, researchers have developed a number of data collection and analysis methods. In addition, a number of techniques with associated equipment have been developed to improve the accuracy and depth of the information gathered. However the type and nature of the information acquired depends upon the type of methods used. This chapter discusses the research design; the strategies and the general data collection/analysis methods used in this research. The methods used to conduct the interviews and administer the questionnaires as well as the difficulties involved are discussed. It should be pointed out that the research method used in this study was a combination of quantitative and qualitative techniques, in accordance with the aims of the research and the questions to be answered.

The overall aim of this research is to investigate and assess the deployment of information systems in a foreign crude oil company and a domestic crude oil company, both

in Libya. It examines how the information systems in the companies communicate in relation to different business functions in the companies. The research also studies the information system strategies that the companies use to drive their business performance and operational efficiency, as well as different integration approaches between information system strategy implementation with business strategy in both types of company. Subsequently, the research develops a comprehensive framework for assessing the deployment of information systems in Libyan oil companies.

4.2   Research Philosophy

The main objective of any research is the development and creation of new knowledge based on data collection and analysis along with careful observation. The knowledge developed is usually new knowledge in a particular field based on what exists and what is investigated (Pearlson and Saunders, 2010, pp. 35-38). Researchers take very different positions on the nature of reality and the possibilities of knowing about it (Gomm, 2004, p. 27). Research philosophies that are adopted in a research process examine the reality and the nature of this knowledge that has been developed in a logical manner. The major philosophical schools of thought are epistemology, ontology and axiology (Gomm, 2004, p. 32). In this study, the research philosophy used can be classified as epistemology with an emphasis on positivism and interpretive science. The concepts are briefly explored below:

Epistemology: This is the study of how well we know and learn about reality in a field of study. It is a branch of philosophy that takes into consideration the nature of the theory of knowledge, in particular its foundations, scope, and validity (Gomm, 2004, p. 39). Epistemology is the theory of knowledge and it answers questions about how one can be a knower; what tests beliefs must pass in order to be legitimised as knowledge; and what kind of things can be known. Sociologists of knowledge characterise epistemology as strategies for justifying beliefs (Gomm, 2004, p. 40).

Positivism: This philosophy was formulated by Auguste Comte who developed the thought that genuine research is one that is based on observation and on experiment rather than on theory and data collection. Here, a hypothesis is developed using an existing theory; the hypothesis is then tested and established leading to the development of a new theory based on research. Quantitative method is normally applied for the positivism study.

Interpretive Science: Interpretive science identifies and understands human experience in context-specific settings using the qualitative and naturalist ideas. Rather than explore the causes and the fundamental laws, interpretive science tries to understand and explain the observable facts (Kutay and Finger, 1990, p. 19). This research work uses more of the philosophy of interpretive science.

A brief comparison between positivism and interpretivism can be seen in the following table 4.1:

Table 4.1: Positivism Vs Interpretive Science

Approaches	Concepts	Methods
Positivism	Social Structure	Quantitative
	Social facts	Hypothesis
Interpretive Science (Phenomenological)	Social Construction	Qualitative
	Meanings	Hypothesis generation

(Source: Holmes and Gardner, 2006, p. 34)

The present research uses the philosophy of interpretive science as it tries to explain the observable facts in context specific situations. In this PhD project, the observable fact is the deployment of information systems in the Libya oil companies. The context specific situation would be the two oil companies in Libya - Waha Oil Company and Petro Canada Company, the domestic oil company and the foreign oil company respectively.

4.3   The Concept of Research Methodology in Relation to this Study

In order to conduct research, certain methods are used by the researcher, usually referred to as a research methodology. The concept of research methodology has been defined in similar ways by different authors. Hence, it can be said that research methodology is a technique used to gather and analyse data. Brown and Rodgers (2002) define research methodology as a systematic approach to gathering data which is often about comparing people, documents or even test records using such activities as description, explanation and understanding. These approaches could range from interviews conducted, administration of questionnaires, statistical inference, discourse analysis and participant's observations. The choice of research methods depends on the project undertaken and the research questions being asked. The research goals must clearly be defined in order to adopt the right methodology (Grix, 2001, p. 14). Grix (2001) also notes that research methods have two main functions. These are:

1. To offer a researcher a way of gathering information or gaining insight into a particular issue.

2. To enable a researcher to re-enact the first endeavours by emulating the methods employed.

Brett (2007) perceives scientific methodology as a series of clear cut rules and procedures on which the research is based so that practical results can be established. This implies that the purpose of methodology should go beyond the application of rules and procedures to involve the process of facilitating scientific communication among researchers; it should also establish a clear cut credible and verifiable systematic rule (Ketchen and Bergh, 2006, pp. 26 - 41).

This study is primarily country specific relating to the deployment of information systems in the oil companies that are based in Libya. Two big players in the Libyan oil and gas industry (one domestic company and one foreign company) have been chosen as case studies. A literature review has been done as part of this study to provide a broad overview of scholarly works on the assessment models for information system deployment, methods of deploying information systems and adopting information system strategies, as well as how improvement can be made on the deployed information systems. Issues that are reviewed include Libya as a country, oil companies in Libya and in the world, information systems, information system integration, information system strategies, IT departments, and existing assessment models for information system deployment, among other related issues.

This is followed by the designing of questionnaires and developing appropriate interview questions that have been used in the designated chosen case studies. The collected data, which are the findings of this study, are discussed and presented. Thereafter, the collected data has been analysed and appropriate conclusions and recommendations are presented.

In order to collect the required data from the Libyan oil companies, the first step is to approach the necessary top management staff of the companies and discuss the research work and its aims and objectives with them. This was done formally by scheduling a short interview session and meeting with the necessary top management staff of the Libyan oil companies. Once approved, a sample of the questionnaire was discussed and provided for completion by the companies' employees. The questionnaires along with the interviews and relevant scholarly works have been used in this research work.

Building on the information and data gathered from the questionnaires and interviews, scholarly models have been used to analyse them in a well-constructed structure. There is proper arrangement of the gathered data and information for comparison and evaluation to identify the key elements of success or failure in the deployed information systems, and the information system strategies of the case study companies. This research highlights the strengths and weaknesses in the deployed information systems in the case study companies and suggests ways of dealing with them (Kellen, 2003, p. 2).

The scholarly models reviewed in the literature are used for assessing and evaluating the information systems in the case study companies based on the gathered data and information during this study. The final outcome is the development of a new framework for assessing deployed information systems in Libyan based oil companies – both domestic and foreign. The framework may also be useful for Libyan companies in industries other than the oil and gas industry.

4.4 Research Strategy

A number of research strategies are available depending on the nature and objectives of the research. Bryman and Bell (2003) identify two main types of research strategy: deductive and inductive. Deductive research strategy refers to the logic of drawing conclusions on the basis of given facts (Bryman and Bell, 2003, p. 15). Hence, this type of method implies the collection of a great number of facts, from which conclusions can be drawn. In other words, a number of given facts do not need to be proven, and the conclusion

should not be thought of as really new, but only presented in a new form which is more or less inherent in the already given information. The deductive approach starts by the development of a theory and hypothesis to finish with the design of a research strategy to test the hypothesis. It tests theory that is developed under the inductive approach and moves from theory to data. The focus of a deductive approach to research is to explain causal relationships between variables that call for the collection of quantitative data and statistical tools for relationship-testing.

Bryman (2001) explains that inductive research strategy takes advantage of observation and data collection to answer research questions in order to establish laws and theories. In an inductive approach, the data are collected before being analysed in order to develop a theory. Inductive research is usually undertaken to gain an understanding of the meanings, attitudes or perceptions that human beings attach to or develop towards events and stimuli (Sproull, 1988, p. 74). Therefore, such research is based on data that is gathered through a qualitative means of data collection. The present research uses the inductive approach strategy to deal with the data collected through the use of the questionnaires and interviews. This research aims to analyse the development and implementation of information system strategies. The overall objective of the study cannot be satisfactorily fulfilled through quantitative research, since it is rigid. This research adopts a qualitative and interpretive approach since it requires flexibility. In this study the researcher has   undertaken a further case-study of two companies and has studied the history, development, implementation, current situation and future strategies with regard to information system deployment in the companies.

4.5   Methods of Data Collection

Methods used in research can be categorised into three: the qualitative method, the quantitative method and the combined method of data collections (Bryman and Bell, 2003, 31). These are explored below:

Qualitative Method: Qualitative research concentrates on observable facts which cannot be expressed in numbers. Bryman (2001) writes that the three characteristics of qualitative method in research are inductive, constructive and interpretive. The author however clarifies that researchers may not always follow all the three characteristics in their research. The qualitative research method involves analysis of gathered data and presents an avenue for the

interpretation of the study. The qualitative method reflects the phenomenological philosophy of research as the investigation is based on a recognition of the importance of the subjective, experiential realities observed by human beings. The qualitative approach can be characterised as follows (Fowler, 1993, pp. 14 - 17):

1. Tends to produce qualitative data.
2. Uses small samples.
3. Concerned with generating theories.
4. Data is rich and subjective.
5. The location is natural.
6. Reliability is low.
7. Validity is high.

Quantitative Method: This is a type of research where data is analysed statistically and the findings are presented in numerical form (Fowler, 1993, p. 23). According to Bryman (2001), quantitative method helps collect numeric data and presents a view of the relationship between theory and research as deductive, a predilection for a natural science approach and as having an objectivist conception of social reality. The features of this type of research are deductive and inductive. A typical quantitative research process is given below in Figure 4.1.
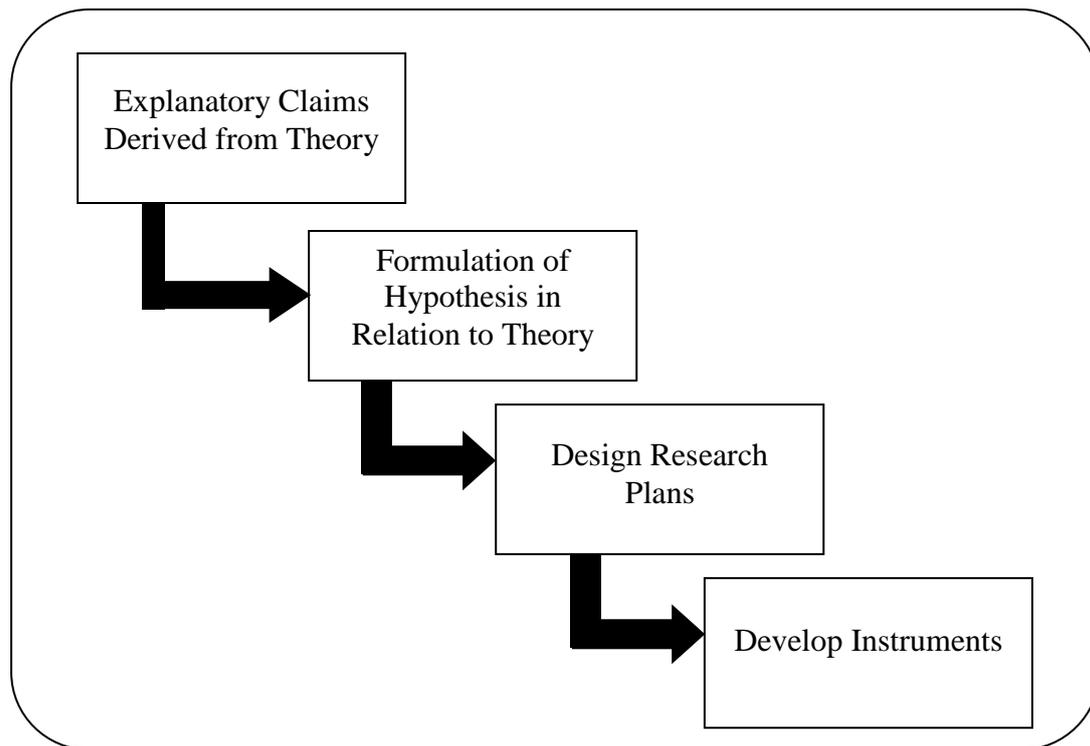
Figure 4.1: Typical Quantitative Research Process

Fowler (1993) summarises the general characteristics of the quantitative method thus:

1. Tends to produce quantitative data.
2. Uses large samples.
3. Concerned with hypothesis testing.
4. Data is highly specific.
5. Reliability is high.
6. Validity is low.

Combination Method: Bryman (2001) and Fowler (1993) have observed that the two research methods mentioned above do not usually exist in isolation during research. A combination of the research methods when used gives rise to the combination method. As methods of data collection have limitations and weaknesses, using a combination approach appropriately can develop the strengths of the two earlier mentioned methods and neutralise or cancel out some of their weaknesses. Hence, the combining method combines both qualitative and quantitative methods.

4.6   The Research Methodology in the Study

In the adoption of a particular research methodology, this study primarily uses the qualitative research methods. The gathering of the data is qualitative, as is the analysis of the research. The data collection was conducted in Libya and the two oil companies considered for this study are Waha Oil Company and Petro Canada Company, as they are the only companies that offered to participate in the research work during the pilot study. In order to investigate the deployment of information systems and adopted information system strategies in Libyan based oil companies, questionnaires were administered on two different occasions, and several one-to-one interviews were conducted as demanded by the progress in the research work; these were carried out in line with the literature reviewe in Chapter Three. Both English and Arabic languages have been used to ensure that the questionnaires and interviews are efficient in gathering of data.

4.6.1   Case Study Method

Case studies are particularly appropriate when theory is well developed, and the use of multiple cases helps to ensure that conclusions are based on comparable outcomes and common patterns rather than a generalised one from what could be one-off chance occurrences (Fowler, 1993, p. 40). Yin (2003) explains that a case study method provides an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially, when the boundaries between the phenomenon and context are not clearly evident. This is particularly relevant for the purposes of this study, which is concerned with exploring the processes and associated issues relating to information system deployment and information system strategy implementation. Yin (2003) highlights the steps in the case study approach to research thus:

1. <u>Design of the Case Study Protocol</u>: At this stage, the required skill is determined and the protocol (e.g: Single or Multiple Case. Holistic or Embedded Approach.) for carrying out the research is established and reviewed.

2. <u>Preparing for Data Collection</u>: This step entails making preparation to collect data, selecting the cases and conducting a pilot study as well as carrying out necessary training to ensure the success of the research.

3. <u>Data Collection</u>: At this stage, the interview is conducted, the administration of questionnaires is done. Hence necessary collection of required evidence is carried out.

4. <u>Analysing the Collected Evidence from the Case Study</u>: With the use of appropriate analysis techniques and strategies, the collated evidence is discussed and analysed.

5. <u>Reporting Case Studies</u>: Make conclusions, recommendations, and explain the implications of any discoveries based on the analysis of the evidence.

Based on the discussions above, it is clear that the case study method is an appropriate method to generate pertinent information from the sample oil companies. The rationale behind using this method for gathering data is that it enables the researcher to take an in-depth look into the processes, resources, designs and the entire mix of factors and tasks that are involved in studying the deployed information systems and the implementation of information system strategies, which may consist of differences or similarities between the companies that are being studied. The theoretical principles and the established methods by which information system strategies are developed are interpreted by each company in the context of its own resources, scale of business, nature of business, geographic considerations, stakeholders including customers and several other factors. In this scenario, the case-study method of data collection is seen to be most relevant to the overall objective of the study.

Given the scale of the study and the information required for analysis, the primary research of each company has been carried out by the use of the data collection tools of process mapping and system profiling, which have been discussed in terms of their meanings, relevance, data generation and contribution to the overall objectives in Chapter 3. The deployment of information systems and the implementation of information system strategies have become a core part of business strategy of business organisations. In this context, this study focuses on the selection, implementation, usage, evaluation of information systems in the case study companies, and the provision of management information from data contained therein, and on the remodelling of core business processes as a result of the information system deployment. The research is based on two in-depth case studies, each one taken from the two groups of oil companies in Libyan – Foreign Oil Companies and Domestic Oil Companies.

4.6.2   The Questionnaires

According to Bryman (2001), a questionnaire consists of a number of questions in relation to the subject of the research, whereby answers are expected to be provided to the questions for the research to achieve its aims and objectives. The questions should always be

clear and easy to understand and should be included on one form. Bryman (2001) explains that the questionnaire can be presented to participants in one of four ways:

1. by mail in which case an interview is necessary after completion
2. by telephone
3. by hand
4. by the internet either through a website particularly designed for this purpose or e-mailed

The primary research conducted for this study consists of questionnaires distributed to the two Libyan based oil companies. The purpose of these questionnaires is to collect data on the deployment of information systems in the companies, the adopted information system strategy in the companies, the assessment factors on the deployed information systems in the companies, and other related information. The questionnaires provide one of the two mediums used for gathering data in this research. Design of the questionnaires: The questionnaires were administered on two separate occasions; the second one seeks to clarify some unclear responses from the first administered questionnaire and the first set of conducted interviews. It also covers other required questions to aid the research. The topics included in the two questionnaires can be categorised as follows:

a) Company information: To find out the company profile, size, business and other general information.
b) Company processes: To explore the company's main business processes as well as primary and secondary operations.
c) The information systems: To study the deployment of information systems and adopted information system strategies, and to explore the company's information system structure.
d) Current System Status and Architecture: To explore the current state of the information system functionalities in relation to the satisfaction of the departments that use them in the company.
e) Problems and Challenges with Information Systems: To address any problems, issues and challenges that the company may have with their currently deployed information systems and information system strategies implemented.

f) Business Information Systems: To find out the different types of usages of the deployed information systems in the company and how they are aiding   business activities.

The questionnaire includes open-ended, semi open-ended and closed questions. The benchmarking study of DTI (2001) has been taken as the point of reference for the instrument in designing the questionnaire. The DTI benchmarking instrument uses a model to analyse the growth of a company whilst also analysing its performance and management, then agreeing on an improvement strategy (DTI, 2001). The benchmarking study of DTI (2001) was chosen because it includes questions and allows analysis of information systems at a process level. This makes it particularly relevant and useful because the starting point of this research work is the top level process mapping. It could also be adapted to go beyond the standard narrow definition of e-business to encompass all information system deployment at process level.

4.6.3   Interview

This study also employs the interview technique of gathering data from respondents. An interview is the most common method used for qualitative research (Bryman and Bell, 2003, p. 37). It is interactive in form and enables the researcher to gather data that directly addresses the research aims and objectives. Although the process of conducting interviews is generally straightforward, considering that both the researcher, who gathers data, and the respondents are human beings, the most important parameter of success here is to listen carefully to whatever is being said leaving aside all personal perceptions and prejudices by the researcher. The reason this study also uses the interview technique as a research tool is to gather comprehensive information on the topic based on the literature review and at the same time make an attempt to find the respondents opinions on the factors on the deployment of information systems in the oil companies in Libya. Interviews can represent a rich source of data on people's experiences, opinions, aspirations and feelings. In order to achieve this, researchers need to understand the dynamics of the interview and sharpen their own use and understanding of the different methods of interviewing, together with an awareness of their strengths and limitations (Bryman and Bell, 2003, p. 41).

The advantages of interviews as given by Bryman and Bell (2003) and Bryman (2001) are summarised as:

1. To allow the researcher or interviewer to ask open ended questions.

2. The researcher can record the interviews if the respondent has no objection. However, taped interviews might sometimes cause bias in the respondents' answers because they may be uncomfortable knowing that their voices are being recorded.

3. To enable the interviewer to explain to each respondent how he or she came to be chosen for the sample and why it is important that he or she rather than someone else should take part in the interview.

4. To give the researcher the opportunity to initiate good levels of communication and trust with the respondents to make him or her comfortable enough to provide truthful data and answers without any fear of adverse consequences. To this end, the researcher should state briefly the objectives of the interview and assure absolute confidentiality on the source of the responses.

5. The questions can be modified if this is thought to be necessary. This might involve rephrasing or repeating questions to ensure that they are properly understood by the interviewee.

6. To improve response rates. A questionnaire may easily produce a low response rate, while interviews can generally do much better than this.

7. To allow the researcher to easily communicate with the less educated respondents. For example, the interviewer can help interviewees who may have reading difficulties, offer standard explanations to specific questions that arise, prevent misunderstanding, keep control over the respondents environment when answering questions, and regulate the respondents order of answering questions.

8. To prevent others answering for the respondent, and to ensure that all questions are fully answered.

Choice of interview questions in this research work: As mentioned earlier, the aim of the interview is to gather comprehensive information on deployed information systems in the oil companies. In this study, the interview questions consist of questions that were asked in order to understand the background and business of the company and that of its information systems. Recognising the background of the company gives an insight into the organisation. The respondents were also asked questions relating to the strengths, weaknesses, opportunities and threats faced by the deployed information systems in the company.

The interview goes on to discover information on the kinds of IS/IT strategies implemented by the companies. In addition, the interview seeks to gather information on the current activities that the deployed information systems are used for within the organisation. Some questions relating to the role of the top management in the deployment of information systems and implementation of the information system strategies are also considered. The interviews took place in the respective companies, one on one with the researcher and the respondent, as well as over the telephone. They were conducted in English although the researcher had to translate certain sections of the interview questions into Arabic. This did pose as a small problem as the interview took longer than expected to complete. Each interview took between one to two hours. The responses of the participants were recorded although notes were also made by the researcher.

4.7   Ethical Considerations

Ethical considerations deal with what ought to be done and what ought not to be done during the research. The research should provide a true account of what has been discovered and the investigation should not be influenced by any prejudice or unfair judgment. Also, there should be no misrepresentation of data. Consent given by the participants should be voluntary without any element of force, fraud, deceit, duress, over-reaching or any other ulterior form of constraint or coercion. In some cases, the respondents are not willing to disclose their name and identity during the research, in such a situation pseudo names are used rather than the real names (Smythe and Murray, 2000, p. 331).

In the present study, ethical considerations have been observed by the researcher. In both companies, the purpose of the study was explained to the employees and permission was gained to use their responses. The interview was organised with their consent. During interviews, assurance was given to the participants that the research being conducted was for an academic purpose and that their identity would be held in strict confidentiality, if they so desired. Thus, the respondents willingly agreed to participate in the interview thereby fulfilling the norms of informed consent (D'Cruz and Jones, 2004, p. 24). Consent forms were signed by the respondents for the questionnaires and the interviews, the consent for the interviews include supplementary data gathered via telephone interviews.

4.8   Background of the Case Study Oil Companies

As discussed in chapter two and the earlier sections of this chapter, two oil companies in Libya were chosen as case studies for this research work. They are:

1. Waha Oil Company (Domestic).
2. Petro Canada Company (Foreign).

Waha Oil Company and Petro Canada Company are two of the largest oil companies in Libya. While the Waha Oil Company is a domestic upstream crude oil company, Petro Canada Company is an international oil company, which works in collaboration with the National Oil Corporation in the upstream sector of Libyan oil industry.

The reason for choosing the two case studies is not only because they are both big players in the Libyan Oil and Gas industry, but they are from the two different categories of oil companies in Libya - Foreign Oil Companies and Domestic Oil Companies. Hence, they provide the opportunity to investigate the deployment of information systems and adopted IS strategies in both Libyan domestic and foreign oil companies. These companies being foreign and domestic will likely point out the significant differences and similarities in their IS deployment and ISS adoption. These companies will help the research to gain considerable background information on the different IS deployment and ISS adoption in Libyan foreign and domestic oil companies.

During the field pilot study to choose case studies for this research work, the choice of Waha Oil Company and Petro Canada Company was made among all other oil companies in Libya because of the following:

1. Waha Oil Company is the largest domestic oil company in the country and Petro Canada Company is among the largest foreign oil companies in Libya.
2. Responses from Waha Oil Company and Petro Canada Company suggest that both companies have deployed information systems and established information system strategies.
3. Responses from Waha Oil Company and Petro Canada Company reveal that they consider the use of information systems as being vital to their business success.
4. The field study also revealed that both companies are ready to provide the data for the purpose of the research study. The feedbacks from other companies are not encouraging.

The following table provides an overview of both Waha Oil Company and Petro Canada Company with regard to the description of the company in terms of their operations in Libya, giving year established, company type, ownership, number of employees, company

oil wells, annual revenue and location of the company headquarters. The overview of the findings on the background of the companies is as shown in Table 4.2 below:

Table 4.2: Background of the case study oil companies

Case	Year Established	Type	Current Ownership	Number of Employees	Company Oil Wells	Annual Revenue (in Million LD)	Libyan Headquarters
Waha Oil Company	1955	Local	59% Public 41% Private	3,200	1,100	689.85	Tripoli
Petro Canada Company	1975	Foreign	100% Private	6,000	1,500	365.00	Tripoli

The findings reveal that Petro Canada Company merged with Suncor Energy (another oil company but outside Libya) in 2009, a deal in which Suncor Energy investors received 60% ownership of the merged company and PCC investors received 40% ownership.

4.9   The Case Study Respondents

The study was conducted with four respondents to the questionnaires, two from each company – The respondents from PCC were labelled P-1 and P-2 and those from WOC were labelled W-1 and W-2. In the interviews, two respondents participated, one from each company – P-1 and W-1. The responses provided by the respondents gives the researcher valuable insight into the deployment, use and implementation of an effective IS and IS strategy for the success of the oil companies. The respondents are all experienced in the usage, support and management of the information systems in the two oil companies. The details of the various respondents that participated in the study are provided in Table 4.3 and 4.4 below.

Table 4.3: Summary of case study respondents to the questionnaires

For the Questionnaires:

Respondents	Company	Position	Years of Experience in Oil Companies
P-1	Petro Canada Company	IT Officer	5
P-2	Petro Canada Company	Projects /Maintenance Manager	16
W-1	Waha Oil Company	IT Manager	12
W-2	Waha Oil Company	Finance Manager	19

Table 4.4: Summary of case study respondents to the interview questions

For the Interview:

Respondents	Company	Position	Years of Experience in Oil Companies
P-1	Petro Canada Company	IT Officer	5
W-1	Waha Oil Company	IT Manager	12

4.10   Summary

This fourth chapter builds on chapter three where relevant literatures to this research work were reviewed. It critically analyses the research methods that are adopted for use in this research work. It presents the concept of case study in research. In addition, it discusses questionnaires and interviews as tools for gathering data in this study. In this chapter, the chosen research strategy to accomplish the aims and objectives of this research work was presented. The methods of data collection were discussed. Thereafter, the chapter discusses the ethical considerations on what ought to be done and what ought not to be done during the research work. Backgrounds of the case study oil companies have been looked into and the participating workers of the oil companies have been presented. The following chapter – Chapter Five – presents the integral part of this study - the empirical survey findings.. The fifth chapter also provides a clearer view of the departments, processes, information systems and other relevant information that is relevant to the investigation of the deployed information systems and associated strategies in the case study companies.

CHAPTER FIVE – RESEARCH FINDINGS

5.1   Introduction

As seen in chapter four of this research work, two case studies through which the study was conducted have been presented: Petro Canada Company, Libya and Waha Oil Company, Libya. The case study method discussed in the previous chapters was used at the data collection stage of this research work. This was done through the use of both the interview process and questionnaire administration. Some of the data on the information system strategy for Libyan Oil companies were gathered by interviewing respondents from both Petro Canada Company and Waha Oil Company, while the remaining data were gathered from questionnaires distributed in the two Libyan based oil companies.

Two batches of questionnaires were administered during this study; the second one was administered for further findings to collect additional data that were not covered in the first questionnaire. The questionnaires were complemented by an interview. The purpose of the interview questions was to find the respondents opinion on the necessity of IS, deployment of IS, the chosen IS strategy and associated issues in Libyan oil companies. The interview questions were used to gather information on the current information systems used in the organisation: the strengths, weaknesses, opportunities and threats faced by the business with the deployed information system. The kind of IS/IT strategies being implemented by the company in their projects, the current Business Information Systems within the organisation, the changes that the work force might want to bring about in the company and the role of management in the implementation of the IT/IS systems in the respective companies were all considered.

The language used in both interviews was more Arabic than English for easier communication between the researcher and the respondents. Some of the interview sessions were conducted at the Oil Companies in Libya, while some were conducted over the telephone based on certain research areas that had not been covered by the earlier scheduled interviews. The times allotted for the interviews were usually between 40 minutes to 2 hours. The data gathered from this study is intended to help provide answers to the research questions as stated in chapter one. The case study interviews and administration of questionnaires were carried out between January 2010 and May 2012., The research work and findings were interrupted by one year due to war in Libya in 2011, and this resulted in some research difficulties which included problems in gathering additional relevant information.

The findings from the two oil company case studies are presented in nine sections of this chapter (Section 5.2 to Section 5.10).

5.2   The IT Department/Functions: PCC and WOC

5.2.1   Case Study 1: Petro Canada Company (PCC)

The IT department of PCC is made up of seven regular staff, all of whom have the minimum educational qualification of High Diploma. Four of them are Software Engineers with job titles of IT Officer – Software Applications. These four staff have good knowledge of VB6.0 and SQL, in-depth knowledge of Microsoft Access and Excel as well as an understanding of basic JAVA-oriented information system and e-business technologies such as HTML, CSS, XML, XSL, JSP and ASP. Two of the regular staff have the title IT Officer – Network and Infrastructures. These two staff are skilled in network administration and they have good knowledge of Hardware, IT infrastructures, Exchange Server Maintenance and resolving Networking problems. The last member of staff in the department performs the role of an IT Manager because he is the head of the IT department. However, his title is Projects /Maintenance (IT) Manager. In accordance with the answers from one of the PCC respondents, it is important to note that the department does take interns and temporary staff on a contract basis, depending on the tasks and challenges that arise. PCC also has an IT consultancy company that is related to its IT department to ensure the smooth running of its business. Shown below in Table 5.1 is the summary of information obtained on the staff of the IT department.

5.2.2   Case Study 2: Waha Oil Company (WOC)

The IT department of WOC is made up of five regular staff and one expatriate, who visits the company at intervals and gives professional advice. The department works hand-in-hand with an external IT consultant company which handles most of the official IT issues of the company.   All the five staff in the IT department have minimum educational qualifications of Bachelor Degree. They are regularly trained by the external IT consultant company based on any change in the implemented SAP ERP or any other information system

Table 5.1: Summary of Information on Staff of the IT department at Petro Canada Company

Representative Code	Position	Educational Qualification	Academic Background	Professional Qualification	Years of Experience (Oil Industry)
PCC-IT 1	IT Officer – Software Applications	Bachelor's Degree	Electrical Electronics Engineering	MCTS	7
PCC-IT 2	IT Officer – Software Applications	Bachelor's Degree	Computer Science	MCTS	4
PCC-IT 3	IT Officer – Software Applications	Master 'sDegree	Computer Science and Engineering	MCTS	5
PCC-IT 4	IT Officer – Software Applications	High Diploma	Computer Science	MCTS, MCP	4
PCC-IT 5	IT Officer – Network and Infrastructure	Bachelor's Degree	Electrical Electronics Engineering	A+, CCNA	7
PCC-IT 6	IT Officer – Network and Infrastructure	Bachelor Degree	Computer Science	A+, CCNA	7
PCC-IT 7	Projects /Maintenance (IT) Manager	Master's Degree	Computer Science	MCTS, MCP, MCSE	16

in the company. The head of the IT department is the IT manager; the remaining four staff are called IT Officers, with two of them responsible for the in-house support and basic maintenance of the information systems. The other two are responsible for managing and supporting the hardware and networking facilities; they resolve all hardware and network related problems in the company. The skills of the two staff responsible for the in-house support and basic maintenance of the information systems include knowledge of HR, FICO, and SD modules of SAP as well as COBOL. The other two staff have good skills in managing and supporting the hardware and networking facilities. The IT department of WOC

also accepts students for internship and thereby have temporary staff at times. Shown below in Table 5.2 is the summary of information obtained on the staff of the IT department:

Table 5.2: Summary of Information on Staff of the IT department at Waha Oil Company

Representative Code	Position	Educational Qualifications	Academic Background	Professional Qualifications	Years of Experience (Oil Industry)
WOC-IT 1	Software Engineer	Bachelor's Degree	Electrical Electronics Engineering	Certficate in mySAP ERP Operations and Financials	5
WOC-IT 2	Software Engineer	Bachelor's Degree	Computer Science	Certficate in mySAP ERP Operations and Financials	3
WOC-IT 3	Network Administrator	Bachelor's Degree	Computer Science	A+	7
WOC-IT 4	Network Administrator	Bachelor'sDegree	Computer Science	CCNA	3
WOC-IT 5	IT manager	Master's Degree	Electrical and Electronics Engineering	PMP, MCSA	12
WOC-IT 6	Projects Manager	Bachelor's Degree	Computer Science	Prince2, ITIL	11

5.3 The Crude Oil Supply Chain in Libya

The supply chain of crude oil in Libya can be broadly divided into the following two categories:

1. The upstream supply chain;

2. The downstream supply chain.

This is in line with the general crude oil supply chain in the world:

The supply chain of the petroleum industry is extremely complex compared to other industries. It is divided into two different, yet closely related, major segments: the

upstream and downstream supply chains. The upstream supply chain involves the acquisition of crude oil, which is the speciality of the oil companies. The upstream process includes the exploration, forecasting, production, and logistics management of delivering crude oil from remotely located oil wells to refineries. The downstream supply chain starts at the refinery, where the crude oil is manufactured into the consumable products that are the speciality of refineries and petrochemical companies. The downstream supply chain involves the process of forecasting, production, and the logistics management of delivering the crude oil derivatives to customers around the globe (Hussain, Assavapokee and Khumawala, 2006, p. 93).

5.3.1 The Crude Oil Supply Chain: Upstream Sector

Nnadili (2006) explains that the supply chain structure of the crude oil upstream sector is more discrete when compared to the supply chain structure of other industries. The reason for this is because the supply chain structure of the crude oil upstream sector entails many independent operations, from exploration, logistics, trading, up to different modes of transportation which depend on companies' operations as well as the very large-scale optimisation models used by upstream crude oil companies in managing their supply chain (Nnadili, 2006, p. 35). In the research work of Nnadili (2006), the diagrammatic representation of the activities of the petroleum upstream supply chain is given thus:

Upstream Petroleum Supply Chain Activities

| Crude Oil Exploration | Demand Planning | Price Modelling | Crude Oil Trading | Transportation Planning | Crude Oil Refining |
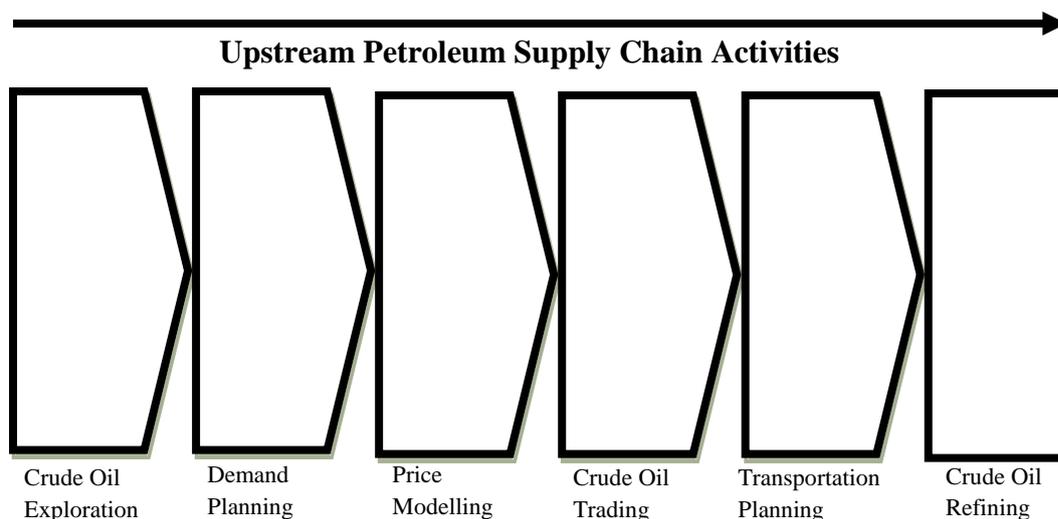
(Source: Nnadili, 2006, p. 37)

Figure 5.1: The Activities of the Upstream Petroleum Supply Chain

Crude oil exploration is a process that takes place where it is expected that oil will be found. It involves drilling for oil, oil well analysis and the final extraction of the crude oil. Historically, scientific exploration for oil, in the modern sense, began in 1912 when geologists were first involved in the discovery of the Cushing Field in Oklahoma, USA. The fundamental process remains the same, but modern technology and engineering have vastly improved performance and safety (Boyd, 2002, pp. 97 - 106).

After the exploration, the trading of the crude oil begins. The trading of the oil involves huge capital investment along with operating cash flows. The current trading patterns in the world mainly reflect the result of buyers and sellers responding to market forces to obtain different types of crude oil from where it is produced to where it is most valued, accounting for the cost of transportation. This implies that the trade flows at any point in time are largely a result of the relative advantages in transportation costs and buyers' preferences for different qualities of crude oil.

When all trading activities are completed, the transportation of the crude oil is the next process. Schwartz (2000) explains that commodities such as oil, gas, and petrochemicals require specific modes of transportation such as pipelines, vessels or tankers, and railroads. These commodities are produced in specific and limited regions of the world, yet they are demanded all over the globe since they represent an essential source of energy and raw material for a large number of other industries. Several weeks lead-time from the shipping point to the final customers' locations is very common in this type of industry. For example, it takes five weeks for the Persian Gulf's oil to make its way to the United States and up to another three weeks for it to be processed and delivered. The upstream supply chain of crude oil terminates at the point of delivery to the crude oil refineries, where the downstream supply chain begins.

5.3.2   The Crude Oil Supply Chain: Downstream Sector

All activities of the crude oil downstream supply chain are centred on refining the crude oil and the subsequent distribution of different oil products from the refined crude oil. "The downstream supply chain involves the process of forecasting, production, and the logistics management of delivering the crude oil derivatives to customers around the globe. Challenges and opportunities exist now in both the upstream and downstream supply chains." (Hussain, Assavapokee and Khumawala, 2006, p. 96).

5.3.3 The Crude Oil Supply Chain in Waha Oil Company and Petro Canada Company

Waha Oil Company and Petro Canada Company in Libya are only involved in upstream crude oil business activities; this is the basis of their crude oil supply chain. The main customers of Petro Canada Company are Halliburton and Harouge, two large international oil companies, while the main customers of Waha Oil Company include Ntrchal, Total and Zueitina, to whom large amounts of crude oil are transferred on a regular basis for refining and other downstream activities.

Based on the findings of this research work, the supply chain of the upstream crude oil in Waha Oil Company and Petro Canada Company consists of some core processes, which begin from the crude oil exploration and mining, up to the crude oil refining operation. Moreover, the findings in this research work reveal that there are some core processes common to both companies, e.g: Forecasting Process, Financial Management Process and Human Resource Management Process.

Petro Canada Company and Waha Oil Company Supply Chain

Oil exploration represents the very first piece of both companies' supply chains, which ultimately brings crude oil to the reservoirs of both companies, from where supplies of crude oil are made to their customers after trading agreements. In the process called "Oil Exploration", a potentially attractive Libyan area to drill - either onshore or offshore – is identified by the companies. The choice of the area can be made because:

1. It is near to another discovery.
2. It used to be an operating well that has now dried up.
3. Government and/or approved independent bodies have released some data that suggests the presence of hydrocarbons (i.e. crude oil).

Waha Oil Company depends more on suggestions by the government data to explore an area, while Petro Canada Company depends on approved independent bodies.

Both companies conduct initial professional surveys to better understand the presence and availability of crude oil under the surface. An example of such surveys, as mentioned by both Waha Oil Company and Petro Canada Company participants, is called seismic mapping. Waha Oil Company carries out seismic mapping by exploding dynamite and measuring the

way in which the resulting seismic waves travel through the underground formations, while Petro Canada Company carries out seismic mapping by stamping the ground with a large pillar and measuring the way in which the resulting seismic waves travel through the underground formations. The results obtained give an idea of how deep the crude oil is, the rock formations, presence of sponge-like porous rock, and how large the deposit of crude oil might be – all these factors guide the decision of both companies on whether to drill a well or not. Another issue that is usually considered by Petro Canada Company oil, but is not mentioned by Waha oil Company, is that Petro Canada Company places preference on exploring for oil where there is the lowest safety risk in the exploration process.

Once a decision is made to drill in the chosen area, both companies construct a drilling rig that bores a hole into the earth through which steel pipes are inserted. Pipes or casings sucha as cement are then put in between for strength as well as for separating different pressure zones - if they exist. The well is then drilled further, and more casings are added. Petro Canada Company has a standard of three layers of casings, while Waha Oil Company usually opts for two layers of casings, but three layers of casings at times, depending on the geological composition of the chosen area. When the hole is established, the rotator table then passes a drill string into the hole. The drill string extends the drill bit by its rotation. The drill bit then cuts the rock into pieces. A drilling fluid is then pumped down the drill string. This fluid clears the cut rock piees onto the surface. Compressed air is substituted for the fluid by Petro Canada Company, at times. Then the crude oil is pumped to the surface and sent, via an established maritime or pipeline transportation infrastructure, into a storage reservoir owned by the companies.

Unlike Waha Oil Company whiich handles all the oil exploration process with its planning and oil production sub-processes, Petro Canada Company has three sub-processes for its oil exploration process: Planning, Petroleum Engineering and Oil Production – The Planning sub-process handles how to find the right area to drill, the Petroleum Engineering sub-process handles the setting up of the oil rig, its maintenance and management of the transportation infrastructure from the oil rig to the crude oil storage reservoirs. The oil production sub-process takes care of the amount, quality and other important data of the extracted crude oil, from its pumping from the oil rig to its storage in the reservoirs.

Waha Oil Company and Petro Canada Company trade with oil companies that are involved in downstream business activities. The price of the crude oil to be sold depends on the characteristics of the oil. The Forecasting and Crude Oil Trading processes of Petro

Canada Company are involved in the sales transactions of the stored crude oil. In a similar vein, the trading activity is handled in Waha Oil Company via the Crude Oil Trading process, which uses some information from the Forecasting process. Once a trade agreement is reached, both Waha Oil Company and Petro Canada Company organise how their respective customers will receive the purchased crude oil. Petro Canada Company has a well structured process for the distribution and transport logistics of the crude oil purchased by the customers. Waha Oil Company on the other hand usually makes a third party arrangement for the crude oil transportation. The Crude Oil Trading as well as Financial Management processes are used to manage these transactions with the customers and the third party logistics company. Given below is a diagrammatic representation of the supply chain activities in Waha Oil Company and Petro Canada Company in Libya.

Testing for the right area to drill. → Setting up the oil rig. → Pumping crude oil to the surface. → Oil transport to the reservoir. → Trading the oil. → Oil transport to downstream customers.
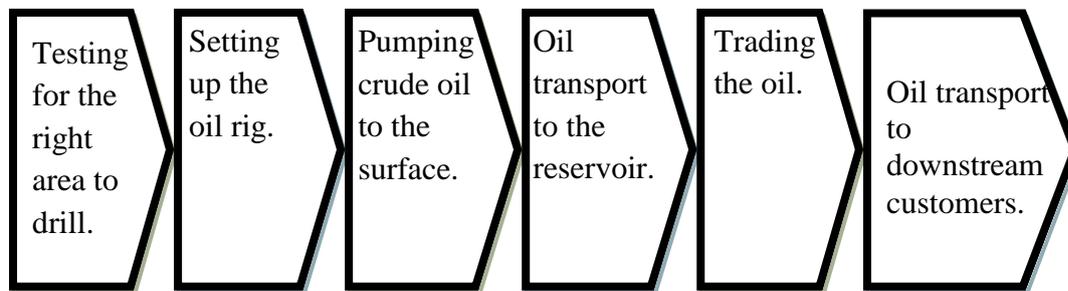
Figure 5.2: The supply chain activities at Waha Oil Company and Petro Canada Company in Libya.

5.4   The Business Processes and Sub-Processes: PCC and WOC

5.4.1   Case Study 1: Petro Canada Company (PCC)

The business of Petro Canada Company revolves around six main processes, each of which consists of sub-processes; the six processes are as listed below:

1. Exploration: The exploration process involves prospecting for crude oil, discovering the oil, drilling for the oil and extracting it into a storage tank. The Crude oil exploration process in the company is divided into three sub-processes: Planning, Petroleum Engineering and Oil Production. The sub-processes are automated except for the planning sub-process, which is done manually.

2. Forecasting: This process focuses mainly on sales forecasting and price modelling, which are the two sub-processes in the forecasting process. Forecasting process

monitors the current demand and supply of crude oil between Petro Canada and its customers in relation to external market reports of related demand and supply to suggest an expected rate of drilling, management of stored crude oil for sale, pricing of the oil with the customers, among some other important managerial decisions. The sub-processes use an information system that is developed with Microsoft Access and also uses some configured Excel sheets, both take as input the outcomes of forecasting activities done online via the e-business system of PCC.

3. Financial Management: The Financial Management Process is subdivided into two sub-processes, namely: financial accounting and management accounting. The information system being used for this process is also developed with Microsoft Access and specially configured Excel sheets along with the in-house information system.

4. Transport and Distribution Logistics: This process is divided into inventory management and distribution management sub-processes. A very efficient in-house system is developed and maintained in-house with VB 6.0 and SQL for Distribution-Management Sub-process. The Inventory-management sub-process has a different information system called the IM system: the system was implemented and it is still supported by a third party software company.

5. Crude Oil Trading: This process uses an in-house developed information system, and partly Excel for some non-automated needs of the process. Crude Oil Trading as a process consists of two sub-processes:

   1. Sales management, which handles quotes, orders and all other sales activities as well as sales reporting.

   2. Customer relationship management, which focuses mainly on managing good relationships with the customers.

   In addition, registered and approved PCC customers are allowed to initiate their order requests via e-mail through the PCC e-business system.

6. Human Resource Management: This process manages staff activities as well as the payment of salaries and other allowances appropriately. The process is subdivided into personnel management and payroll management. The information system for this process is developed in-house and its functions cover all the Human Resource activities of the company.

Shown below in Figure 5.3 is a diagrammatic illustration of the relationships among the business processes and sub-processes at PCC:

Figure 5.3: Diagrammatic illustration of relationships among business processes and sub-processes at PCC

All supplies of materials and purchases at PCC are handled by the 'Transport, Distribution and Logistics' department. The suppliers transact businesses with the company via the inventory management sub-process. The inventory management sub-process interacts with the financial management process in two ways. The first way is the processing of suppliers' payments via the financial accounting sub-process, as well as registration of the

acquired material as appropriate: e.g. if the purchased material is a fixed asset, it will be registered in the fixed asset register. The second way is that the information on t the newly purchased item is made available to the management accounting sub-process. The inventory management sub-process also contains a store for the purchased materials and can transfer them with approved requests to other processes (e.g. when purchased pipes are transferred to the Exploration department).

The purchase requests of PCC customers are handled by the sales management sub-process which uses information from the Forecasting process. The information gathered by the sales management sub-process is made available to CRM sub-process for managing and improving satisfaction of PCC customers on their business relationship with the company. The sales management sub-process exchanges information with the financial management process on customers' payments, the volume of crude oil sold, among others. The sales management also communicates with the transport, distribution and logistics process to confirm availability of oil and facilitates instructions on the distribution based on confirmed customers' orders. The deliveries of crude oil to designated customers are managed by the transportation and distribution logistics process.

The human resource management process exchanges information with the financial management process for payment of staff and other workers. The Exploration process also makes available information on its activities (e.g.: volume of crude oil mined, volume of crude oil transferred to transportation and distribution logistics process, etc) to the financial management process. The exploration process also exchanges information with the transportation and distribution logistics process.

The e-business system is not integrated at present with any of the processes at PCC. However, e-mail communications via intranet are available for communication between PCC employees and the human resource management (HRM) department. The HRM process is fed with some of the information in the e-mail for its activity (e.g. staff absence from work). E-mail is also used as a medium of communication between the customer and sales management section of the company. In addition, most of the information used for the forecasting process is derived from the internet facilities.

5.4.2 Case Study 2: Waha Oil Company (WOC)

The business activities of Waha Oil Company can be grouped into 6 processes, each process has an associated information system, the processes are explained below:

1. Exploration: At Waha Oil, the exploration process is broadly carried out under the "oil production" sub-process. The company carries out seismic mapping by exploding dynamite and measuring the way in which the resulting seismic waves travel through the underground formations to detect crude oil, which when found is subsequently drilled for and pumped to the surface via oil wells into storage tanks. The exploration process in the company is divided into two sub-processes: Planning and Oil Production. The Oil Production sub-process is automated with an in-house information system developed with COBOL, the activities of the Planning sub-process are carried out manually to date, sometimes with the use of a basic application package such as Excel.

2. Forecasting: This process has 3 sub-processes, all of which are partially automated with a specially designed Microsoft Access and Excel package. The 3 sub-processes are "Sales Forecasting", "Price Modelling" and "Demand Planning". The Forecasting process takes current crude oil market data as input into its system and uses the current supply and demand of crude oil between Waha Oil and its customers to determine some variables and constants to produce managerial reports that are used in forecasting sales, modelling prices and managing the known and envisaged demand. The Forecasting information system that is developed with Microsoft Access and Excel does not completely automate the process; there are some supportive manual activities that are done to obtain some data to enter into the information system.

3. Financial Management: The Financial Management Process at Waha Oil is completely automated. The process is subdivided into two main sub-processes: "Financial Accounting" and "Management Accounting". The information system being used for this process is an implementation of Financials and Controlling (FICO) module of SAP, an Enterprise Resource Planning (ERP) application. Real-time and reliable managerial reports are available from the system and any new format of financial reporting needed can be customised and generated from the system.

4. Transport and Distribution Logistics: At Waha Oil, this process largely involves usage of third party companies for its transportation and crude oil distribution logistics to the customer, this is a sub-process called 'Transportation Management'. The 'Transportation Management' sub-process is not automated unlike the other two sub-processes – 'Inventory management' which is automated with an in-house system

developed with COBOL and 'Vehicle Management' which is automated with an information system developed with Microsoft Excel.

5. Crude Oil Trading: This process is divided into two sub-processes: 'Sales Management' and 'Marketing Management'. Both sub-processes have all their activities fully automated with the implementation Sales and Distribution (SD) module of an Enterprise Resource Planning (ERP) system called SAP. The marketing sub-process involves Customer Relationship Management, prospecting for new customers and recording management of all marketing activities.

6. Human Resource Management: This process is centrally managed and automated with the Enterprise Resource Planning (ERP) system called SAP. The SAP HR module is tailored to suit the Human Resource needs of the organisation. This process is subdivided into two sub-processes: Personnel Management and Payroll Management. The SAP handles the creation of new employees, managing employees' records, and all their professional relationships with the company, which include leave management, bonuses, allowances, salary payment, etc.

Shown below in Figure 5.4 is a diagrammatic illustration of the relationships among the business processes and sub-processes at WOC:
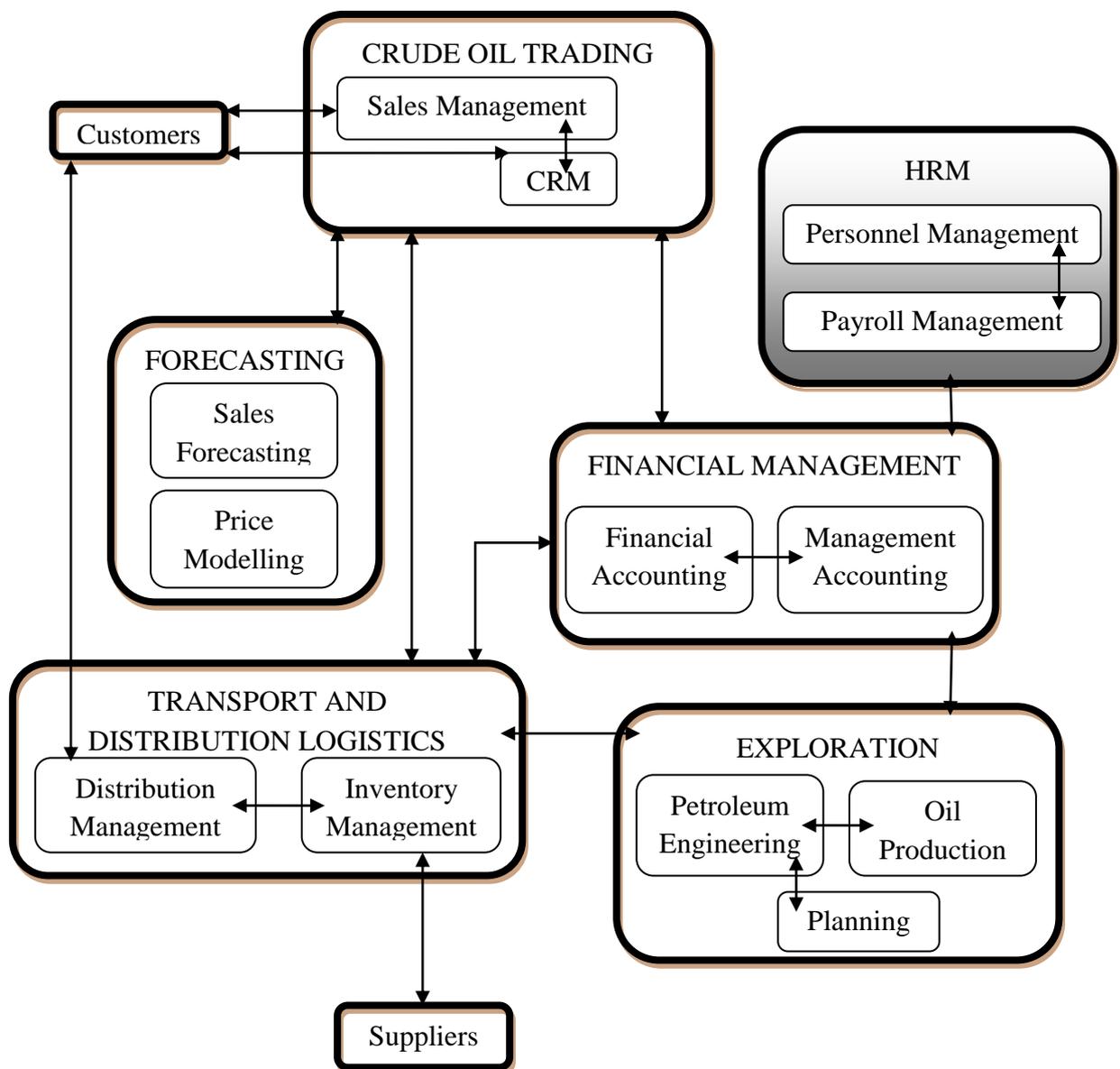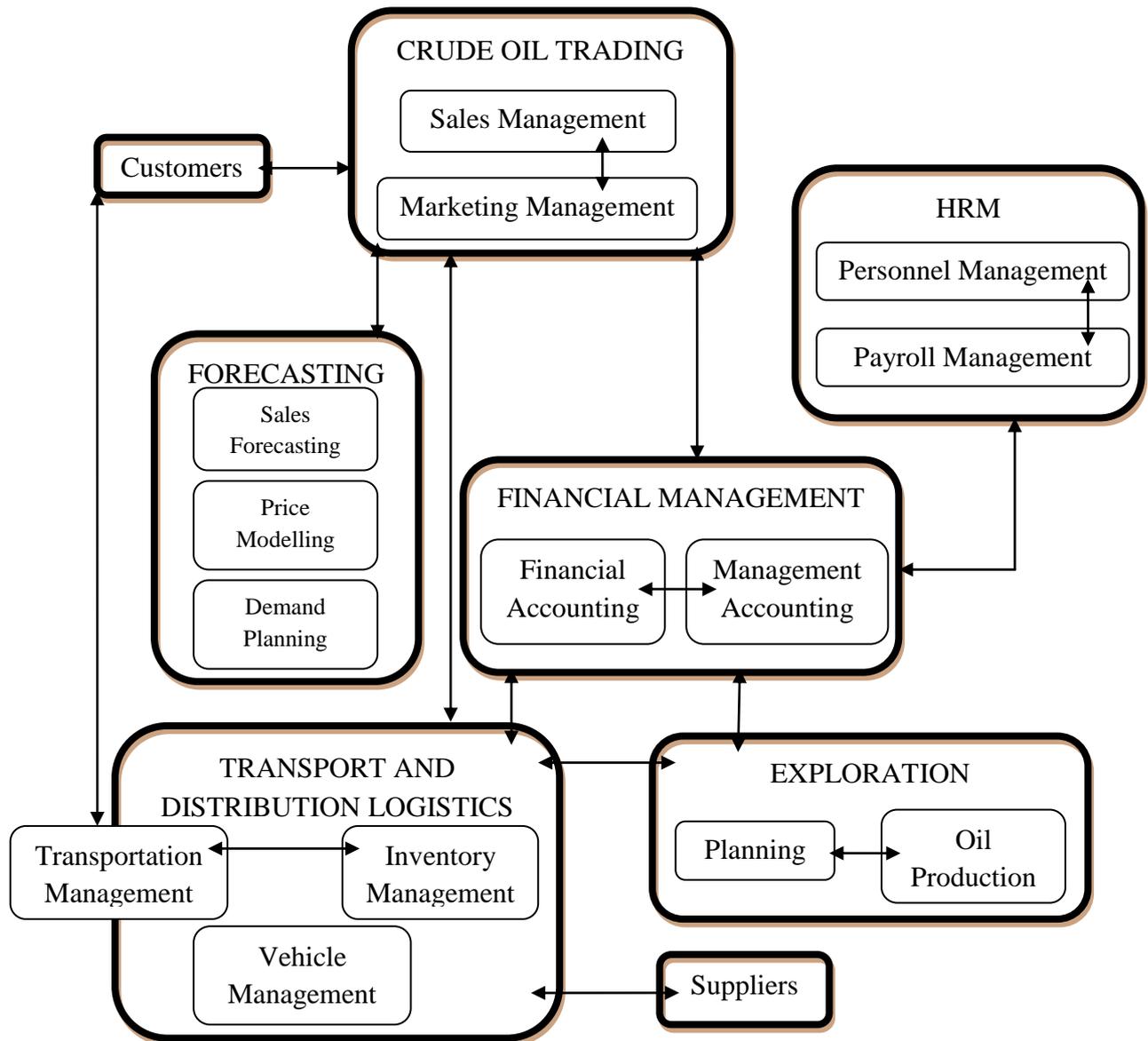
Figure 5.4: Diagrammatic illustration of relationships among business processes and sub-processes at WOC

The financial management process at WOC appears to be the nucleus of all business activities in the company. It is directly integrated along with crude oil trading and human resource processes with the use of SAP R/3 technology. It also accepts information on crude oil production from the exploration process via the oil production sub-process. The transportation management sub-process which extends beyond the processes of WOC by its usage of third party transport companies for distribution of purchased crude oil deliveries also exchanges information with the financial management process.

The customers' requests for quotes, making of orders, records of payment, confirmed orders among other business activities are managed by the crude oil trading process by

inputting their requested data into the system. Quotes that are sent to the customers as well as orders received from the customers are sometimes exchanged via e-mail and the associated data are entered into the information systems. The sales forecasting, price modelling and demand planning are done in a separate information system and the results generated from the forecasting process are entered into the crude oil trading process for subsequent sales plans, and are available for the financial management process.

The purchase and maintenance of official cars and other vehicles of WOC are managed by the vehicle management sub-process and other assets and materials are managed by the inventory management sub-process.

5.5   Tabular Summary of the Business Processes and Sub-Processes: PCC and WOC

5.5.1   Case Study 1: Petro Canada Company (PCC)

The current information system strategy adopted at the Petro Canada Company is mainly an In-house/Bespoke approach. All the business processes at PCC are subdivided into sub-processes, with each of the sub-processes having an associated information system for all activities. The In-house/Bespoke consists of applications developed with Microsoft Access (referred to as ACCESS at PCC), applications developed with Microsoft Excel (referred to as EXCEL at PCC) and applications developed with Visual BASIC 6.0 and SQL (referred to as IN-HOUSE at PCC). These three groups of In-house information systems generate reports in different formats. The other part of the strategy involves the deployment of the IM system, which is a software package from GeoTech Consulting (GTC), a Libyan based IT company and a member of GeoTech Group of Companies with branches in USA and Saudi Arabia. The IM system is used for Inventory Management. The system works independently of the In-house information systems. The management depends on the top-managerial reports of the different information systems to derive a complete overview of the business at any point in time. Since 2005 when PCC adopted its new ISS, the respondents from the company have made it known that there has been an annual improvement review of the strategy for continued support for the business strategy of the company. An integral accepted recommendation of the review was to gradually support all business processes of the company with the In-house information system developed with VB6.0 and SQL. This, according to the respondents, would make available timely access to all the company's business information and reports by authorised users for continuous support of the business

strategy of the company. Shown below in Table 5.3 is a summary of sub-processes at PCC and associated information systems:

Table 5.3: Summary of Information systems and associated sub-processes at Petro Canada Company

Sub-process	Description	Information System and Technology Used
Planning	Manages all data related to sourcing for new promising areas for crude oil mining as associated testing done by PCC.	Manual
Petroleum Engineering	The sub-process manages all PCC data that relates to setting up of the oil rig, carrying out drilling, and maintaining the oil rig structure as well as the transport infrastructure for the crude oil to the main crude oil reservoir.	In-house : VB6.0 and SQL
Oil production	Manages the channelling of crude oil from the main oil reservoir to other reservoirs as well as handling records of volume of mined crude oil, grade of mined crude oil, and other attributes of the crude oil across different reservoirs.	In-house: VB6.0 and SQL
Sales Forecasting	Manages the previous sales data of PCC to predict likely periodical sales of crude oil in the company over both short and long term.	Access/Excel: Microsoft Access and Microsoft Excel
Price Modelling	The sub-process establishes and provides guiding reports on the best possible price for different grades of crude oil in the PCC.	Access/Excel: Microsoft Access and Microsoft Excel
Financial Accounting	This sub-process manages the balance sheet, income statement, cash flow and other financial presentations, analysis reports in PCC.	Access, Excel and In-house: Microsoft Access, Microsoft Excel and VB6.0 and SQL
Management Accounting	This sub-process manages different types of costs and expenses that are involved in making crude oil available for sales and provides data needed in reports and statements generated by the financial accounting sub-process.	Access, Excel and In-house: Microsoft Access, Microsoft Excel and VB6.0 and SQL
Personnel Management	This sub-process manages records of PCC and activities in the company: Different type of leave taken by staff, staff welfare, health insurance, staff performances, job descriptions, etc.	In-house: VB6.0 and SQL
Payroll System	This sub-process manages the payment of salaries and wages to the PCC employees – casual and regular staff. This includes generation of payslips among other reports.	In-house: VB6.0 and SQL
Sales Management	This sub-process keeps track of quotes, orders, invoices and all sales activities of the company. It also generates several sales reports.	In-house/Excel: VB6.0 and SQL/Microsoft Excel
Customer Relationship Management	This sub-process keeps track of the customers' transactions and business issues with the company and provides for proper customer support.	In-house/Excel: VB6.0 and SQL/Microsoft Excel
Distribution Management	This sub-process manages all logistics data on crude oil movement from PCC to the customer's destination.	In-house: VB6.0 and SQL
Inventory Management	This sub-process manages the data of crude oil availability in the company. It also manages data on the visible and tangible stocks for maintenance/repairs activities in the company as well as all materials required for continuous operation of PCC.	IM system: Java and SQL

5.5.2 Case Study 2: Waha Oil Company (WOC)

The information system strategy adopted at the Waha Oil Company is mainly a proportionate blend of both In-house/Bespoke approach and Enterprise Resource Planning (ERP) approach. All the business processes at Waha Oil Company are subdivided into sub-processes, with each sub-process having an associated information system for all its activities. Most of the sub-processes are automated with an In-house/Bespoke system developed with COBOL; some sub-processes are however automated with Microsoft Access, while others are automated with Microsoft Excel. The top-managerial reports are centrally available via the SAP system and the in-house developed information system with COBOL. The top-management staff depend on the reports of the different information systems to derive a complete overview of the business at any point in time. Shown below in Table 5.4 is a summary of sub-processes at WOC and associated information system:

Table 5.4: Summary of information systems and associated sub-processes at Waha Oil Company

Sub-process	Description	Information System and Technology Used
Planning	The sub-process manages data related to seismic mapping of prospective exploration areas, and other related information.	Manual
Oil production	The sub-process manages all data associated with exploration of crude oil from setting up oil rigs to pumping the oil into the reservoirs. Data managed by this process includes: the volume, grades and chemical/sulphur content of the extracted crude oil.	In-house : COBOL
Sales Forecasting	This sub-process uses the repository of WOC sales records to project future sales for WOC.	Access/Excel: Microsoft Access and Microsoft Excel
Price Modelling	This sub-process manages data on different chemical compositions of the crude oil and provides reports on the optimal price for different grades of WOC crude oil in their reservoirs.	Access/Excel: Microsoft Access and Microsoft Excel
Demand Planning	Effective demand planning can guide users to improve the accuracy of revenue forecasts, align inventory levels with peaks and troughs in demand, and enhance profitability for a given channel or product. This sub-process uses data from customer standing orders and planned sales orders, among other statistics, to users to boost the accuracy of income forecasts as well as aligning inventory levels in line with demands.	Access/Excel: Microsoft Access and Microsoft Excel
Financial Accounting	This sub-process manages the balance sheet as well as profit and loss account, different journals used and other financial reports.	SAP /R3 ERP System
Management Accounting	This sub-process handles the financial costing activities and proposes appropriate prices for sales for crude oil.	SAP /R3 ERP System
Personnel Management	This sub-process automates the staff record management of WOC. It manages data on official doings of all staff.	SAP /R3 ERP System
Payroll System	This sub-process handles the periodical assessment of each staff activity with data from the personnel management sub-process, it thereafter manages the payment of salaries and wages to regular and casual staff .	SAP /R3 ERP System

Sales Management	This sub-process deals with raising pro forma invoices and orders, managing the order among all other business crude oil sales activities are taken care of by this sub-process.	SAP /R3 ERP System
Marketing	This sub-process contains up-to-date records on WOC customers and their business activities with the company. The records are used to respond to all customer queries and provide other support by WOC to maintain their custom.	SAP /R3 ERP System
Inventory Management	This sub-process manages data on the tangible items owned by WOC.	In-house : COBOL
Vehicle Management	This sub-process manages data on the fleets of vehicles owned by WOC.	Microsoft Access and Microsoft Excel
Transport Management	This sub-process manages all logistics data on crude oil movement from WOC to customer destinations. The transportation and logistics are handled at WOC by a third party but the company keeps records..	Manual

5.6 The Information Systems Portfolio: PCC and WOC

5.6.1 Case Study 1: Petro Canada Company (PCC)
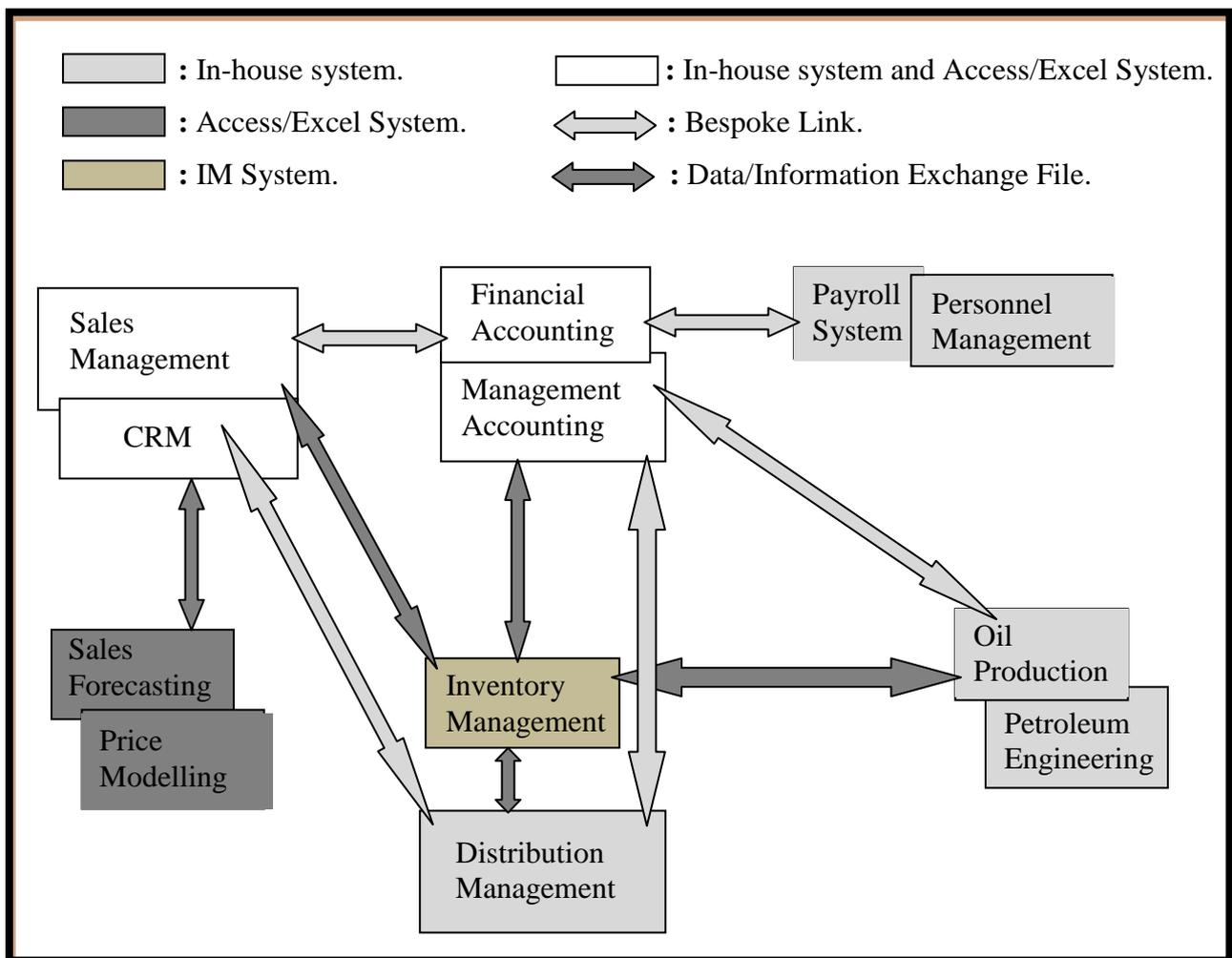
Figure 5.5: Information Systems Portfolio Map of PCC

As explained in section 5.4.1, there is no complete integration among the three groups of information systems in PCC (the in-house information system developed with VB 6.0/SQL; the Access/Excel information systems; and the IM system). However, there is regular information exchange between the information systems with the use of Excel files. The VB6.0 has been used to develop a facility so that the in-house information can easily exchange information with Microsoft Office Applications. The facility enables two-way communication between the in-house information system and the Access/Excel information system, thereby eliminating repetitive tasks like inter-IS data entry. The vendor of the IM system also provides import and export facility in the system for information in Excel format. Although there is no direct integration among the information systems, there is an indirect integration via the functionalities that allow Excel-format exchange of data/information across the information systems.

5.6.2 Case Study 2: Waha Oil Company (WOC)
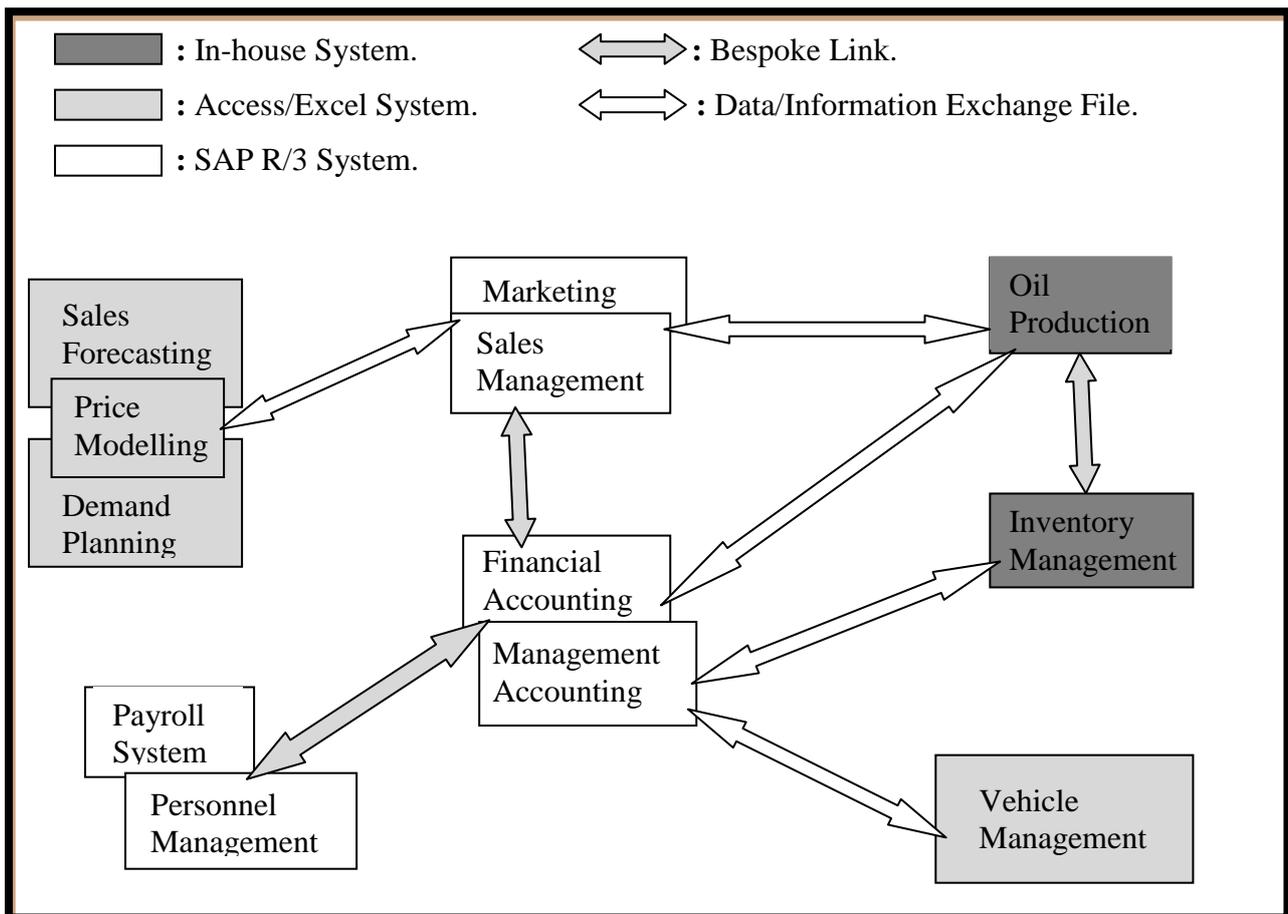
Figure 5.6: Information Systems Portfolio Map of WOC

As earlier discussed in section 5.5.2 , the financial management process, the crude oil trading process and the human resources process of Waha Oil are efficiently integrated because they are all managed by the SAP R/3 technology. The other two information systems with which the remaining WOC processes are managed are the In-house information system developed with COBOL and the Access/Excel system developed with Microsoft Access and Excel. There is no integration among the three types of information systems at WOC. However, processed information in Access/Excel systems from forecasting process as well as transport and distribution logistics processes are exported in comma delimited files (.csv format) and imported into the SAP R/3 system via dataports. In a similar vein, data are exported in a CSV format from SAP R/3 and imported for use in the Access/Excel information system and the In-house COBOL-oriented information system. The comma delimited file is used with human support to bridge the integration-gap among the three types of information systems that are used at WOC.

5.7 The System Processes/Sub-processes with Information Systems Mapped to them: PCC and WOC

5.7.1 Case Study 1: Petro Canada Company (PCC)

According to the completed questionnaires and interviews , the process map of the main business processes, with their sub-processes mapped to the information systems used for managing them at Petro Canada Company, is as shown in Figure 5.7 below.

EXPLORATION

Planning

Petroleum
Engineering

In-house

Manual

Oil Production

In-house

FORECASTING

Sales Forecasting

Access/Excel

Price Modelling

TRANSPORT AND
DISTRIBUTION LOGISTICS

Inventory
Management

IM System

Distribution
Management

In-house

FINANCIAL
MANAGEMENT

Financial
Accounting

Management
Accounting

Access, Excel
and In-house

CRUDE OIL
TRADING

CRM

In-house /Excel

Sales
Management

HR
MANAGEMENT

Personnel
Management

Payroll
System

In-house

(Based on the system profiling developed in Wynn, Turner, Abas and Shen, 2009)

Figure 5.7: Existing Information Systems mapped with sub-processes at PCC

Note: The in-house information system developed with VB 6.0/SQL by the in-house IT team at PCC and the IMsystem acquired from an external vendor.

As discussed in section 5.4.1, there is no complete integration among the three groups of information systems in PCC (the In-house information system developed with VB 6.0/SQL by the in-house IT team at PCC; the Access/Excel information systems; and the IM system acquired from an external vendor). However, there is regular information exchange between the information systems with the use of Excel files. The VB6.0 has been used to

develop a facility so that the In-house information system can easily exchange information with Microsoft Office Applications. The facility enables a two-way communication between the in-house information system and the Access/Excel information system, thereby eliminating repetitive tasks like inter-IS data entry. The vendor of the IM system also provides import and export facility in the system for information in Excel format. Although there is no direct integration among the information systems, there is an indirect integration via the functionalities that allow excel-format exchange of data/information across the information systems.

5.7.2 Case Study 2: Waha Oil Company (WOC)

In accordance with the findings from the data gathered from the questionnaires andinterviews , the process mapping of WOC sub-processes (from its main business processes) to its information systems are shown in Figure 5.8 below. The financial management process, the crude oil trading process and the human resource process are efficiently integrated because they are all managed by the SAP R/3 technology. The other two information systems with which the remaining WOC processes are managed are the in-house information system developed with COBOL and the Access/Excel system developed with Microsoft Access and Excel. There is no integration among the three types of information systems at WOC. However, processed information in Access/Excel systems from the forecasting process, as well as the transport and distribution logistics process is exported in comma delimited files (.csv format) and imported into the SAP R/3 system via data-ports. In a similar vein data are exported in a .csv format from SAP R/3 and imported for use in the Access/Excel information system and the In-house COBOL-oriented information system. The comma delimited file is used with human support to bridge the integration-gap among the three types of information systems that are used at WOC.

EXPLORATION

Planning

Manual

Oil Production

In-house
(COBOL)

FORECASTING

Sales Forecasting

Access/Excel

Price Modelling

Demand Planning

CRUDE OIL TRADING

Marketing

SAP

Sales Management

FINANCIAL
MANAGEMENT

Financial
Accounting

SAP

Management
Accounting

SAP

HR MANAGEMENT

Personnel
Management

SAP

Payroll
System

TRANSPORT AND
DISTRIBUTION
LOGISTICS

Inventory
Management

In-house
(COBOL)

Vehicle
Management

Excel

Transport
Management

Manual
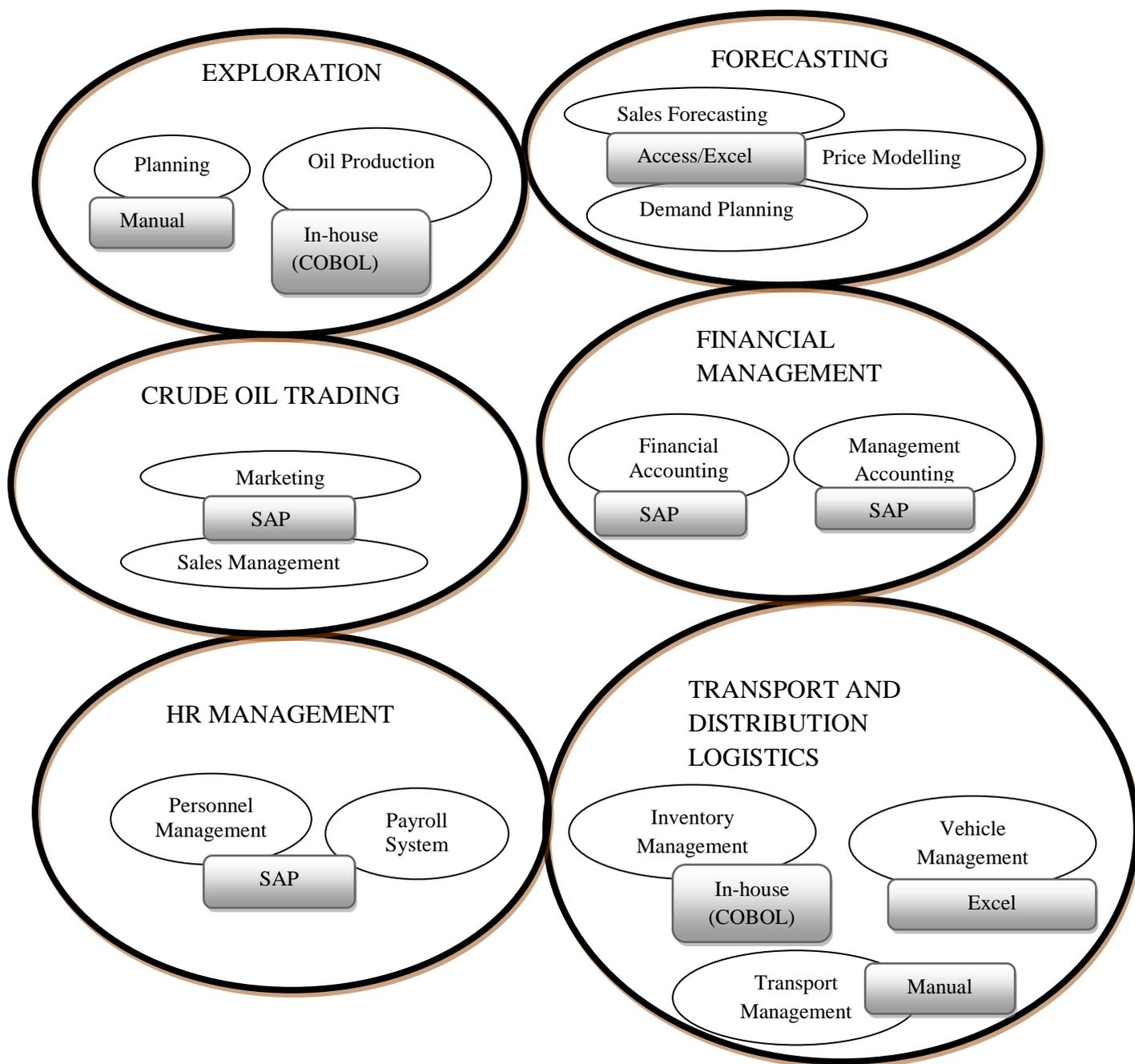
(Based on the system profiling developed in Wynn et al., 2009)

Figure 5.8: Existing Systems mapped with sub-processes at WOC

5.8   The E-Business Systems: PCC and WOC

The e-business systems mentioned refer to all the internet facilities and online capabilities employed by the companies in carrying out their business activities.

5.8.1   Case Study 1: Petro Canada Company (PCC)

E-business provides new ways of carrying out business activities; however, its adoption varies across different countries of the world. PCC's adoption of e-business is through the web application of its parent company (SUNCOR Energy – as discussed in Chapters 2 and 4); the web application is made available at www.suncor.com. The following is an illustration indicating the level of e-business adoption and its usage at Petro Canada Company, with focus on the sub-processes in the company:

Table 5.5: Assessment of E-Business Adoption at Petro Canada Company

PCC Sub-process	E-Business System in Use	Summarized Usage
Planning	No	
Petroleum Engineering	No	
Oil production	No	
Sales Forecasting	Yes	Micro and macro forecasting are done online. Extracted figures are further processed via Excel/Access Information System.
Price Modelling	Yes	Scenario analysis and simulations are done online.
Financial Accounting	Yes	Periodic financial reports, dividend payment information and related information are available to authorised users, and reactions are accepted online and responses are communicated back online. Email communications to and from necessary stakeholders are made available.
Management Accounting	Yes	Periodic financial reports and dividend payment information are available to the authorised users, and reactions are accepted online, and responses are communicated back online. Email communications to and from necessary stakeholders are made available.
Personnel Management	Yes	Email communications to and from PCC and its staff. Intranet facility is provided for PCC personnel.
Payroll System	Yes	Email communications to and from PCC and its staff.
Sales Management	Yes	E-mail contacts are made available online to initiate order requests and discuss payment, dispatch and receipt of the crude oil. Email communications to and from PCC and its customers.

		Email communications between the existing/prospective customers and the company is available. Customers can access reports online and submit their responses via designated email addresses. Email communications to and from existing/prospective investors are made available. Financial reports can also be accessed online by investors.
Customer Relationship Management	Yes	
Distribution Management	Yes	Updates on tracking information on the distributions are periodically sent to customers via email. Email communications to and from PCC distribution officers and customers' representatives are made available.
Inventory Management	No	

5.8.2 Case Study 2: Waha Oil Company (WOC)

Worldwide, there has been increasing usage of e-business technologies in boosting businesses. However, the adoption of e-business procedures varies from country to country and from company to company. E-business systems in the context of this research work is defined as all internet-based and online technology used to enhance business processes of WOC, which includes the use of email messages. WOC's adoption of e-business is made available at www.wahaoil.net with the company's web application. Shown in Screen-shot D in Appendix – 5 is the screen shot of the homepage of the Waha Oil Company's e-business system.

The following is an illustration indicating the level of e-business adoption and its usage at Waha Oil Company:

Table 5.6: Assessment of E-Business Adoption at Waha Oil Company

WOC Sub-process	E-Business System in Use	Summarized Usage
Planning	No	
Oil production	Yes	Information on the process is made available.
Sales Forecasting	No	
Price Modelling	No	
Demand Planning	No	

Financial Accounting	Yes	Email Communication between WOC and its stakeholders. Necessary financial/accounting reports are made available to authorised users via the "Uploading and downloading" facility. Required feedback is also retrieved with the facility
Management Accounting	Yes	Email Communication between WOC and its stakeholders. Necessary financial/accounting reports are made available to authorised users via the "Uploading and downloading" facility. Required feedback is also retrieved with the facility.
Personnel Management	Yes	Email Communication between WOC and its staff.
Payroll System	Yes	Email Communication between WOC and its staff.
Sales Management	Yes	Email Communication between WOC and its customers. Information is made available to customers online and their responses are accepted online.
Marketing	Yes	Information availability for WOC's existing and prospective customers. Email Communication between WOC and its existing and prospective customers.
Inventory Management	Yes	Invitation for tender. Email Communication with vendors. Uploading and downloading of documents.
Vehicle Management	No	
Transport Management	No	

5.9   Respondents Evaluation of IS Strategies in the Companies: PCC and WOC

5.9.1   Case Study 1: Petro Canada Company (PCC)

The information systems at PCC are subjected to evaluation to check if they meet the purpose for which they are designed. While administering questionnaires for this research work, the evaluation of the information systems was done with the following criteria in mind:

1. Ease of use and simplicity of its processes.
2. Coverage of all business activities of the sub-process.
3. Use of current technologies (being technically up to date).
4. Integration or mode of exchange of data/information with other information systems in the company.
5. Efficiency in providing the required management information for decision making.

Table 5.7: Evaluation of Information Systems at Petro Canada Company

Sub-Processes/ Business functions	The information system provides good management information and essential reports.		The information system is technically up-to-date.		The information system is easy to understand and use.		The information system automates all the sub-process activities.		The information system is well integrated or has a good mode of exchange of data/information with other information systems in the company.	
	P-1	P-2	P-1	P-2	P-1	P-2	P-1	P-2	P-1	P-2
Planning	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A
Petroleum Engineering	S A	S A	A	D	A	A	S A	S A	A	A
Oil production	S A	A	A	A	A	D	A	A	A	A
Sales Forecasting	A	A	A	S A	A	A	D	D	A	A
Price Modelling	A	A	A	S A	A	A	D	D	A	A
Financial Accounting	A	S A	A	A	A	S A	D	D	A	D
Management Accounting	S A	A	A	S A	S A	S A	D	D	A	D
Personnel Management	A	A	A	A	A	A	A	A	A	A
Payroll System	S A	S A	A	A	A	S A	S A	A	A	A
Sales Management	A	A	A	A	D	S A	D	D	A	A
Customer Relationship Management	A	A	A	A	S A	A	D	D	A	A
Distribution Management	A	A	A	S A	A	A	A	A	A	A
Inventory Management	S A	S A	A	A	S A	A	S A	S A	A	A

Note: Three answering options were given on the statements made in the first row of each column. The options were: A = Agree, S A = Somewhat Agree and D = Disagree. N A = Not Applicable.

The respondents (P-1 and P-2) from PCC were requested to give answers to different evaluation questions on the information systems. The positions of the respondents were checked against three options:

1. A=Agree
2. S A = Somewhat Agree
3. D = Disagree

Shown above in Table 5.7 is the summary of the evaluation.

5.9.2 Case Study 2: Waha Oil Company (WOC)

In a similar way to the evaluation questions administered to the Petro Canada Company respondents, the information systems at WOC were subjected to evaluation to

assess if they met the purpose for which they had been designed. While administering questionnaires and conducting interviews, the evaluation of the information systems was assessed with the following criteria:

1. Ease of use and simplicity of its processes.
2. Coverage of all business activities of the sub-process.
3. Usage of current technologies being technically up to date.
4. Integration or mode of exchange of data/information with other information systems in the company.
5. Efficiency in providing the required management information for decision making.

The respondents (W-1 and W-2) from WOC were requested to give answers to different evaluation questions on the information systems. The positions of the respondents were checked against 3 options:

1. A=Agree
2. S A = Somewhat Agree
3. D = Disagree

Shown below in table 5.8 is the summary of the evaluation:

Table 5.8: Evaluation of Information Systems at Waha Oil Company

Sub-Processes/ Business functions	The information system provides good management information.		The information system is technically up-to-date.		The information system is easy to understand and use.		The information system automates all the sub-process activities.		The information system is well integrated or has a good mode of exchange of data/information with other information systems in the company.	
	W-1	W-2	W-1	W-2	W-1	W-2	W-1	W-2	W-1	W-2
Planning	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A
Oil production	S A	S A	D	D	A	D	S A	S A	A	D
Sales Forecasting	A	A	A	A	D	A	D	D	A	A
Price Modelling	A	A	A	A	S A	S A	D	A	A	A
Demand Planning	A	A	A	A	D	A	D	D	A	A
Financial Accounting	S A	S A	S A	S A	A	A	A	A	S A	S A
Management Accounting	S A	S A	S A	S A	A	D	A	A	S A	S A
Personnel Management	S A	A	S A	S A	A	A	A	A	S A	S A
Payroll System	S A	S A	S A	S A	S A	A	A	S A	S A	S A

116

Sales Management	S A	A	S A	S A	S A	S A	A	A	S A	S A
Marketing	A	S A	A	A	A	A	A	A	A	A
Inventory Management	A	A	D	D	D	D	A	A	A	A
Vehicle Management	A	A	A	A	S A	S A	D	D	D	A
Transport Management	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A

Note: Three answering options were given on the statements made in the first row of each column. The options were: A = Agree, S A = Somewhat Agree and D = Disagree. N A = Not Applicable.

5.10 Assessment of IS Strategies and Business Performance in the companies: PCC and WOC

5.10.1 Case Study 1: Petro Canada Company (PCC)

There was alignment of the ISS with the business processes and strategy of the company in 2005. The overhauling of the existing systems and implementation of this current information system strategy at PCC began in that year. The In-house system, along with its integration with the IM system, as well as the Excel cum Access systems, gives PCC an efficient and effective system. However, the ISS of PCC can be said to be an in-house strategy because the in-house information systems are used to drive most of the business sub-processes of the firm. The combination of all the information systems provides the information system strategy that enhances the business performance of PCC, and it is being used to drive the company's business objectives. The advantage of the information systems adopted has contributed to business improvements in PCC's business performances. Some of the benefits gained, based on respondents' answers, can be generally grouped together as follows:

1. Activities of business process and sub-processes can be completed faster, thereby saving time. The continued effort on incorporating suggestions from annual reviews of the ISS at PCC makes the company strive towards having all its business processes being managed by the in-house (VB6.0 and SQL) information system alone. At present the ISS strategy has made possible integration of financial management information flow from activities done in Excel and Access into the in-house information system. This, for example has made it possible to run a trial balance report and have an up-to-date brief about the current financial status of the company.

2. There is an improved reliability in the data and information, which in turn facilitates prompt decision making. This is achieved in line with the ISS target of PCC to

eliminate the export of data from one information system and import into another. The process of the exporting and importing of information among information systems is carried out by some staff, and the human intervention in the process reduces the reliability of the information, as negligence of some staff in handling the exchange of information among information systems has led to incorrect information being fed into another information system. For example, if the Excel-based information system used in crude oil trading were integrated with the in-house information system, there would be no need for human intervention before there could be exchange of data between the two systems.

3. There is real-time and easy access to information by authorised users. The increased integration of the information systems at PCC has made the task of accessing information relatively easy. Once the user's profile is authorised to access the necessary information, the user can check reports with a single log-in process, rather than having to access them by logging into the information systems separately and collating information for the desired report. For example, the financial accountant can view the sales reports, and also view a cashier's report in another system, to resolve any problems associated with its balance sheets and other accounts.

4. On average, the information systems prevent errors as much as possible. However, when errors are made, they provide corrective routines to human errors with specific levels of authorisation. There are cases when incorrect monetary values are entered into the information system by the cashiers, due to errors in the mail sent by customers. When there are needs for such transactions to be corrected, the cashier cannot correct it himself, but it will be corrected by the treasury manager after the cashier has reported it to the head cashier, who will in turn report it to the treasury manager and justify with necessary documents (if any) why the value should be changed.

5. In-house systems can be extended to handle changes in business processes and sub-processes. The ISS at PCC is moving in the direction of managing all its business processes with the in-house information system with VB6.0 and SQL, in order to reduce the overheads needed to maintain different kind of systems, and this makes the management of all business activities available in a single information system.

However, some problems were mentioned by the respondents as challenges that are preventing the company from improving its information systems. The problems are as grouped below:

1. Non-readiness of the company to invest more in IT, as the management team appear to be content with the existing systems despite the fact that some areas of the business appear to need application of the latest technologies. The management is not convinced that investment in the latest technologies has a cost justification, even in long term.

2. More qualified staff are needed in the IT department. There is too great a work-load for the current staff in the department.

3. Level of technological applications in business activities is low in Libya.

4. Unavailability of regular funds for continual training of the IT staff.

Table 5.9: Summarised Assessment of the Information Systems Strategy and Business performance at Petro Canada Company

Issues	P-1	P-2
The effects of the information systems on the business processes and sub-processes.	Reduces the time taken for business activities, especially the inter-departmental sub-processes, thereby saving time and effort.	Faster operations with dependable data and useful information.
Information systems handling of changes/errors in the business processes and sub-processes.	There are some preventive and corrective measures in the system, and the in-house team usually work to make sure that the information systems accommodate the required new changes.	Error management provision is made in the system and extendable facilities for business changes are provided.
Challenges in improvement of the Information Systems.	Lack of funds, lack of conviction of the top-management of the benefits over cost.	Technical limitations of Excel and Access, Availability of sufficient IT staff to drive the company's processes and training provision for IT staff.
Problems with Information Systems on Business Processes.	Human errors and un-communicated changes in business processes	Negative culture/disposition to the use of Information systems of some staff.
Benefits of the Information Systems over their Costs.	The Information systems provide more benefits than their costs.	The Information systems have reduced the staff head-count, thereby saving costs and provide several intangible benefits that far outweigh the cost.
The business information required from the information systems.	Most are available on a real-time basis and are reliable data information.	Necessary information is periodically made available as designed, new reports can always be designed based on requirements.

Shown below in Table 5.10 is the summary of responses from the respondents on the contributions of the deployed information systems and implemented Information System Strategy (ISS) towards improvement of the business performance. The contribution of the deployed IS and implemented ISS in boosting business performance at PCC can be summarised as follows:

1. It has reduced the staff head-count, thereby saving costs. For example, the ISS has improved data analysis and reporting, thereby eliminating the need of several data analysts that used to work with the company.

2. It provides information for decision-making. A typical example of this is the customer performance report that PCC regularly monitors to decide on how to follow up on customers in order to ensure that there is no unusual decrease in their purchase requests.

3. It reduces the time required for carrying out various business activities. With elimination of redundancies and duplication of efforts, business activities are completed on time.

4. It brings about more accuracy and eliminates errors related to manual processing. The increase in efforts to eliminate all manual processes and embrace automated processes has gone a long way to reduce associated human errors.

5. It eliminates unnecessary procedures. Efficiencies have been built into the in-house system to reduce duplication of efforts in customers' registration and suppliers' management.

6. Information is provided on time. Management information systems report, such as the up-to-date financial income statement report, is accessible without any delay.

7. It has brought about improvement in customers' satisfaction in terms of the company's services. Customers' performance and sales reports provide information for managing relationships with the customers.

Table 5.10: Contributions of the ISS to business performance at PCC

Respondents	Contribution of the ISS to Business Performance at PCC	
	Contribution of ISS to improvements in business performance	Further improvement suggestions
P-1	Provides vital decision-making information that drives management decisions. It saves cost and time, thereby increasing efficiency. Removal of unnecessary procedures.	Simplification of automated procedures and automation of current manual procedures. The Excel and Access systems should also be changed.
P-2	Availability of accurate and timely information to drive the business strategy of the company.	Proper integration of all the information systems to reduce human errors. The limitations of Excel and Access systems demand a change in the information systems that are built by the duo.

5.10.2 Case Study 2: Waha Oil Company (WOC)

The current information system strategy at WOC was adopted in 2007 to drive the business strategy and bring more business success. In that year, a committee was set-up by the management of the company with members chosen from across all departments. The committee focused on aligning the business processes of WOC with the newly adopted ISS. There has been a gradual phase-out of the in-house systems that were developed with COBOL since 2007. The phasing-out comes with the replacement of the in-house systems with the Enterprise Resource Planning (ERP) System called SAP. At present, SAP is being used extensively and completely for three processes at WOC: Financial Management, Human Resource Management and Crude Oil Trading. The in-house information systems that are still being used are used because they are continue to meet the basic needs of the sub-processes that they are handling. The SAP combined with the in-house system as well as Excel and Access systems provides the information system strategy that drives the business performance of WOC. As illustrated in table 5.11 below, there are substantial benefits derived from the information systems to drive business performance at WOC. The benefits can be generally grouped as follows:

1. Improved turn-around time in business activities. A typical example given by a respondent was the elimination of comparative checks of reports between the ones generated by the financial management process and crude oil trading process. The fact that both processes are managed by a single information system (SAP R/3 ERP system) eliminated the need for comparison of reports generated by the two processes.

2. Real-time access to information based on authorisations. Once the information from other systems are exported and imported into the SAP ERP system, the management reports at WOC become available on a real-time basis: e.g. the analytical report on the forecasted sales and the actual sales for a specified period.

3. There is an increased centralisation of all information of the company, thereby reducing human error that comes with importing and exporting information across different information systems. With the initial ERP implementation for financial management process, and the subsequent implementation for crude oil trading and human resources department, there is more centralised access to the company's information across WOC.

4. The data and information becomes more dependable. This is as a result of the centralisation of information as explained in point 3. Only one version of data and information is available in the company when needed by different processes.

5. Decision making reports are available with little or no effort. The information systems at WOC provide the reports required to guide decision making. For example, reports on the weekly oil production and weekly oil dispatched to customers are used as a guide on how to take decisions on maintenance and the management of the oil storage infrastructure of the company.

However, there are some problems in the information system that have a negative effect on the business performance; and although the negative effects seem minimal, correcting them will likely improve the business performance of WOC. The problems are as grouped below:

1. Unwillingness of the company to invest more in e-business systems integration with the SAP ERP, as the management team appears to be satisfied with the existing and expected functionalities of the ERP system. It was observed from the interview that the main focus of the current information system strategy of WOC is to manage all its business processes with the SAP ERP system.

2. More qualified staff is needed in the IT department to drive and support the information systems. The work-load of the current staff in the department appears to be too great: This is because only two staff of the IT department at WOC take responsibility for supporting the information systems of the company.

3. Considering the country as a whole, the level of technological applications in business activities in Libya is low.

4. Unavailability of regular funds for continual training of the IT staff.

Table 5.11: Summarised Assessment of the Information Systems Strategy and Business performance at Waha Oil Company

Issues	W-1	W-2
The effects of the information systems on the business processes and sub-processes.	Improves business communications and data movements across different departments in WOC, bringing about improved efficiency in terms of time and staff effort.	Gives an easily accessible centralised view of information that drives the business strategy of WOC, as well as other important decisions.
Information systems handling of changes/errors in the business processes and sub-processes.	Most changes in the business process require the involvement of the consultant company that implemented the SAP for WOC. Error handling techniques are also provided in the system.	Errors are prevented to a great extent, but when made, authorisation is needed to correct them.
Challenges in improvement of the Information Systems.	Lack of necessary support and some compatibility problems associated with the in-house system developed with COBOL, and management satisfaction with the Excel/Access Systems.	Lack of funds and lack of feed-back strategy for improving the information system.
Problems with Information Systems on Business Processes.	Human Issues	Negative attitudes of some staff to changes in the Information systems.
Benefits of the Information Systems over their Costs.	The benefits of the Information systems, especially the SAP, will outweigh its cost over time.	The Information systems' benefits are greater than their costs.
The business information required from the information systems.	The business information becomes more reliable and requires less human manipulation.	The information systems provide centralised, reliable and real-time business information as required.

The responses of the respondents with regard to the current and future benefits of the deployed information systems and implemented Information System Strategy (ISS) in improving the business performance of WOC are summarised and shown below in table 5.12, while the contribution of the deployed IS and implemented ISS in improving the business performance at WOC is summarised below:

1. It has provided a more centralised overview of information. The SAP system has a central database where most reports are generated in WOC, which provides the same information for the generation of different departments' reports.

2. Accurate and timely information can be accessed by authorised users to solve different business problems. The centralised database of SAP reduces differences that arose (before SAP was embraced at WOC) from using information systems with

different databases in the past, and authorised users can now access the required information from the central database.

3. Reliable information is available on a real-time basis for decision-making. Whenever information is needed, e.g. a sales report for the current month needed by the Head of Finance, the information is available on real time basis.

4. Regular information is provided for driving the business strategy of the organisation. Reports are made available for managers, heads of units and directors to monitor the progress of the business strategy successes and manage/make changes when needed.

5. Unnecessary procedures in exchanging data among different information systems are eliminated. Before the implementation of SAP at WOC, data/information was exported from an information system and imported to another information system that required the data/information: SAP has eliminated all the problems related to this.

Table 5.12: Contributions of the ISS to business performance at WOC

Respondents	Contribution of the ISS to Business Performance at WOC	
	Contribution of ISS improves the business performance	Further improvement suggestions
W-1	Improved customer satisfaction, improved staff efficiency at work and provides important reports that guide managerial decisions.	Extending the ERP system to all other company processes will eliminate many problems.
W-2	Real-time and accurate information is made available to guide different managerial decisions. It has reduced unnecessary delays in business procedures that cut across different departments and processes.	Automation of current manual sub-processes and better automation of the information systems built with Excel and Access platforms.

5.11   Summary

Chapter five of this research has presented in detail, the empirical survey findings of this study. The chapter also provides a clearer view of the departments, processes, information systems and other relevant information that are relevant to the investigation of the deployed information systems and associated strategies in the case study companies. The chapter begins with details of the IT department, information systems deployed, information system strategies adopted in both case study companies: Waha Oil Company and Petro Canada Company. It has gone further to discuss the crude oil supply chain that is applicable to each of the companies based on the findings of the survey. Thereafter, the chapter has presented the business processes along with associated sub-processes in each of the two case study companies with texts, figures and tables. The information system portfolio map of the two case study companies has been presented along with the mapping of the sub-processes to the associated processes using the system profiling diagram structure developed in Wynn *et al.* (2009). The assessment of deployed information systems and associated information system strategies in the case study companies has also been discussed. The following chapter in this thesis (Chapter Six) analyses and discusses the empirical survey findings presented in this fifth chapter, and reviews the models used to assess the deployed information systems.

CHAPTER SIX – ANALYSIS AND DISCUSSION

6.1   Introduction

This chapter presents the analysis and discussion of the research findings that have been presented in chapter five. The research findings that are analysed in this chapter were gathered through the survey questionnaires and interviews (See Appendix 1 to 4 for details). This chapter is broadly categorised into the following sections:

1. Analysis of information system deployment in WOC and PCC using Nolan's "Stage Growth Theory" model.
2. The Information System Strategy and the Business Performance of PCC and WOC.
3. Analysis of deployed information systems with Systems Profiling by Processes and Sub-processes in PCC and WOC.
4. Analysis of the e-Business Adoption at PCC and WOC using CPIT Model.
5. Analysis of the deployed Information Systems in PCC and WOC with Zuboff's "Automate, Informate and Transformate" Model.
6. Analysis of the deployed information systems at PCC and WOC using McFarlan-Peppard's Model (Quadrant grid of information systems applications portfolio).

In general, the research findings of this work reveal that adoption of information systems strategies in oil companies in Libya has brought improvements to individual oil company's business processes. The information systems strategy has gone a long way in bringing about more efficient business transactions, activities and processes in the Libyan oil companies. In addition, there are many advantages of e-business technology that are yet to be tapped by the oil companies in Libya compared to what is obtained in oil companies in developed countries.

6.2   Analysis with Nolan's Model (The Stage of Growth Theory): PCC and WOC

Recently in the oil companies, there has been a concerted effort towards using information systems to drive their performance and bring more success to their businesses. Petro Canada Company (PCC) overhauled its information system strategy in 2005 while Waha Oil Company (WOC) adopted a new information system strategy in 2007, with a plan to replace their existing information systems with a new information system over a period of

six years. Although both companies were negatively affected by the Libyan war which began in February, 2011, the recent relative peace in the country has given them the chance to forge ahead with their businesses and chosen information system strategies. However, there is the likelihood that there will be an extension in the planned time frame for the strategies because of the Libyan war which lasted for a whole year, and the aftermath of the war, which cannot make it easy to establish the exact time when complete normality will return to the country.

The information system strategy adopted by PCC centres on information systems developed in-house; it also consists of an application for inventory management (the "IM system") from an external vendor. The integration of the information systems is only achieved among the in-house information systems. However, a facility was built into the in-house system that allows data exported from the IM system to be accepted in batches into the in-house system so as to be able to generate overall reports on all activities of the company. The currently embraced overhauled information system strategy of PCC does not lay great emphasis on tapping the benefits that e-business systems can offer the business in its activities and procedures of the company.

On the other hand, the information system strategy adopted at WOC is continually moving towards using an Enterprise Resource Planning (ERP) software system to manage all the business activities of the company. SAP R/3, an ERP system, is currently the main information system of the oil company. The SAP system which currently manages the following processes at Waha Oil Company: 'Financial Management'; 'Human Resources Management'; and 'Crude Oil Trading' is gradually replacing the in-house information systems of the firm. In the next three years (assessed before the advent of the Libyan war), the information system strategy of WOC is expected to have had all the business processes of the company replaced by the ERP system called SAP. However, little attention has been given to improvement on the company's e-business adoption in the strategy.

The research findings of this work related to the implementation of information systems strategies in the two companies can be analysed as follows:

1. The current information system strategy at Petro Canada Company was adopted in 2005 after the overhauling of the former information system strategy of the company, while the current information system strategy at Waha Oil Company was adopted for the first time in 2007. The research findings assert that both companies have recorded successes in their businesses with their information system strategy based on the information gathered during this research work.

127

2. Waha Oil Company commenced its ERP implementation using SAP with the financial management process along with the crude oil trading process. With the ISS of WOC being ERP-oriented, it has extended SAP to handle its human resource management. The company's ISS is steering towards using SAP to manage all its business processes. PCC on the other hand has its ISS focusing on having a single, well-structured information system that will integrate all its business processes. The target is to extend and continue to overhaul its current in-house information system developed with VB6.0 and SQL.

3. In line with the Stage of Growth theory by Richard Nolan (also known as Nolan's model), the information system strategy of WOC adopted in 2007 is probably the one that has brought the best result to the oil business activities of the company. There has been a significant reduction in the support time required to maintain the information systems, and improved reliability and dependability of information in the company because of centralisation of most of them, without human intervention in moving information from one system to another. WOC, with its 2007 adoption of the current information system strategy in the company, has been able to eliminate the problems associated with its in-house information systems by replacing most of them with a centralised ERP system (SAP) that manages all the processes of 'Financial Management', 'Human Resource Management' and 'Crude Oil Trading' in the company. Different types of authorisation have been given to different roles to ensure a secure information system. There has been a continuous expansion in the usage of the ERP system in the organisation and the general users' acceptance of the system appear to have contributed a lot to its successful implementation and use. This general acceptance can be said to be as a result of proper commitment of the WOC management to the staff training and their all-inclusive implementation process, whereby staff at all levels of the company are included in the process. Figure 6.1 below presents the stage of growth of information system through the adopted strategy at WOC.

4. Analysing the information system strategy of PCC adopted in 2005 with the Stage of Growth theory proposed by Richard Nolan, it can be asserted that PCC has made progress in its business based on the information system strategy. However, the level of its progress as observed in the findings is not comparable to the progress made by

128

WOC. The information system strategy at PCC has brought about regular upgrades on the in-house information systems and improved efforts towards integration of sub-processes and processes that cut across different departments in the company. Stakeholders' commitment to the success of the adopted information system strategy is said by a respondent to be the strongest key to the success recorded by the in-house information system at PCC. With good support from the staff of the IT department, PCC staff embrace the upgrades in the information systems and use it as trained. This has increased efficiency and reduces time-taken to complete cycles of business activities, e.g. hours worked by casual staff and level of job done as ascertained by different supervisors and managers can be efficiently monitored to guide the wage payment of the casual staff in a prompt and reliable manner. Figure 6.1 below presents the stage of growth of information systems through the adopted strategy at PCC.
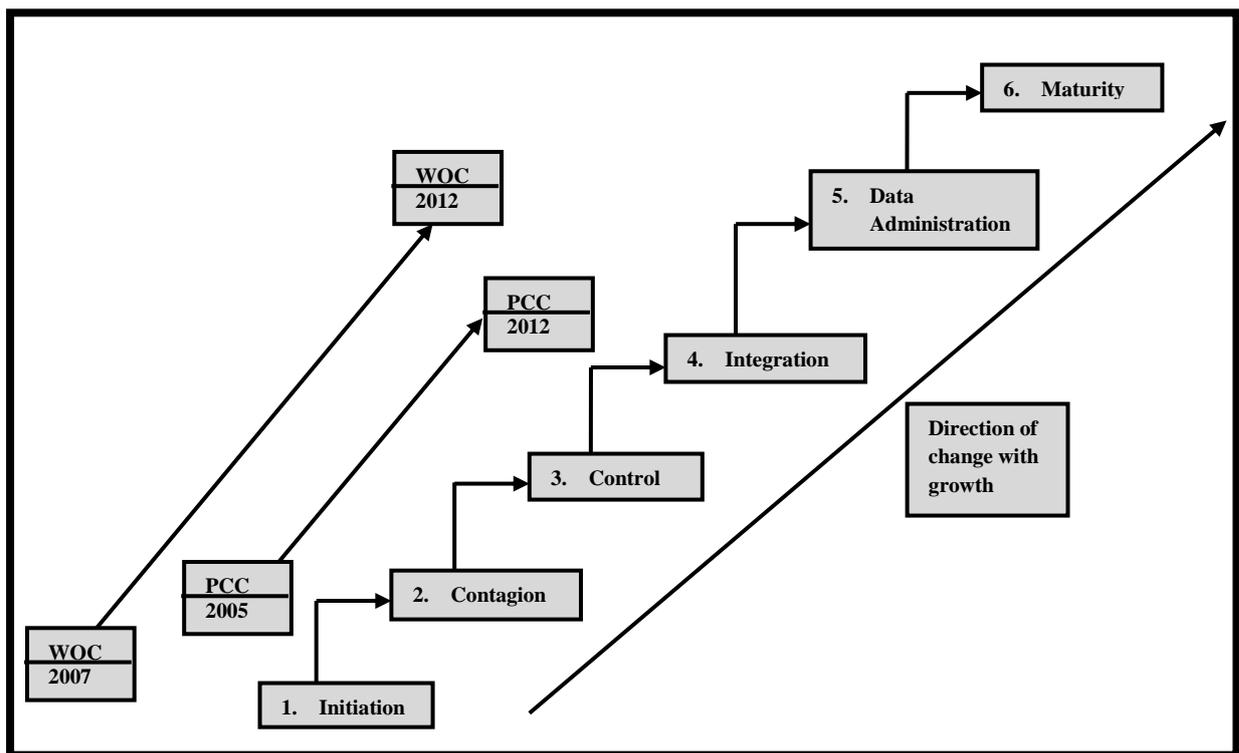
Figure 6.1: IS/ISS progress of WOC and PCC against Nolan's model

5. As illustrated above with Nolan's model, WOC can be said to have made better progress compared to PCC. WOC advanced from a position of having a poor

information system structure in place in 2007 to an integrated SAP R/3 dominated information system structure in 2012. As of 2007, WOC information systems were built mainly with COBOL and supported with Access/Excel systems. There were problems of upgrading i the main information system with some business changes of WOC, e.g. there was a need to restructure the system by allowing sales departments to be able to view available inventory and oil production activities. This, among some other upgrade problems, has been resolved with the centralised information system structure provided by the adopted SAP R/3 ERP system. Although, the in-house system developed with COBOL is still in use at present (2012), the SAP R/3 manages the majority of the business activities in the company – with initial implementation of the SAP in 2007 to manage the company's financial processes and subsequent implementation of the SAP to also drive the crude oil trading processes and human resources management between 2008 and 2010. The SAP R/3 has provided proper control in the system, given WOC a well-integrated process of crude oil sales, customer account management, financial activities to handle all business activities, along with effective data administration for human resource management.

6. PCC progress based on Nolan's model can be said to be significant too. The company's current information system strategy was adopted in 2005 to drive a change in what the management of the company perceived as a poor attitude to the usage of information systems, and low quality function of the information systems. Concerted efforts were begun in 2005 towards upgrading the existing information system structures, providing greater information system capabilities and changing the users' negative orientation to what the information systems were able to offer their business roles in the company. After an overhauling committee was set up in 2005, certain recommendations were put forward which enabled the company to make the first significant progress based on these recommendations in 2006 with the development of a user-friendly interface link between the crude oil sales process activities and the financial management process activities – the effectiveness and performance of the link was improved over 2006-2007. In a similar vein, between 2006 and 2009, the existing interface links were upgraded and new ones developed to properly structure the data and information flows across the following business sub-processes in the company: oil production, inventory management, management accounting, payroll management, personnel management, financial accounting, distribution management

and sales management. At the end of 2009, the in-house bespoke system had become popularly accepted in the company, with the centralisation of the main information among other functions that it provides. Since 2010 to date (with the exclusion of the Libyan war period and including the continuing after-events of the war), the information strategy of PCC has focused on enhancing the crude oil sales process and financial management process to carry out all their business activities with the sole use of the in-house bespoke system for eliminating the use of the Access/Excel information system.

7. As mentioned by Al-Mabrouk and Soar (2009), many oil companies in Libya invest large sums of money to adopt, implement, manage, and integrate information technology so as to provide better products and services, and they invest billions of dollars to build infrastructure to support the reliable transfer and efficient management of information and to regularly update their company hardware and software. Effective from 2007, WOC has spent an approximate total value of $1.5M on hardware and $4M on software. Effective from 2005 at PCC, the information systems in the company were upgraded every financial year at a proportion of 80% for hardware and 60% for information systems. Unlike PCC, WOC does not upgrade its information systems annually; it is done whenever the need arises. The main investments of PCC are on the improvement of the network infrastructure and upgrade of the in-house system to accommodate new business activities. In WOC, the main investment is on the ERP licence renewal and support from the company's ERP consultant, and some basic hardware/infrastructure needs.

6.3   Information System Strategies and Business Performance: PCC and WOC

Papp (1999) mentions that organisations use information systems in order to increase their operational efficiency; hence their overall performance as also able to increase the company's profitability. In relation to the research question that seeks answers to the impact of the information systems on the oil company business performances based on the adopted information system strategies, this section discusses various information systems used in both PCC and WOC. It also analyses the impacts of the information systems on business performance.

It can be deduced from the findings that WOC has improved in managing their internal processes by reducing the time needed to carry out different business transactions of

the company, thereby improving the turn-around time of their business activities. For example, the confirmed orders, sales made, invoices generated, amount involved, tax deducted, discount given and all the financial legs in the 'Crude Oil Trading' process can be accessed by authorised users in the Financial Management Department, because business transactions in both 'Crude Oil Trading' and 'Financial Management' processes are done with the same information system – SAP R/3 ERP System. This reduces a lot of time wastage that comes with reconciliation of financial activities, when both processes are not completely on the same efficient information system. In a similar vein, PCC integration of its in-house information systems, except for the IM information system (that comes from a vendor), have eliminated unnecessary timewasting that comes with having a series of stand-alone information systems that are not integrated. As rightly illustrated by a PCC respondent, the new information system strategy adopted in the company has made it possible for members of the Sales Management team – a sub-process under the Crude Oil Trading process – to readily have access to the in-house information system to know the availability of crude oil, with the reports that contain information extracted from "Oil Production" – a sub-process under the Exploration process.

As mentioned by Bendoly and Jacobs (2005), good access to communication services and facilities within an organisation makes information available to employees of the organisation, and this in turn enables the organisation to focus on its important business activities, aligned with producing positive performance results for the overall benefit of the organisation. In line with PCC's information system strategy, its information systems focus is on reducing the time required to complete various business activities, making information available on a real-time basis to boost efficiency and guide decision-making across all the company's business processes, and ensuring the increased profitability and business growth of the company. The information system strategy at WOC on the other hand focuses on customers' satisfaction in order to increase the demand for its crude oil, improved efficiency on its business activities to save time and do more work within a unit of time, and making appropriate reports available as needed. The information systems at both companies have contributed significantly towards helping the companies to meet their strategic targets.

Other discussions of the general findings in this research with regard to information system strategy and business performance are given below:

1. The chosen information system strategies by the two oil companies can be said to have improved the business performance of both companies. This is because the information systems in the companies contribute to making managerial information readily available and accessible (with authorisation), with improvement in integration of information systems across the company thereby increasing centralisation of business information of the companies. There is a regular review of the information system strategies in both companies to enhance the ISS support for business strategy in both the domestic and foreign oil company in Libya. The business performance improvements that come with the adopted information system strategies in both oil companies in Libya have been achieved as a result of a combination of the following:

   a. Commitment of the top-management to the adopted strategy.

   b. The all-inclusive way in which the information system strategy has been adopted in each company. All the staff, including the lower-level employees, are carried along and made to feel very important to the success of the strategy.

   c. Technical capabilities to drive the chosen information system strategy in each company were made available via an in-house system or external consultancy system.

   d. Regular basic user training and support are made available.

2. The aforementioned observations suggest that information systems at both WOC and PCC have reached stage IV of Gottschalk's "Stages of Growth" model, which was reviewed in Chapter Three (Section 3.8.8) of this research work. Gottschalk (2002) pointed out that information systems can be at four different stages of beneficial support for business organisations. At the first stage, end user tools are provided for the employees to work with. At the second stage, information on basic entities in the business is made available via the information system. At the third stage, information that represents knowledge is made available by the information system. At the fourth stage, the information systems are capable of providing processed information and reports for the business use of the company.

3. The information system strategy in each of the organisations seeks to eliminate human intervention in the flow of information across different information systems. This is achieved by eliminating both malicious and subconscious errors that may occur with the information due to human mistakes. Reliable and dependable information is

essential for making reliable and dependable decisions. Erroneous information leads to wrong decisions. One of the critical success factors that is of central importance to both PCC and WOC, and ensured by the information systems strategy in each company, is "Information Accuracy". Prior to the general overhauling of the existing information systems at PCC and subsequent adoption of its current information system strategy in 2005, the information of the organisation was said to have an average of 9.1% error rate, according to the responses in the questionnaire. However, with the current information system strategy, the error rate according to the questionnaire respondents is now (2012) said to be an average of 4.3%. Similarly, the error rate in information at WOC before the adoption of its current information system strategy was 11.33% on average. However, the respondents ascertained that the adoption of its current information system strategy had reduced the error rate significantly, to an average 2.08% in 2012.

4. The chosen information system strategy in both companies provides communication media of different information systems in the company. As rightly pointed out in Earl's three-pronged model (discussed in chapter three), the two companies have a blend of information systems in their information system strategy. This can be safely said to be traceable to the concept of top-down, bottom-up and inside-out issues analysed by Earl in his three-pronged model. While WOC appears to be changing gradually into having a single main information system strategy with its ERP implementation, the company business activities are still supported by the COBOL oriented in-house system and the Access/Excel package. On the other hand, PCC is making progress in the integration of its in-house systems to cover all its business areas, but the company's business strategy continues to involve the usage of other information systems – IM system and Access/Excel information system. This target of information system strategy in both companies allows some important information to be readily available on a real time basis. This has supported the management of both PCC and WOC in managerial decision-making and provides timely and centralised information for solving some managerial problems.

5. The information system strategy at both oil companies recognises and accommodates some of the mainstream risks involved in IS strategy deployment. At PCC and WOC, authorisation is required to access the information system so as to prevent

unauthorised users. A user log is kept in the ERP of WOC to monitor user activities on the system. Access to some reports at PCC requires an additional level of authorisation for employees below the managerial level. In addition, the strategies at both companies encourage the use of up-to-date anti-virus, and the avoidance of unapproved external storage devices on the companies' networks.

6. There is a considerable effort geared towards the adoption of e-business activities in the information system strategy, but the effort appears to not be good enough, if the vital benefits of e-business are to be tapped by both companies. E-business, if properly embraced and used by the two oil companies, as it is done in developed countries, has the potential to contribute significantly to the business growth of both establishments. However, the level of technology advancement in Libya has partly contributed to the poor use of e-business capabilities at both PCC and WOC. Notwithstanding this fact, it is worthy of being mentioned that PCC's usage of e-business technology is more efficient than that of WOC because of its parent company – Suncor Energy – which is based in a developed part of the world.

6.4 System Profiling by Process/Sub-process in PCC and WOC

6.4.1 The Main Business Processes/Sub-processes and Information System Profiling at the PCC

The main business processes and IS profiling at Petro Canada Company, according to the questionnaires administered and interviews conducted, is as shown in Figure 6.2 below. The information systems used for the human resource management process, along with transport and distribution logistics process, are observed to be satisfying the expected business functions at PCC. The financial management process is supposed to be the backbone of a company, the use of semi-manual systems such as Excel sheets in the process fell short of expectations. There is need for complete automation of activities in the process. In a similar vein, complete automation of the forecasting process and crude oil trading process would give these processes a more reliable and effective information system. Oil production and petroleum engineering sub-processes are well managed by the in-house system. However, it would be more efficient if the planning sub-process that is being done manually could have an automated system developed for it.
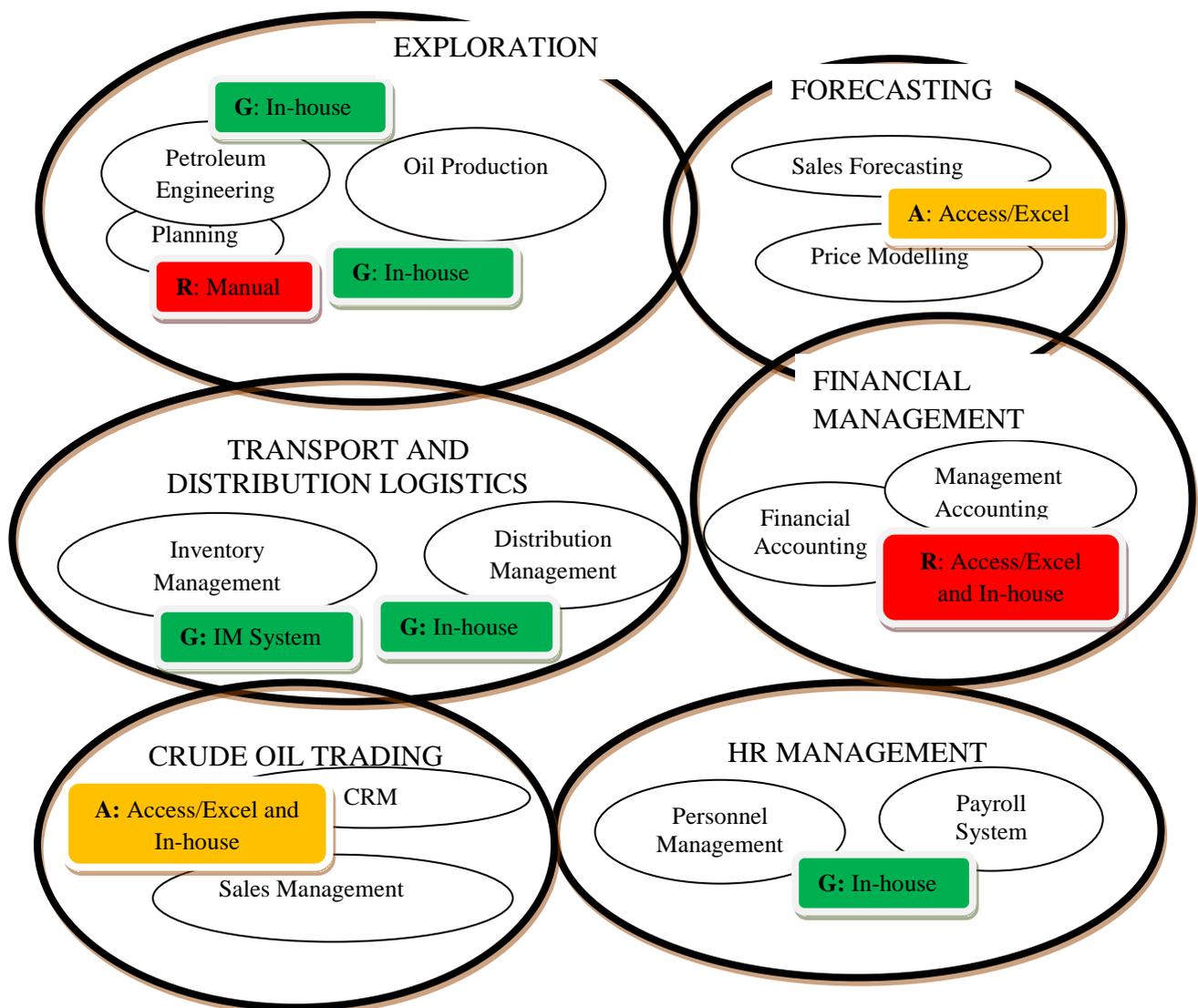
Notes: G (Green) = indicates a system that is effective.
A (Amber) = indicates a system that may need replacement.
R (Red) = indicates a system that is defective and needs replacing.
(Based on the system profiling developed in Wynn et al., 2009)

Figure 6.2: Main business processes and IS Profiling at Petro Canada

6.4.2 The Main Business Processes/Sub-processes and Information System Profiling at WOC

The main business processes and IS profiling at Waha Oil Company, according to the respondents is as shown in Figure 6.3 below:
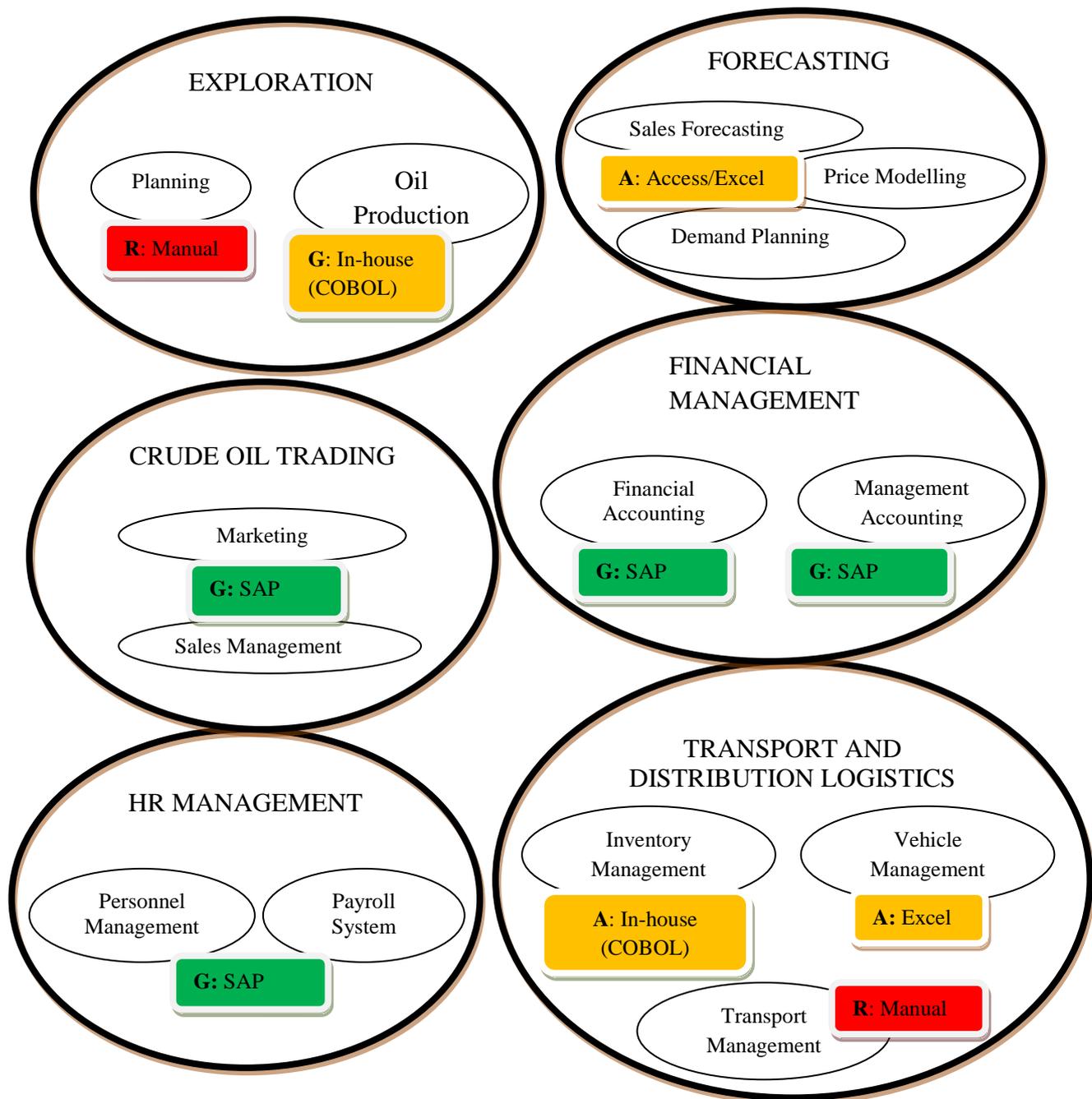
Notes: G (Green) = indicates a system that is effective.
A (Amber) = indicates a system that may need replacing.
R (Red) = indicates a system that is defective and need replacing.
(Based on the system profiling developed in Wynn et al., 2009)

Figure 6.3: Main business processes / sub-processes and IS Profiling at Waha Oil Company

The information system strategy at WOC is moving towards incorporating all the company's main business activities into the SAP R/3 ERP information system. SAP has recently been implemented for the following processes: financial management, crude oil trading, and human resource management. Although the in-house information systems developed with COBOL are still acceptable for managing some sub-processes at WOC, their

lack of flexibility and associated upgrade problems calls for their replacement. This is because as the company's business processes change with time, the COBOL-based in-house information systems may not be able to properly accommodate the changes and this may bring manual handling of some activities, operating alongside the in-house information system. Moreover, the semi-automated vehicle management sub-process with Excel should be fully automated, and the manual approach to the following sub-processes needs to be completely replaced by an automated system: Planning, and Transport management.

6.5   Analysis of the e-Business Adoption using CPIT Model: PCC and WOC

The e-business adoption in the current information system strategy at both Petro Canada and Waha Oil are analysed below using the CPIT model that is reviewed in chapter 3. CPIT model of e-business adoption clearly defined two elements:

1.   The Connect, Publish, Interact and Transform (CPIT) axis which classifies how e-business technologies can be used.
2.   The business processes or activities that the e-business technologies can be applied to.

The CPIT model shows the integration between business processes with the use of a series of expanding arrows to replicate how business processes interact and overlap. Shown below in Figure 6.4 is the basic structure of the CPIT model as used in this analysis:
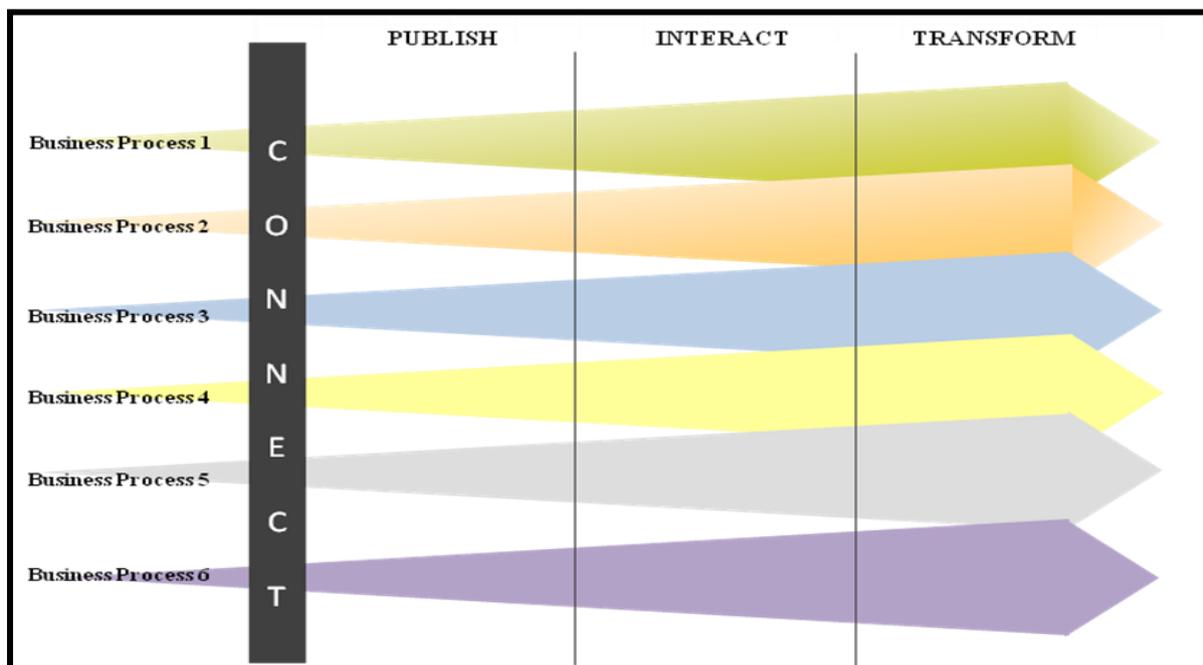
Figure 6.4*:* Structure of the CPIT Model used for analysis of e-business adoption at WOC and PCC

Based on the feedback from the respondents, the oil businesses of PCC and WOC are generally divided into 6 business processes for each company. Presented below is the diagrammatic analysis of the level of e-business adoption of each process and subsequent CPIT model of the two oil companies, taking one company at a time. PCC appears to be ahead of WOC in terms of e-business adoption. From the feedback, the advancement of PCC in e-business adoption is as a result of its online relationship with its parent company - Suncor Energy, which isa company from the developed part of the world that has greatly embraced e-business technologies for business activities.

6.5.1 Petro Canada Company

6.5.1.1 Exploration Process

Figure 6.5*: Analysis of e-business adoption on Exploration Process at PCC
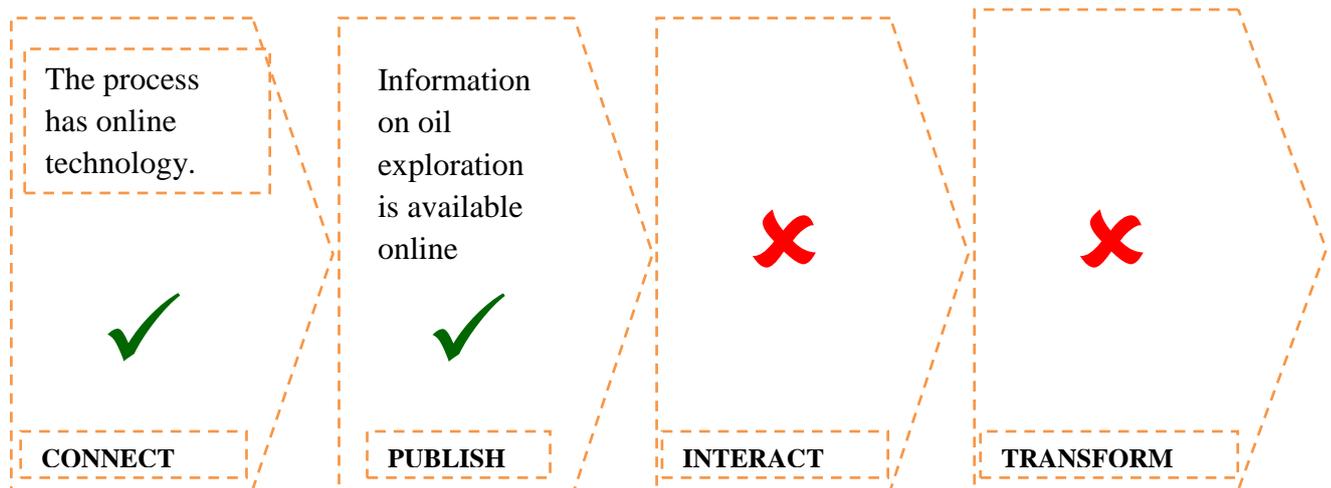
Although the oil production sub-process of the exploration process is, in the main, neither driven nor managed by the e-business system, basic information on PCC oil production is available on the website. This is why it can be safely stated that the Exploration process is connected and information ont the oil produced is availabl. The exploration process is mainly managed by the in-house information systems at PCC. Hence the company does not see any necessity to further develop an e-business application for the process.

6.5.1.2 Forecasting Process

Figure 6.6: *Analysis of e-business adoption on Forecasting Process at PCC*
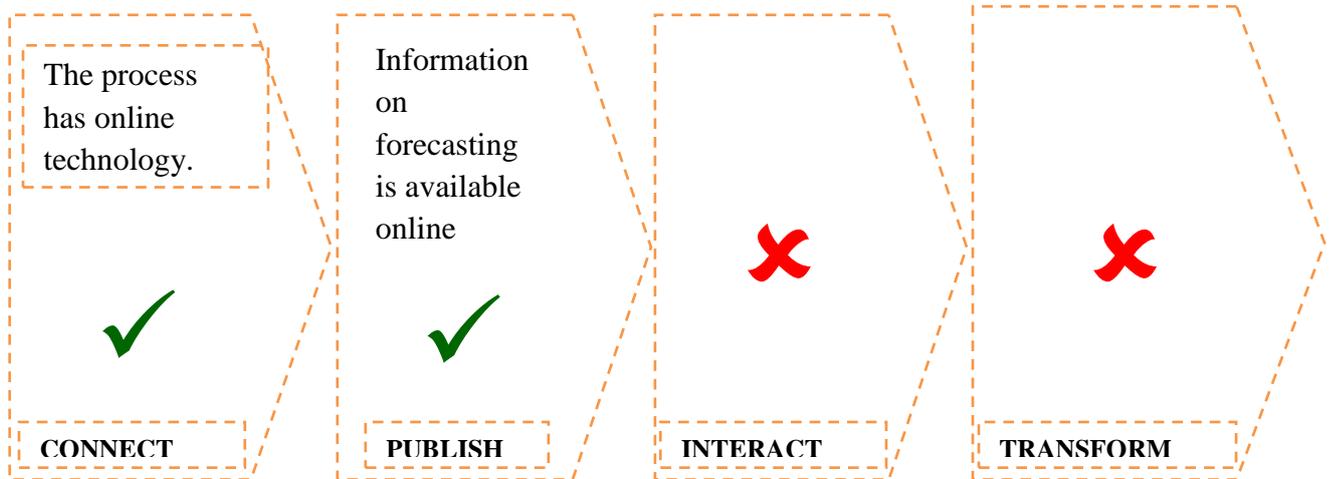
The forecasting process uses the information derived from the internet via the web application of the company via the established Excel/Access information system. The Excel/Access information system is dependent upon the company for the forecasting process. Hence, it can be concluded that the application of the e-business system in this business process of forecasting covers CONNECTS and PUBLISH in the CPIT model. However, e-business applications can INTERACT with the desired online resources to bring TRANSFORMATION into the forecasting process. The process is a business function that given some specification to e-business application, can give a more accurate forecast of different functional activities in forecasting, e.g: Scenario analysis and simulations.

6.5.1.3 Financial Management Process

Figure 6.7: *Analysis of e-business adoption on Financial Management Process at PCC*
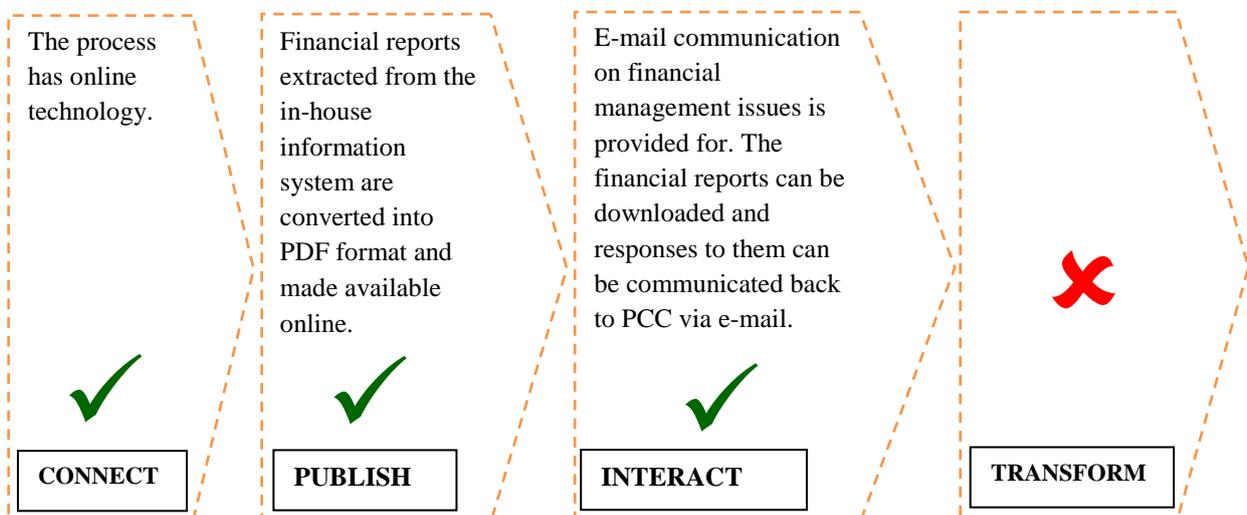
Both financial accounting sub-process and management accounting sub-process that make up the financial management process are at the interactive level when evaluated against the CPIT model. There is an online facility at PCC where periodic financial reports are made available to authorised users and there are designated email addresses to which replies on the reports are sent. The financial management department can access those replies and act upon them as necessary. Hence the business function can be said to be at the INTERACT level of the CPIT model. It cannot be said to have transformed the business as the fundamental financial management functionalities are managed with the in-house and Access/Excel information systems.

6.5.1.4 Human Resources Management Process

Figure 6.8: Analysis of e-business adoption on Human Resource Management Process at PCC
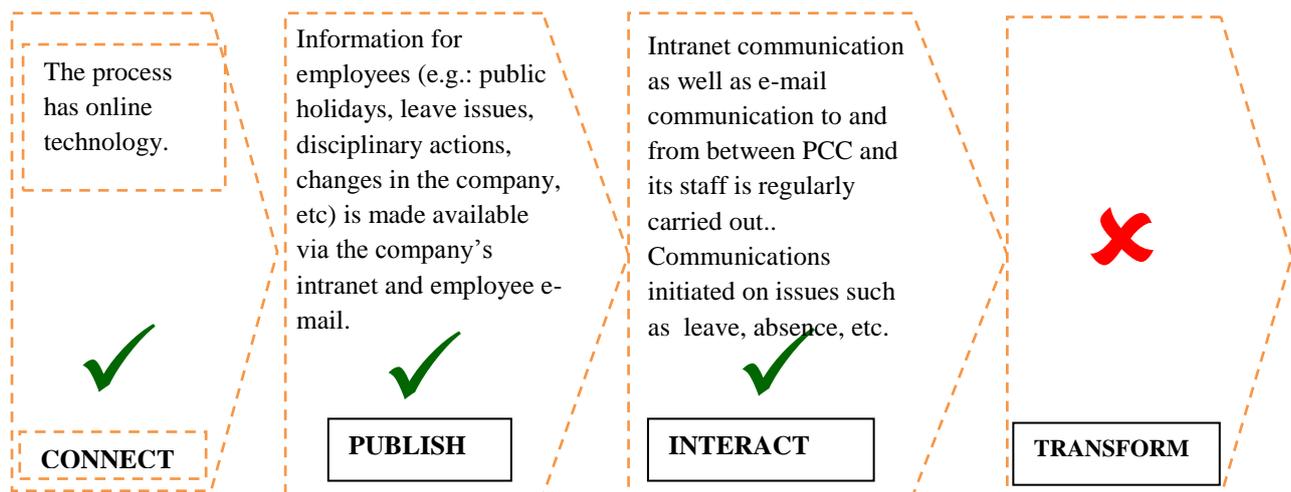
The web-based communication system between the human resource department and the staff of the company is good enough to be classified as INTERACT level on the CPIT model. However, it is not up to TRANSFORM level as the main functions of the human resource department are carried out with the usage of the in-house information system.

6.5.1.5 Crude Oil Trading Process

Figure 6.9: Analysis of e-business adoption on the Crude Oil trading Process at PCC

The process is online	E-mail contacts are made available online to initiate order requests and discuss payment, dispatch and receipt of the crude oil.	There is e-mail communication with customers to monitor dispatch and receipt of the oil.	The portal system brings about a faster trading process.
✔	✔	✔	✔
CONNECT	**PUBLISH**	**INTERACT**	**TRANSFORM**
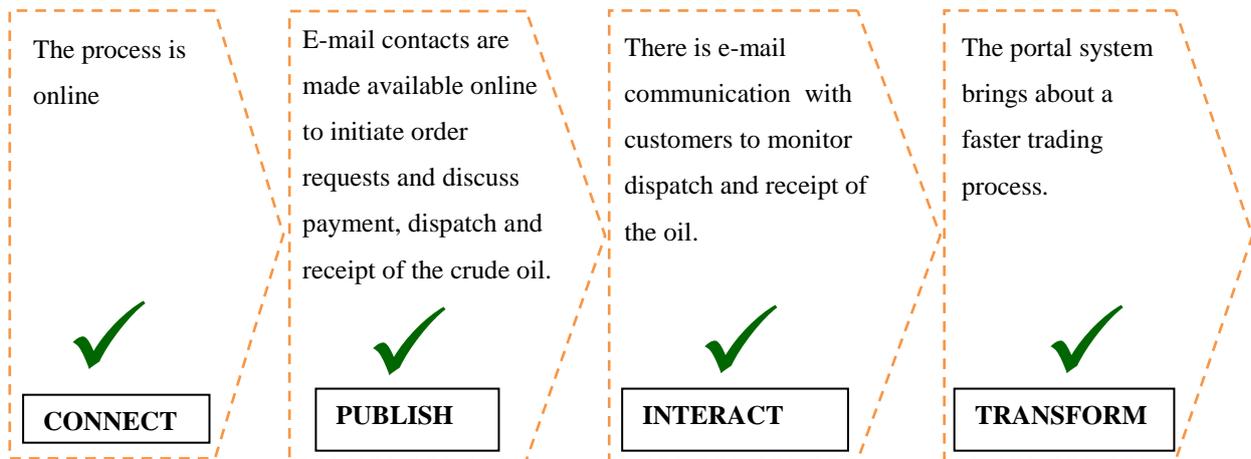
The crude oil trading process is handled by a combination of the in-house information system and the Excel/Access information system. However, the dedicated e-mail communication system between PCC and its customers discusses all the sales activities from ordering request, to dispatch of the crude oil, up to receipt of the crude oil by the customer. This has added transformation to the crude oil trading process of the company. The dedicated e-mail system has strengthened the company's relationship with the customers to a better extent.

6.5.1.6 Transport and Distribution Management System

Figure 6.10: Analysis of e-business adoption on Transportation and Distribution Management Process at PCC

The process has online technology.	Up-to-date information on tracking the crude oil distribution is made available online, and accessible to authorised users.	Information onon dispatch of crude oil and confirmation of acceptance by the customer is available.	Reliability and certainty are introduced into transport and distribution logistics.
✔	✔	✔	✔
CONNECT	**PUBLISH**	**INTERACT**	**TRANSFORM**
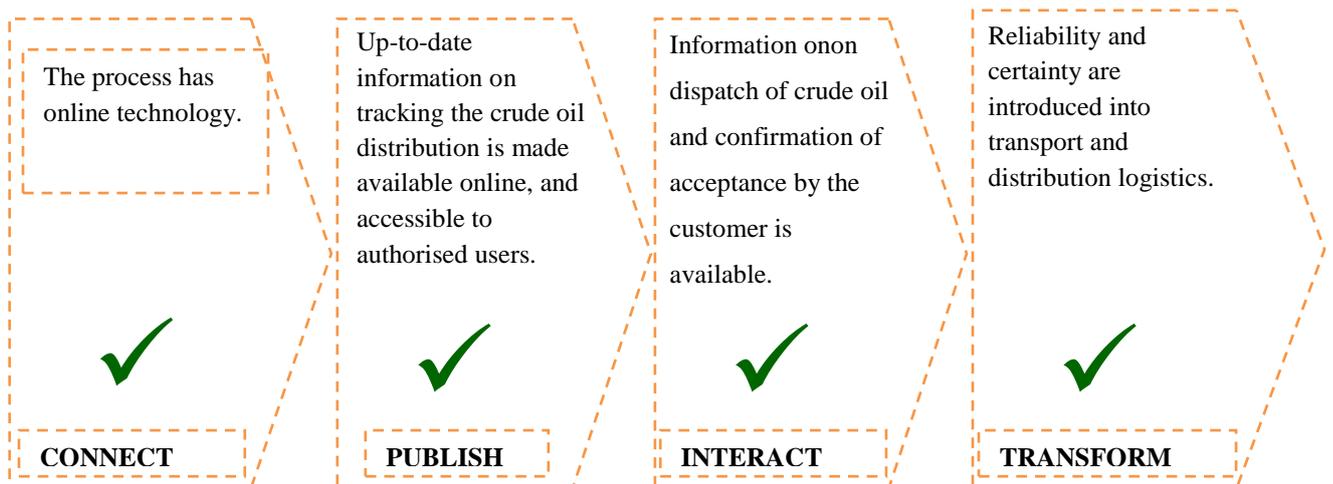
During the transportation and distribution of crude oil, the tracking of movements of the oil is of immense importance to both PCC and its customers. Some PCC staff are

dedicated to monitoring the movements of the dispatched crude oil and sending an up-to-date email to the customers giving the locations of their purchased crude oil vessels. This has brought more reliability and certainty to the delivery of crude oil to the customers.

The summarised analysis of all the processes at PCC using CPIT Model is shown below:

Figure 6.11*:* The analysis of e-business adoption at PCC using the CPIT Model
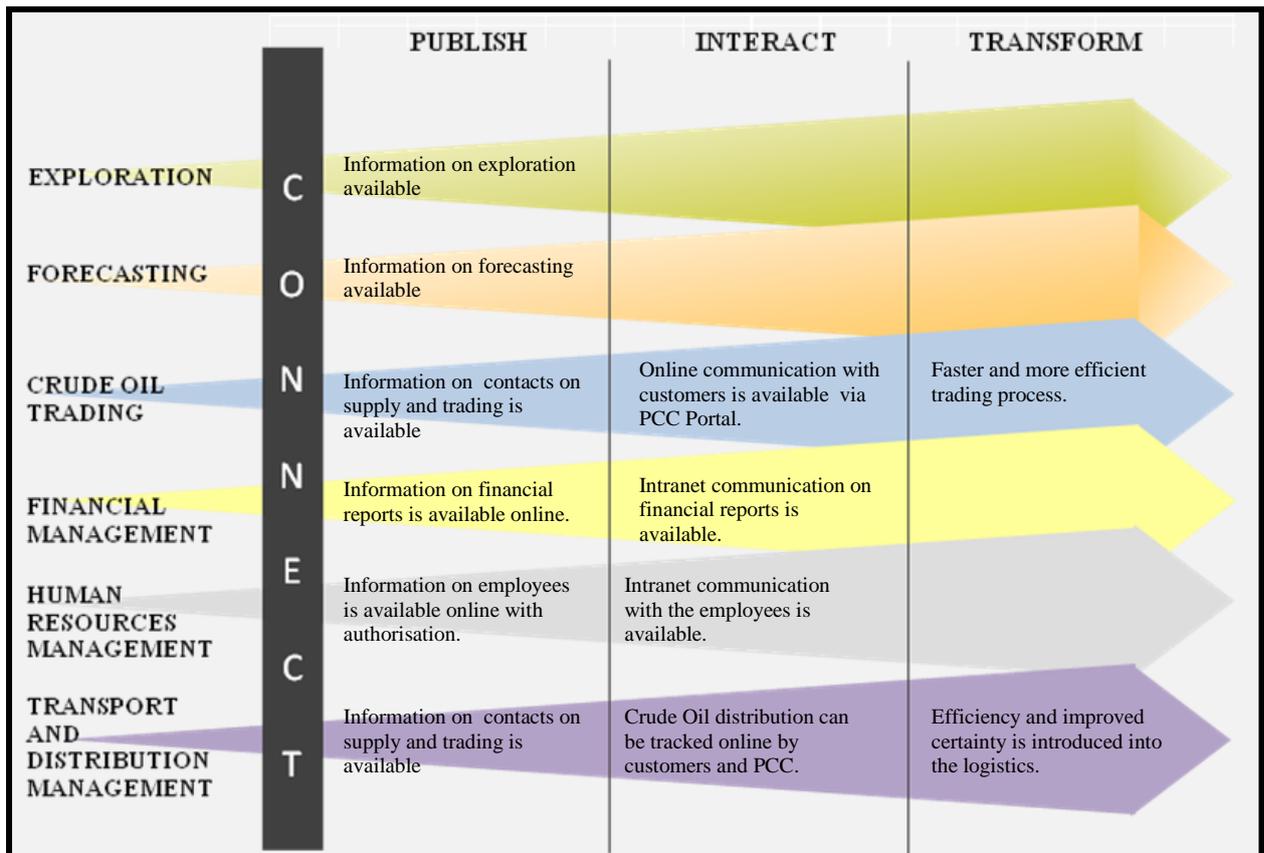
6.5.2   Waha Oil Company

6.5.2.1 Exploration Process

Figure 6.12*: Analysis of e-business adoption on Exploration Process at WOC*
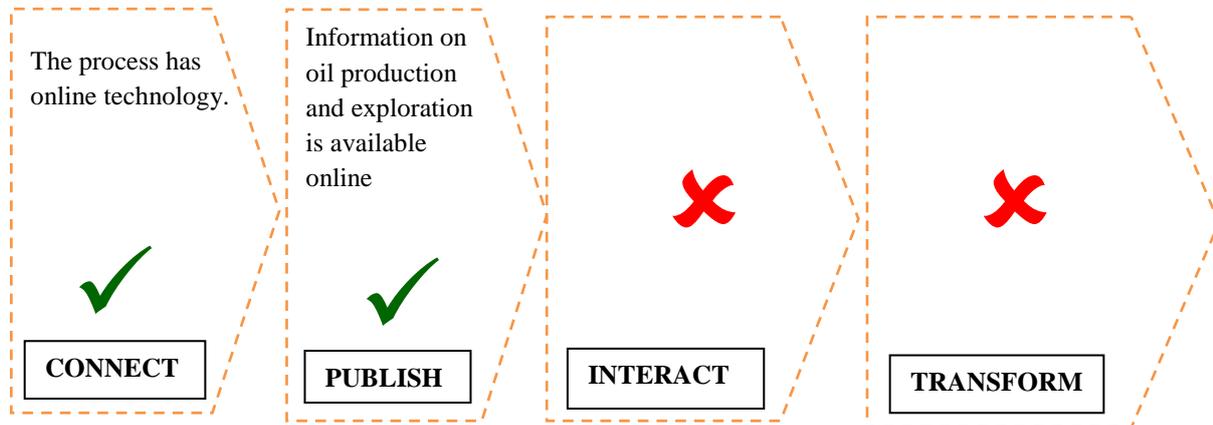
The Waha Oil Company's web application contains published details on the oil production sub-process in the company. Therefore it is safe to consider the Exploration process as being at the PUBLISH level. However, if the application can be further developed to manage the data of planning and crude oil production as well as generating desired reports, the level of application of the e-business in the business function of this process will improve when checked against the CPIT model.

6.5.2.2   Forecasting Process

Figure 6.13*: Analysis of e-business adoption on Forecasting Process at WOC*
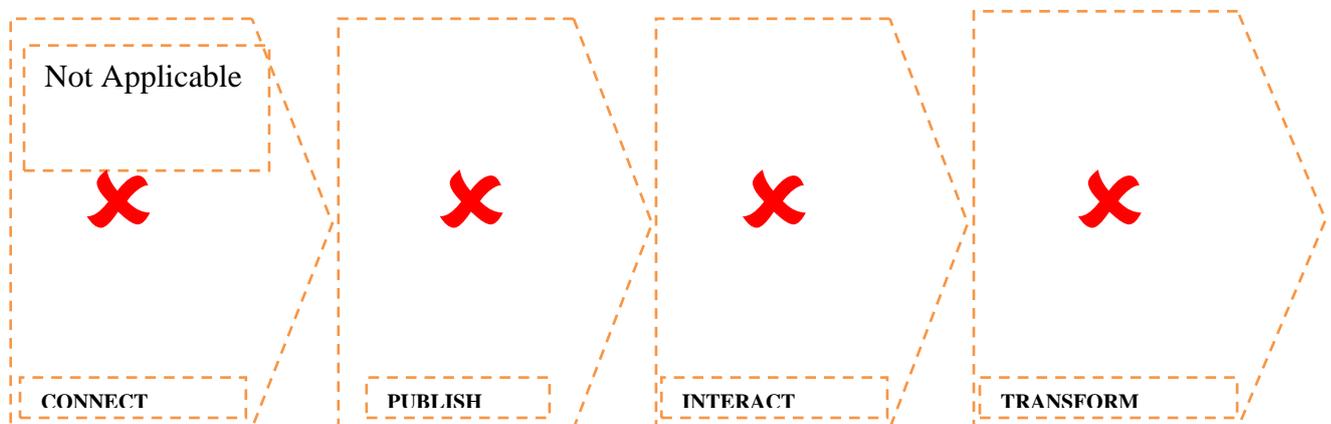
The forecasting process at WOC makes use of no e-business facilities. Hence CPIT model is not applicable to evaluate the process. This business function is entirely carried out at WOC with the customised Excel/Access information system.

6.5.2.3 Financial Management Process

Figure 6.14*: Analysis of e-business adoption on Financial Management Process at WOC*

The process has online technology.	Necessary financial / accounting reports are made available to authorised users via the "Uploading and downloading" facility.	The "Uploading and downloading" facility provides to and fro communication with top-management stakeholders.	Improvement and faster resolutions of issues on financial matters.
✓	✓	✓	✓
CONNECT	**PUBLISH**	**INTERACT**	**TRANSFORM**
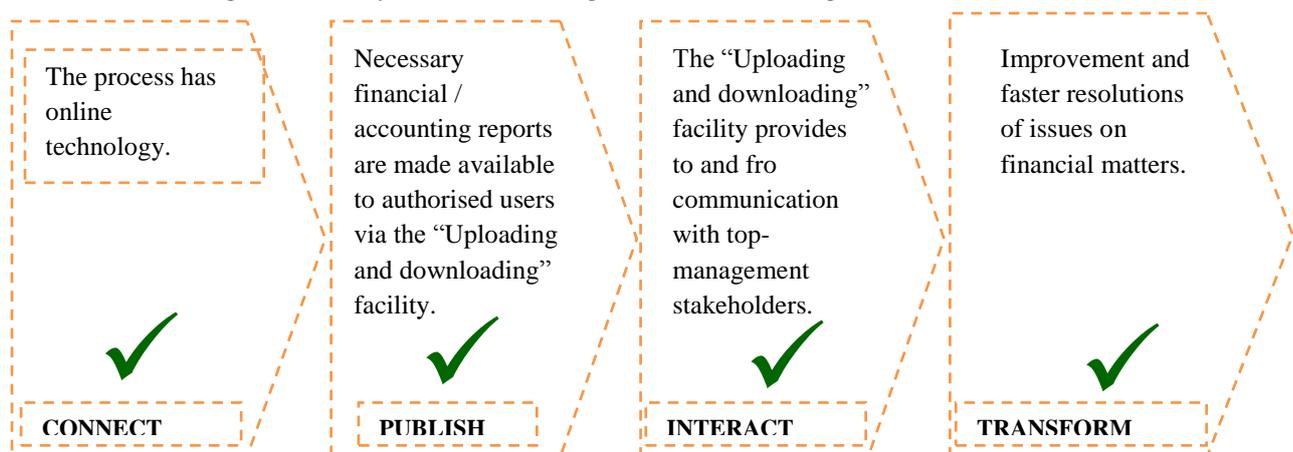
WOC has an e-business functionality called "Uploading and Downloading" on its website. This functionality is fully explored in the financial management department of the company. This has brought about transformation of the business activities in the financial management process. Important financial reports including up-to-date trial balance report, income statement report are made available for authorised users to access. The inputs of the authorised users are also acceptable via the "Uploading and Downloading" facility on the web application of the company. This, along with the intranet communication facility and the SAP R/3 ERP system that is used mainly for managing the financial management process, has aided the process to attain the TRANSFORM level upon assessment with the CPIT model.

6.5.2.4   Human Resource Management Process

Figure 6.15*: Analysis of e-business adoption on Human Resource Management Process at WOC*

The process has online technology.	Internal information is available for the WOC employees via the company's intranet.	Intranet communication to and fro between WOC and its employees.	✗
✓	✓	✓	
CONNECT	**PUBLISH**	**INTERACT**	**TRANSFORM**
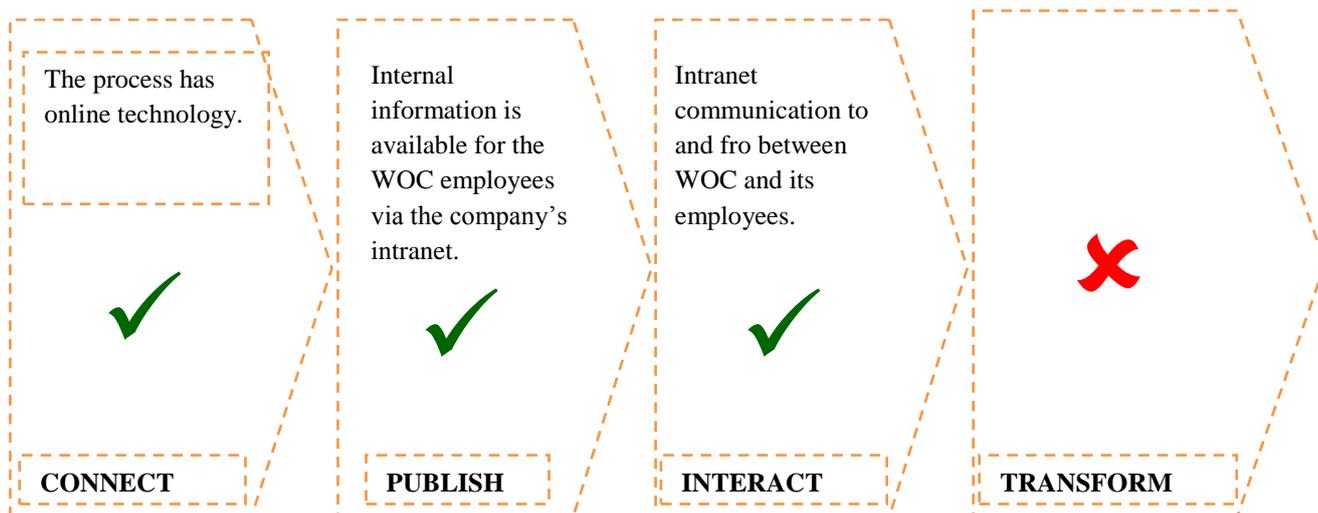
Important information for employees is circulated via the intranet of WOC by the Human Resources department. This information is not only accessible by the designated employees; the intranet system allows a bi-directional communication between the department and the employees. The intranet mailing facilities also aid effective and timely interaction between the employees and the human resources department of WOC. Hence, this business process can be said to be at INTERACT level of the CPIT model.

6.5.2.5   Crude Oil Trading Process

Figure 6.16*: Analysis of e-business adoption on Crude Oil trading Process at WOC*

The process has online technology.	Information for customers on trading matters is available online.	Communication with customers is available via email and the "Uploading and downloading" facility.	Fairly improved trading process. Online mails can be sent for ordering, to notify payment, to confirm receipts and so on.
✓	✓	✓	✓
CONNECT	**PUBLISH**	**INTERACT**	**TRANSFORM**
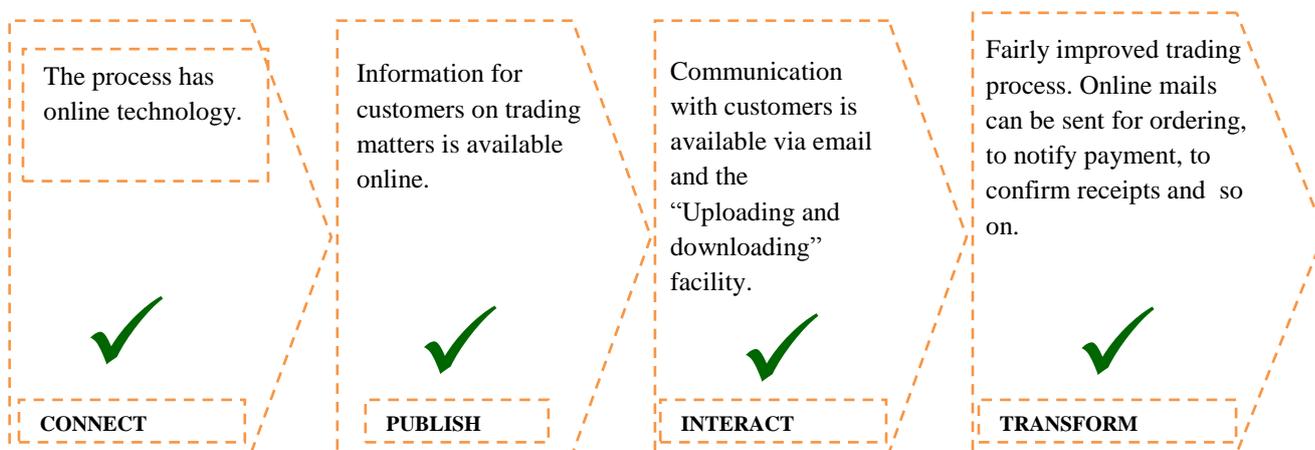
The crude oil trading process is another process at WOC that reliably uses the "Uploading and Downloading" function of the company's web application. The combination of this e-business function with the SAP R/3 ERP system mainly dedicated to the business process has jointly transformed the business process. The customers and the Sales Management unit and the Marketing unit (the two sub-processes in the crude oil trading process) interact with both the "Uploading and Downloading" function and the e-mail facility to aid the ERP system for the process. This brings an improvement to the crude oil trading process.

6.5.2.6 Transport and Distribution Management System

Figure 6.17: Analysis of e-business adoption on Transportation and Distribution Management Process at WOC
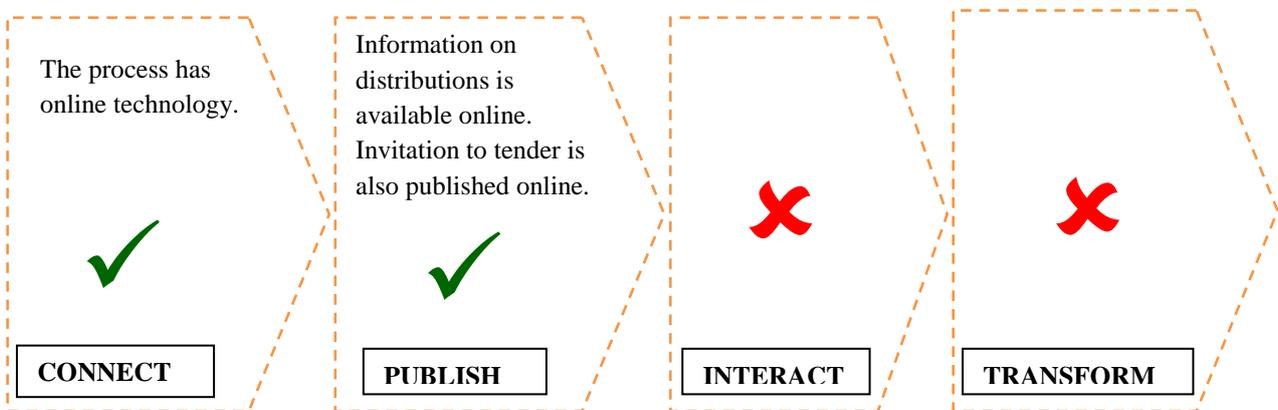

Waha Oil Company also uses e-mail in interacting with distribution partners. The invitations to tender for their suppliers are also published on the company's website. Hence, the process can be considered as being at the PUBLISH level in the CPIT model.

The summarised analysis of all the processes at WOC using CPIT Model is shown below:

Figure 6.18: The analysis of e-business adoption at WOC using the CPIT Model
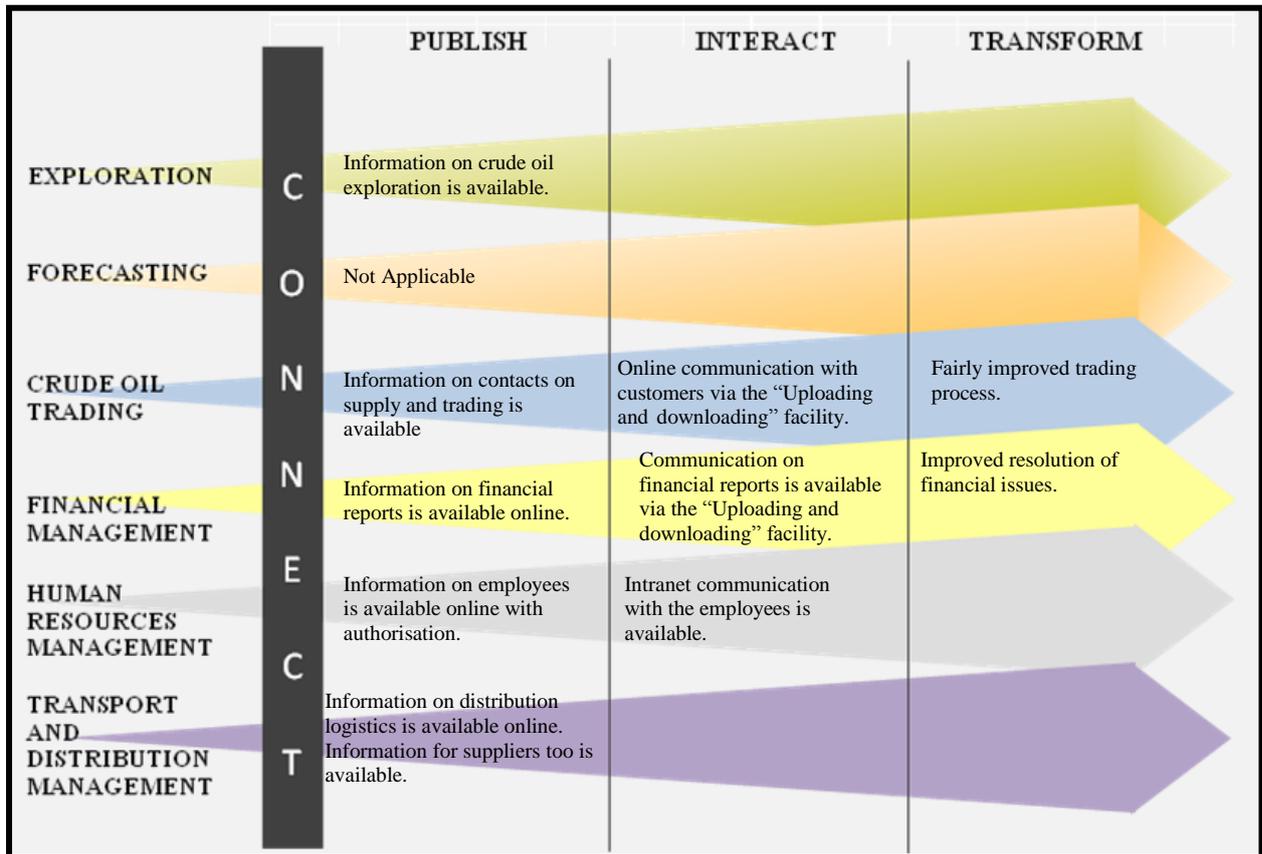
6.6 Analysis of deployed Information Systems with the Zuboff's Model: PCC and WOC

Zuboff's model as mentioned in chapter three is used to analyse the impacts of IT/IS on businesses and how these impacts brought process changes that have made the two oil companies' information system strategies to be a success. Gomez and Pather (2010) describe Zuboff's model clearly in this format: Zuboff's 'automate – informate – transformate' model. This model is used to analyse the 'automate – informate – transformate' of the information systems strategies adopted by the two case study oil companies in Libya. The business processes were placed on Y-axis while the 'automate – informate – transformate' were placed on the X-axis as shown in Table 6.1 below. Discussions were made at various intersections of the X and Y to give

further analysis on the relationship between the 'automate – informate – transformate' and the business processes of each oil company.

Table 6.1: Structure of Zuboff's Model used for process analysis at WOC and PCC

Business Processes	Automate	Informate	Transformate
Business Process 1			
Business Process 2			
Business Process 3			
... **...** **...**			
Business Process N (Where N is the last number of the business processes in the company that is being analysed)			

As Chatterjee, Richardson and Zmud (2001) rightly point out the automate phase refers to the role of information systems in organisations replacing human labour by technological devices and technological processes. Simply put, this phase entails the preliminary use of the computer to support business processes. In the automate phase, the information system strategy at PCC focuses on the choice of technology adopted to drive the business processes in 2005, the overhauling of the existing information systems in the company as at that year are put into consideration on how the processes can be technologically driven to replace human labour. Hence, PCC decided to upgrade all its information systems and strengthen its use of VB6.0 and SQL. For instance, the upgrade comes with integration of the information systems which eradicates the human labour of several staff whose positions are called: 'Data Analysts' in the company. Similarly, the automate phase at WOC of the current information system strategy in the company can be said to have begun in 2007. The company's adoption of ERP as a strategy, which will gradually replace its existing in-house COBOL-developed

information systems, brings about the use of technological processes and devices to replace several activities previously carried out by human labour. The real time availability of information that comes with the ERP has reduced the human effort required to collate data and do some manual transactions on them as the existing in-house information systems require upgrading and some new code developments to perform some required business activities.

On the Informate phase, Zuboff (1988) has established that in this phase, there is an empowerment by the information system. This empowerment implies that operational reports, management reports and other important information can be generated to drive business plans and strategies as well as to make vital decisions. Examples of the Informate phase at PCC include but are not limited to the following:

1. Oil production reports being used for decision making by the different managers that are involved in crude oil trading.
2. Sales management reports used in sales forecasting.
3. Financial management reports are also used in sales forecasting.

The Informate phase at WOC also comes with empowerment at different business processes of the company. Examples of the Informate phase at WOC include but are not limited to the following:

1. Monthly, quarterly and annual sales reports in different dimensions being used by different top-management level staffs.
2. Customer Analysis and Performance Reports.
3. Ageing Analysis Reports in different dimensions.
4. Financial management reports.

On the Transformate phase, Chatterjee, Richardson and Zmud (2001) write that it is a phase in which a traditional means of working is transformed into sophisticated business processes, and also mentioned is that in this phase the measurement of transformation should be against the business benefits. In the Transformate phase, the information system strategy has a major change on the business processes, thus bringing about transformation in the business. Some of the business processes at PCC still use information systems built on Microsoft Excel and Access technology; this has hindered significant transformation in those processes replacement of these information systems with information systems developed with more advanced technology may be needed to achieve any meaningful transformation. Furthermore, the Planning sub-process, which is managed manually, may be improved by

automation. However, good transformation at PCC based on assessment from the questionnaire and interview is seen in its business processes that use the in-house information systems developed and upgraded with VB 6.0 and Structured Query Language (SQL), as well as the IM system that is used to manage the inventory of the company. Zuboff's 'automate – informate – transformate' model for the PCC business processes are as shown in table 6.2 below:

Table 6.2: Business Processes Analysis at PCC with Zuboff's Model

Business Processes	Automate	Informate	Transformate
Exploration	In-house information system developed for both "Oil production" and "Petroleum Engineering" activities.	Summary reports are available on volume of oil drilled, chemical details of the oil content, source field.	Reliable and detailed information empowerment for different managers in their planning.
Forecasting	Microsoft Access database and Microsoft Excel spreadsheets support "Sales Forecasting" and "Price Modelling".	The reports generated come with some limitations but they provide general predictions of expected sales and information that guide pricing of the crude oil.	
Crude Oil Trading	A blend of in-house information system and Microsoft Excel spreadsheet are in place to drive "sales management" and "customer relationship management".	Reports are generated for mangers and other top-management stakeholders. Some of the reports are dedicated to customer performance monitoring. Examples of such reports include: -Monthly, quarterly and annual sales reports to monitor the growth in sales of the company. -Customer performance reports to monitor the business relationships with them. -Ageing analysis report on customers' debt management.	
Financial Management	An information system developed with Microsoft Access is used to manage both financial and management accounting activities. Microsoft Excel spreadsheets complement the Microsoft Access systems.	Daily, weekly, monthly, quarterly and annual reports with summaries of all financial activities of the company are available.	
Transport and Distribution Logistics	In-house information system in place for "Distribution Management" and a package called IM System acquired to manage inventories at PCC.	A summarised and detailed view of all crude oil transportation and distribution logistics activities are provided via several reports. There are reports on problems and adopted solutions during distribution.	Access to reliable and up-to-date tracking information on crude oil distributions. Improved communication between PCC and its customers.
HR Management	In-house information system upgraded to suit all the business needs of "payroll management" and "personnel management" activities	Reports on staff activities such as leaves (sick, annual, examination, etc), absence, medical issues as well as payroll processing details are available.	Performance analysis of PCC personnel becomes available. Dimensions of measuring performance are based on some vital part of personnel's Job Descriptions

The transformation of business processes at WOC seems to be more significant based on the feedback from the questionnaires. On crude oil trading at WOC, the management of customers' relationships by giving the customers appropriate reports, information situation of their accounts and transactions with WOC as well as other important customer relationship updates that are made possible by the availability of reliable pool of information through SAP has improved customer loyalty and purchasing interest in the company. Other transformations are also presented in table 6.3 shown below:

Table 6.3: Business Processes Analysis at WOC with Zuboff's Model

Business Processes	Automate	Informate	Transformate
Exploration	In-house information system in place for the "Oil production" sub-process.	Summary reports are available on oil production activities.	
Forecasting	Microsoft Access database and Microsoft Excel spreadsheets support "Sales Forecasting", "Demand Planning" and "Price Modelling".	Limited reports are generated at present. Despite the limitation, information provided in the reports is used by the managers in their planning activities.	
Crude Oil Trading	The SAP ERP system put in place to drive all business activities of "sales management" and "marketing".	Up-to-date and comprehensive reports that are considered very reliable, dependable and timely are generated for mangers and other top-management stakeholders to take vital decisions and address some managerial problems.	Improved relationship with the customers with increase in customers' loyalties.
Financial Management	The FICO module of the SAP ERP system is the information system implemented to manage all financial issues of the firm which is broadly divided into financial accounting and management accounting.	Comprehensive as well as summarised financial reports on daily, weekly, monthly, quarterly and financial activities of the company are available and accessible by authorised users on a real time basis. It also provides reports that the external auditors usually demand for.	Financial related transactions of all departments in the company can be monitored and financial decisions and advice can be sent to the departments.Expenditure requests in the company goes through an online approval system.
Transport and Distribution Logistics	In-house information system put in place for "Inventory Management", while Microsoft Excel spreadsheets used to manage the sub-process called "vehicle management".	Summarised reports are available on inventory management activities, limited reports are generated at present on vehicle management. (No in-house reports are generated on distribution, as this is handled by a third party logistics company).	
HR Management	The HR module of the SAP ERP system manages all HR issues of the firm which is broadly divided into payroll management and personnel management.	The SAP HR package provides both detailed and summarised reports on personnel. The reports include analysis of different dimensions on staff activities.	Employee payslips and other records are directly accessible on line. Online communication between individual employee and the HR department is now achievable.

6.7 Analysis of the Information systems using McFarlan-Peppard Model (Quadrant grid of IS applications portfolio): PCC and WOC

Case Study One: Petro Canada Company

At the Petro Canada Company, there are three main categories of information systems. These are:

1. The in-house information system built by VB6.0/SQL.

2. The IM system purchased from a vendor and maintained by the vendor.

3. The Access/Excel system developed with Microsoft Access and Excel.

The forth category is a combination of category one and three specified above. The in-house information system is strategic to the operations of PCC. It manages the exploration process. Along with the Access/Excel system, it supports the financial management process along with crude oil trading and provides essential financial reports, sales reports, customer performances reports among other essential reports. It also handles the human resource management process in its entirety as well as the distribution management sub-process. Therefore, the in-house information system can be said to be of high strategic importance in the current business environment of PCC. With the continuous enhancement and improvements of the in-house information system since the 2005 adopted information system strategy at PCC, the information system can also be rated high in terms of its importance in predicted environment.

However, the Access/Excel information system only provides supportive functionalities when used along with the in-house information system for financial management process and crude oil trading process. Its strategic importance in its usage in the forecasting process can be said to be low because the crude oil trading process can actually function properly without the forecasting process. The IM system can be said to be of high strategic importance in its current environment as it manages not only the crude oil availability for sales, it also manages all inventories in the company. PCC may change its dependence on the IM system for management of its inventory in the future, so the system can be said to be of low strategic importance in its predicted environment. Illustrated below figure 6.19 is the McFarlan-Peppard Model (Quadrant grid of IS applications portfolio) analysis for PCC information systems.

Figure 6.19: McFarlan-Peppard Model (Quadrant grid of IS applications portfolio) analysis for PCC information systems

	Strategic Importance in current environment Low ————————→ High	
Strategic Importance in the predicted environment High ↑ Low		In-house information system.
	Access/Excel information system.	IM system.
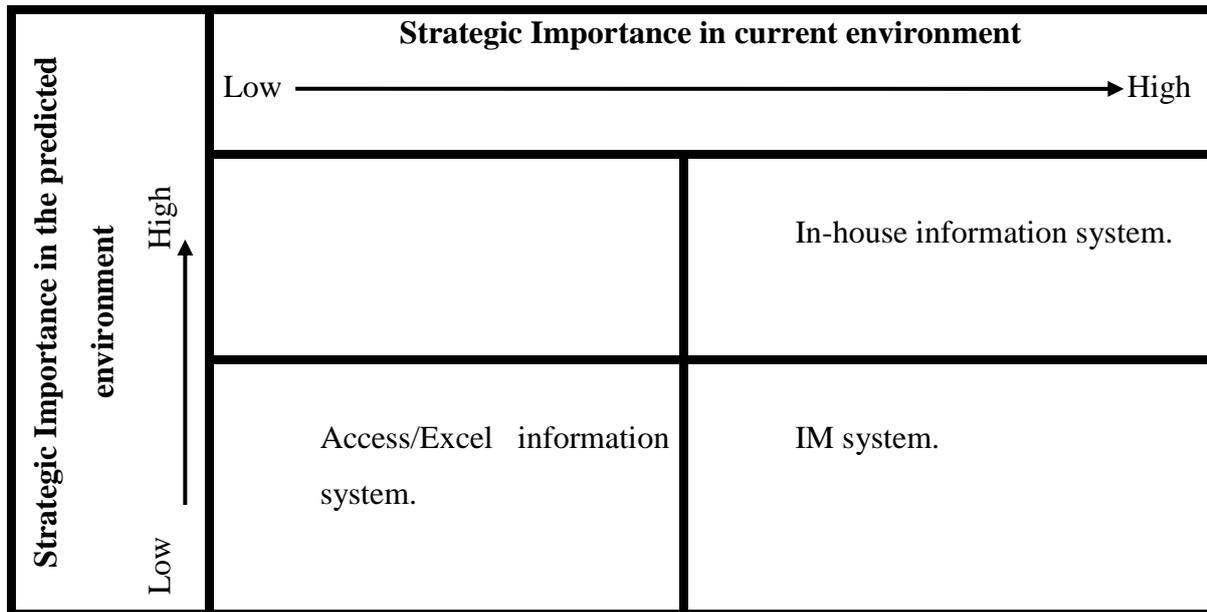
The in-house information system appears to be highly favoured by the top-management of Petro Canada Company, perhaps because of the confidentiality of data it provides as it is maintained and supported in-house. The exact reason for this is not fully established in this research. However, the findings in this study suggest that the in-house system is currently well supported by the decision makers of PCC and its future relevance to the business activities of PCC can be said to be certain from the IS strategy plans of the company. The IS strategy gives great significance to its enhancement and further development to cover all the business activities of the company.

The IM system which manages the records of crude oil that is available at PCC is also considered to be of strategic importance at present. The IM system also monitors all inventory activities in the company. Despite this importance, there is a likelihood that its use will be discontinued in the future. This is because the top-management of the company appears to be interested in extending the functionalities of the in-house system to cover inventory management. However, this may bring problems to the company in terms of sourcing for internal staff who will be able to maintain the functionalities of the in-house system.

The Access/Excel information system is used for supportive roles in the information system structure of the company. It supports the in-house system in both financial management process and crude oil trading process. Although, it is used for the forecasting process, its role

in the process is heavily dependent on information from the in-house system and some extracted data from the company's e-business resource.

Case Study Two: Waha Oil Company

Waha Oil Company at present is strategically heavily dependent on the SAP R/3 ERP system for management of its business activities. The crude oil trading process communicates its activities easily with the financial management process – both of which are driven by the SAP R/3 ERP system. The human resource management process of the organisation is also managed by the SAP R/3 ERP system. The other three information systems are the in-house information system developed with COBOL, the Access/Excel combined information system and the Excel information system that is used for management of the vehicle management sub-process.

The in-house COBOL oriented information system is high in terms of current strategic importance because it is used to managing the oil production sub-process and inventory management sub-process. However, with the ERP moves of WOC, there is a likelihood that it will eventually be replaced by the SAP ERP over time. In a similar vein, the vehicle management sub-process managed by the Excel system is of high strategic importance in its current use but its replacement is highly likely because of the incomplete automation functionalities of Excel as a medium for developing an information system. The Access/Excel information system provides supportive functions to the company and the elimination of its usage will not grind the business activities of the company to a halt. Illustrated below in figure 6.20 is the McFarlan-Peppard Model (Quadrant grid of IS applications portfolio) analysis for WOC information systems.

Figure 6.20: McFarlan-Peppard Model (Quadrant grid of IS applications portfolio) analysis for WOC information systems

	Strategic Importance in current environment	
	Low ⟶ High	
High	Excel information system.	SAP R/3 ERP system.
Low	Access/Excel information system.	In-house information system.

(Left axis: Strategic Importance in the predicted environment — Low to High)
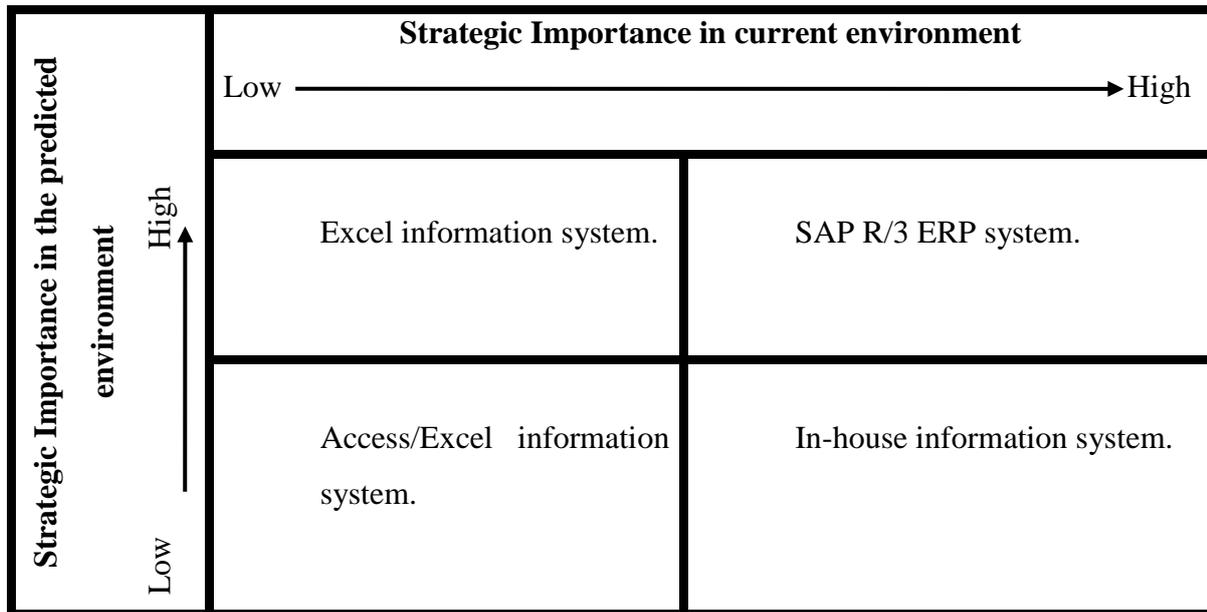
The centralisation of data and information provided by the SAP R/3 ERP system appears to be serving the purpose expected of the information system at WOC. Its ease of use, enhancement capability and enterprise-wide functionalities has made it highly relevant to the day-to-day running of business activities at WOC. It is supported by the current information system strategy to be the main information system of the company, if not the only one, in the future. Hence, its strategic position at present, among the information systems in the company can be said to be high. Moreover, its future strategic position among the information systems in the company can be said to be guaranteed because of the continuous dependence and improvement plans on it by the company.

The in-house information system that is COBOL-oriented is still very relevant at present in the company. Its importance cannot be underestimated as it is used for managing oil production and management of inventory. These two sub-processes are crucial to the business of WOC. Therefore, the information system that manages the sub-processes is of a high strategic importance. However, the future use of the in-house information system is not guaranteed as the top-management can be safely said to be more interested in future customisation of SAP to manage the two sub-processes.

The Access/Excel system manages the forecasting process at WOC. This process at WOC is supportive of the businesses in the company as it gives a rough estimated prediction of what

the company is to expect in the future with regard to demand, price and sales of crude oil. This is a supportive role, and WOC businesses are not heavily dependent on the information system. Hence its strategic importance based on how it is depended upon at WOC can be said to be low. In a similar vein, its future strategic importance is low. This is because it may be changed as more company resources are not committed to its improvement over the coming years at present.

The lone Excel information system is used to maintain the vehicle management sub-process. At present, there is an increased dedicated effort to ensure that it is well suited for the sub-process that it manages. Its future strategic importance can therefore be said to be high. In contrast, its strategic importance can be said to be low at present because it is yet to be perfected for the sub-process that it is dedicated to manage.

6.8   Summary

This chapter has built on the foundation of survey findings in Chapter Five. It presents the analysis and discussion of the research findings based on the literature review in Chapter Three and research methodology in Chapter Four. This chapter presents the analysis of the of information system deployment in both case study companies using Nolan's "stage growth theory" model. The chapter discusses the analysis of the deployed information systems with system profiling by processes and sub-processes in Petro Canada Company (PCC) and Waha Oil Company (WOC). The chapter also presents an analysis of the e-Business Adoption with CPIT Model at the two case study companies. Thereafter Zuboff's "Automate, Informate and Transformate" Model was used to analyse the deployed information systems in PCC and WOC.

The chapter also presents the analysis and discussion of the deployed information systems at PCC and WOC using McFarlan-Peppard's Model (Quadrant grid of information systems applications portfolio). The following chapter (Chapter Seven) uses the analysis and discussions presented in this chapter to make conclusions and recommendations on the entire study. Chapter seven also contains the limitation of the study as well as the suggestions for future research works based on this study.

CHAPTER SEVEN - CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the appraisal of the purpose of this research work and assesses:

1. The contribution of the research to knowledge.
2. The limitations of the research.
3. The potential of the research for further research and future activities.

The major findings of this study show that proper deployment of information systems, the adoption of an appropriate information system strategy and its subsequent implementation and continual usage is vital to continued business growth and increasing efficiencies in all business processes of oil companies in Libya. Adoption and continuous implementation of a particular information system strategy in oil companies in Libya by a domestic or foreign oil company enhances business processes and provides for an effective information driven business environment.

7.1   Conclusion of the Research

This research was embarked upon to study the deployment of information systems and establish a framework for assessing deployment of information systems in oil companies in Libya. The study was done with the aim of providing answers to the research questions laid out in section 3.10 of chapter three. With the analysis presented in chapter six building on the findings in chapter five and the literature review in chapter three, together with the research work in other parts of this study, conclusions to each of the research questions are discussed below.

7.1.1   Research Question 1: What are the current information system strategies used in the oil companies in Libya?

The two oil companies that are case studies in this research work have distinct information system strategies. PCC, the foreign oil company in Libya, has evolved its strategy in response to operational needs and as such it has largely resulted in short-term solutions that arguably lack a coherent underpinning long-term strategy. Many of the solutions are developed in-house using a variety of development tools – Microsoft Access, Microsoft Excel and Visual Basic/SQL. In parallel, hardware infrastructure has been upgraded, but there is no clear strategy regarding a move to packaged software or adoption of a mainstream ERP solution. The company currently uses one mainstream package – the JAVA based system for inventory management. This has resulted in problems of integration

and management information, and has also meant that the move to web enablement, discussed below, has suffered from an inadequate underlying information system infrastructure. It is also true, however, that some of the processes in the oil companies, notably petroleum production, are particular to different business environments, and standard ERP production module functionality would not necessarily be a good overall 'fit' to these requirements. It is partly because of this that PCC elected to bespoke their systems for oil production and have remained with them. This strategy was embarked upon by PCC in 2005, and as suggested by the analysis against the McFarlan-Peppard model (see chapter six), in-house developed information systems are still viewed as of key strategic importance to the company.

The company is moving towards having specific in-house solutions for each of its business sub-processes. This plan of in-house solutions for the company business sub-processes was adopted in 2005 and has been implemented in phases for each sub-process; it was initially intended to have been completed by 2012. However, the expected completion year was extended to 2013 in 2010. The 2013 end date appears not to be achievable, again due to the Libyan war which started in February 2011, and to date (July, 2012), normality has not returned to the business activities in the country. The company is still using a simple file exchange method to share information across its information systems, and there is no effort made towards automated integration of the information systems at present. From the collated data (see Chapter Five), PCC chose the current information system strategy and the currently deployed in-house bespoke systems in the company after a cost-benefit analysis. The present choice is made based on the fair cost and acceptable information value that that the deployed information systems can return. However, it can be mentioned that PCC annually review its information systems strategy and the deployed in-house bespoke systems. If the strategy is no more meeting the information needs of the PCC, the company is ready to invest in any better choice – as long as it is cost justified. The company annually reviews options of the Enterprise Resource Planning system, acquired information systems from software vendors, among some other packages that can be used in the company. Hence, the future information system strategy of PCC cannot be specifically mentioned, but it is can be said that the future information system strategy in the company depends on the information systems that are meeting the strategic information needs and strategic business requirements of the company. The company can discontinue any of its present information systems including the IM system, if it is no longer meeting its business and information needs.

At WOC, the information systems strategy has been largely built around a phased implementation of the SAP R/3 ERP integrated package. Complete adoption of the SAP R/3 ERP information system throughout the company is still on-going, and the ERP system is planned to be web enhanced so as to incorporate web advantages and provide competitive advantages for WOC business activities. Currently, SAP ERP modules operate in conjunction with certain legacy systems that pre-date the first ERP modules. These were developed in COBOL, and there are also point solutions developed in Access and Excel packages of the Microsoft office suite. Integration of the SAP modules with other systems is done via a mix of bespoke links and manual updates. Despite the clear need for automated integration of information systems, the company still relies on a file exchange method for data/information flow across the information systems. However, the information gathered for this research revealed that Waha Oil Company is working on completion of its phased implementation of SAP R/3 ERP package across all its sub-processes, thereby phasing out all other information systems in the company. This will eradicate the need for any integration of the company's information systems. As the analysis against the McFarlan-Peppard model illustrates (see Chapter six) for Waha Oil Company, SAP R/3 ERP information system is currently of high strategic importance in the company, and it is also favoured as the only information system in the company that will have high strategic importance in the future. Hence, it may be concluded that SAP R/3 ERP information system constitutes the future information systems strategy of the company.

Although the two oil companies have generally matured in their deployment of IS since adopting their current information system strategies, integration remains a key issue, particularly at PCC. Human errors can arise from the current alternative (exchange of data/information files) when there is often human intervention to maintain key elements of corporate data – for example, customer and product related information. In addition, the information system strategies in both companies still have many advantages yet to be derived from embracing e-business procedures and processes.

7.1.2 Research Question 2: How effective are current IS strategies in supporting business strategy and business operations in the Libyan oil companies?

As discussed in Section 3.6 in Chapter Three of this thesis, understanding the company's business needs and purpose of deploying information systems is key to the effectiveness of information system strategy in supporting the business strategy and business operations of Libya oil companies. The first important observation from the study is that

timely and reliable information is very important for managers in the oil companies to take certain managerial decisions. It also assists them in solving short-term and long-term business problems. With this, the two oil companies can be said to practise the top-down approach as explained by Earl's model (see Chapter Three, Section 3.8.1). For example, in Waha Oil Company, there is an approval system in the SAP R/3 ERP information system for official expenses by low level employees of the company. The approval system eliminates the unnecessary delay in such expenses, as the senior staff who need to approve the expenses may not be easily accessible, thereby causing unnecessary wastage of time in the operations of the company processes. At Petro Canada Company, regular reports on the sales forecast and historical sales record are vital for use in the IM system, which manages the crude oil inventory in the company. The information system strategies in both case study oil companies have significantly assisted the oil companies in Libya to have more efficient business processes and sub-process operations.

Beside the improved efficiencies in the processes and sub-processes in both companies, the provision of the information as a result of the deployed information systems and adopted information system strategies has also aided the business strategies of the oil companies with reporting components. With this, the two oil companies can be said to practise the bottom-up approach as explained by Earl's model (see Chapter Three, Section 3.8.1 for details). At both Waha Oil Company and Petro Canada Company, updated financial reports such as the income statement, balance sheet, journal activities and trial balances are regularly generated and used by the senior management staff of the companies to make important financial decisions. The availability of such important reports has significantly assisted the surveyed oil companies in Libya to have more improved systems to make both short term and long term decisions. The deployed information systems in the companies have also automated various business activities, especially the sales analysis at Waha Oil Company, thereby reducing headcount of staff, and in turn reducing costs for the companies.

In addition, the information system strategies in both oil companies make provision for customer relationship management process support. This is an integral part of the business strategy of the companies. The records of the customers and their likely crude oil needs are properly sorted and managed in the information systems – this is done with a combination of the in-house information system and Excel package at Petro Canada Company, while it is done at Waha Oil Company by the SAP R/3 ERP information system. Hence, the information system strategies in both companies are helping in satisfying the customer-companies of both

Waha Oil Company and Petro Canada Company. Ageing analysis of the customer-companies' debts, quarterly best performing customers, amongst others, are customer-related reports that are made available in the information systems to help the companies to manage their relationships with their customer-companies.

However, there are still improvements that can be incorporated into the IS strategies to make them more effective in their support of, and alignment with, the overarching business strategy and business operations at both oil companies. In line with perceptions of staff of both Petro Canada Company and Waha Oil Company on the strengths and weaknesses of the information systems in the company (see Chapter Five), improvement suggestions for the IS strategies in the oil companies are presented below:

1. As pointed out in Section 3.3.2 of this study, proper planning is essential for a solid information systems deployment and implementation of an efficient information systems strategy. There is need for Libyan based oil companies to have a more dedicated and efficient review team or evaluation system for their adopted information system strategies. Such a team can observe, recommend and implement positive changes on the information system strategies. The important steps that can be followed are as mentioned in section 3.3.3.. At PCC, there is a review team for the company's information system strategy. However, the team is more focused on the upgrade needs of different functional departments in the company and how the needs are being included in the in-house information system capabilities. The team ensures that the in-house information systems incorporate changes to reflect new business requirements in the company. However, there is the opportunity to expand its role to ensure systems strategy as a whole is aligned to overall business strategy. There is need for the team to take a regular interval survey of employees needs from the information systems, review them and adopt the needs that are progressive for the business and information system strategy. Equally, if there are significant new developments in the top level business strategy, the team can review implications for existing systems. This group could be composed of both IT professionals and system users and chaired by a senior manager, who could liaise with other members of the senior team. This would take the form of two way communication to ensure strategy alignment that only exists through informal networks in PCC at present. At WOC, a system

of using users' complaint registers/logs is in place to boost the existing information system strategies. However, not much importance is attached to these; there is need for issues in the registers/logs to be given more attention in order to improve the existing information system strategy of the company; and alignment of IS and business strategies is similarly pursued only through informal and ad hoc discussions, and would be improved through the introduction of an appropriate information systems steering group or some similar body. The companies should put in place a more effective appraisal and evaluation team as well as a functioning system for periodic review of deployed information systems and the implemented information system strategies in each individual company. Improvement suggestions should be made by the appraisal teams via the functioning system for periodic review of deployed information systems and the implemented information system strategies, on what should be done to make the deployed information systems and the adopted information system strategies better than they are. This would help in driving continuous improvements of the deployed information systems and adopted information system strategies in various oil companies in Libya.

2. The latest technologies capable of managing all business processes in the companies should be integrated into their respective information system strategies. In doing this, it will be appropriate for the two companies to properly take the following components of ISS triangle into consideration: Organisational strategy, business strategy and information strategy (see section 3.3.1). This will be of immense benefit to the two oil companies' strategic planning and corporate appraisal of latest technologies. Although the two oil companies have regularly upgraded their technology platform over the years since they adopted their current information system strategy, PCC is not embracing the latest technology of Visual BASIC that the company is using for its in-house information system, which is the foundation of its information system strategy. The company depends on VB6.0 technology which has its latest version as VB2008 and VB.NET. The new technologies usually offer improvements and additional functionalities over the older versions. Although, the SAP R/3 ERP information systems at WOC can be said to be a latest technology, its COBOL oriented in-house information system is too rigid and it is very hard to incorporate the new business procedures of

163

different business functions at WOC into it. For instance, one of the WOC respondents cited how the issue of grouping the crude oil in store in the company by the oil field where it was extracted using the COBOL oriented information system gave the company a lot of problems that would have been easily solved with the latest information systems technologies, notably a modern underpinning relational database. Existing information systems that cannot be upgraded to meet the ever-evolving challenges of the world business environment in oil industries should be discarded and new technology should be adopted to provide cutting edge technological advantage for the business progress of the oil companies. In a similar vein, if the cost of upgrading a particular information system to meet the increasing business needs of a Libyan based Oil Company is unrealistic, other information system options that are efficient and fit for the business needs but are cheaper in terms of cost should be considered. The consideration should be taken with the aims of the components of the ISS triangle as mentioned by Mateus *et al.* (1996), Kent (2004) and Pearlson and Saunders (2010) (See Chapter Three).

3. The high dependence of both companies on the support of expertise from external IT consultants (pursued because of the relatively higher cost of permanently employed IT staff) should be re-considered because of the risks that may come with such practices. Although it may save costs in the short term, the confidentiality of some of the companies' information in the information systems may be more at risk with external IT consultant staff. There are also issues of continuity of support personnel, and possible conflicts between short-term tactical fixes versus long term strategic considerations. One example here is the need for proper automated integration of the current information systems in both companies, as against the current exchange file system across different information systems, which can be said to be semi-automated at present.

4. Awareness creation and inclusiveness of all levels of staff in briefing and training on the adopted information system strategy and usage of deployed information systems in the oil companies' business environments is urgently needed. The employees of the oil companies, irrespective of their level, are vital company resources that can contribute to the successes of deployed information systems and implemented information system strategies in the oil companies. Periodic training of staff on the deployed information systems and information system

strategy will be very helpful for the improvement of information system strategies in the oil companies. Skilled employees are vital to the success of every information system strategy. The findings from this research reveal that staff of the IT departments in both companies had very little time for training, owing to the fact that all the staff in the department were always busy supporting information systems across the company. This can be attributed to the small number of staff in the IT departments and their mandate to support the deployed information systems across the entire company.

5. The oil companies need to recruit IT staff with appropriate skills and knowledge. Locally available staff are generally not appropriately trained as regards academic and professional education in IT. The IT knowledge that will be useful includes database management, basic computer usage, internet and online resources, information systems (IS) usage, IS development, IS support, IS maintenance, ERP knowledge, etc. Highly skilled staff is fundamental to effective improvements of the deployed information systems and proper usage of hardware and software systems in general.

6. The companies should study the local business environments in relation to how the community members with the appropriate IT professional expertise can be hunted for, recruited and trained to reduce the cost of overall IT and IS support. This will bring about the development of the Libyan local work force, which can be easily accessed and used by the oil companies to drive their deployed information systems and adopted information system strategies. The oil companies should be involved more in corporate social responsibilities that can facilitate improvements in levels of awareness of information technology, information systems and information system strategy in Libya. The oil companies should also relate with the government of the country on how to improve the level of information technology and information systems in the country.

7. Attendance at seminars and workshops that review mainstream developments in IS outside of Libya should be standard practice. For example, review of levels of e-business adoption in developed countries can help the Libyan oil companies in embracing e-business capabilities in all their business processes and sub-processes. The full benefits of the online–based / internet-based information systems are yet to be exploited by the oil companies in Libya. In addition, this will

go a long way to reducing the risks associated with change in information systems in the oil companies because the staff of the companies will be aware of the change in good enough time to accommodate the change when it comes; this is in line with risk management as discussed in Section 3.3.3.

8. In addition to the above highlighted points, more financial resources need to be invested in information systems and their deployment for oil companies in Libya. While the oil companies may need information systems expertise from more technologically advanced countries, they should strive to get the best available information systems expertise in the country and upgrade their knowledge. This will bring improvements in the management of deployed information systems in the Libyan based oil companies.

7.1.3 Research Question 3: How are the Libyan oil companies embracing e-business processes and procedures in Libya?

From the findings of this research (see chapter five), it is evident that the oil companies in Libya are yet to fully embrace e-business procedures. PCC (the foreign oil company in Libya) is ahead of WOC (the domestic oil company in Libya) in terms of e-business adoption. This can be associated with affiliation of PCC in Libya with Suncor Energy (its parent company) which has successfully embraced e-business technology in more developed parts of the world. The PCC has information on its core processes online: for example, some of the information online for the company includes information on oil production, forecasting, some financial reports, crude oil trading and distributions of oil. The company also provides intranet communication facility among its employees.

WOC has also made some information on its processes and sub-processes available online, and provides intranet e-mail exchange among its employees. The most advanced example of adoption of e-business procedures in WOC appears to be the "Upload and Download" facility on the website of the company. This facility is used mainly by two core processes - the financial management process and the crude oil trading process. Financial and accounting reports are prepared in pdf. format and uploaded on the company's website, and authorised users can download from this facility. The authorised users include top management staff, directors of the company and the Libyan government agency for monitoring the oil activities of Waha Oil Company. Suggested modifications, additions and subtractions on the reports can be uploaded by the authorised users using the same facility, and the reports are available for download by the delegated staff of the financial management

department in the company. In a related procedure, the crude oil trading process makes use of the "Upload and Download" facility to share important documents and reports between the staff of the Crude Oil Trading department and the customer-companies of WOC. Individual and exclusive profiles are created by the IT staff for the customer-companies of Waha Oil.

Although the two companies are using the basic functionalities of e-business, there are still many further business benefits of e-business procedures that can be embraced by oil companies in Libya – both domestic and foreign oil companies. B2B benefits of e-business procedures (as reviewed in chapter three) should be properly adopted by the companies. This is a very good fit for the two groups of oil companies because they sell to customer companies in the downstream sector of oil and gas. B2B facilities can also manage the transportation services provided by Waha Oil Company and Petro Canada Company to their customer-companies. Some very important components of B2B that may be beneficial to the business of the two Libyan based oil companies are the e-Procurement, e-SCM and e-CRM information systems.

The e-procurement, e-SCM and e-CRM, as reviewed in chapter three, can be supported with the current IT and IS infrastructure at WOC. This is because of the SAP R/3 ERP package that is adopted by the company. At present, WOC is yet to embrace these three e-business information systems. However, it was established during the findings that the ERP package acquired by the company does not only have provision, tools and techniques for interfacing with third party applications, it also provides for an Internet Transaction Server (ITS) that supports e-business functionalities. Hence, with minimal effort and cost along with proper configuration, WOC can begin to enjoy the benefits of e-business procedures. The main challenge for the company will be the availability, accessibility and support challenge of internet technology in Libya as a country.

The problem of availability, accessibility and support for internet technology in Libya as a country is also a challenge for PCC. However, the current information system strategy in the company, as conclusively illustrated in section 7.1.1, shows that the IT and IS infrastructure in the company may not be good enough for easy adoption of e-business procedures. The crude oil trading process at Petro Canada Company is currently managed with the use of a combination of an in-house information system and the Access/Excel information system. Based on the findings of this research, the IT department is not aware of web compatibility of both information systems. Hence, for PCC to fully embrace the above recommended three e-business procedures, there will be a need to properly plan the adoption

167

and see how it can synchronise with or replace some of the existing information system functions in the company. The company will possibly need to develop or acquire some plug-in middleware technology that will allow the current information systems to have a communication link with the e-business applications.

The existing procurement methodology at Petro Canada Company uses the IM system, an information system from an external vendor. The e-procurement system will allow qualified, registered and authorised supplier-companies to transact business with Petro Canada Company. The business transactions can be initiated and completed online. There should be integration of the e-procurement with the IM system, so that the transaction data and information from the e-procurement application can be visible for use in the IM system. As for WOC, the company's procurement is currently done with the in-house COBOL information system via the inventory management sub-process. The inflexibility problem of the COBOL oriented information system will pose a problem to the e-procurement implementation. Since the company is already on phased implementation of SAP R/3 package, and the COBOL oriented information system has no future in the company as earlier analysed with the McFarlan-Peppard model (see chapter six), it would be advisable to implement the e-procurement system after the phased implementation of SAP R/3 package has been completed for the inventory management sub-process. Hence, it should be easy to implement an interface communication between the SAP R/3 package, which is web-enabled, and the e-procurement application.

In a similar vein to e-procurement implementation, e-SCM and e-CRM information systems can be implemented for PCC, but there will be a process change with more transactions done online, as against the traditional process that uses the within-the-company in-house information system and IM system. There will be a need for proper integration of the in-house information systems and IM system with the e-SCM and e-CRM systems so that there can be easy and appropriate flow of data and information across the information systems of the company. On the other hand, WOC will find it less problematic to implement the e-CRM because of the web enabled SAP R/3 information system that the company is already using for its Crude Oil Trading process. However, the e-SCM will be better implemented after the phased implementation of SAP R/3 ERP package for the Transportation, Distribution and Logistic processes of the company. This is because it will be a waste of effort and investment if the e-business application is integrated with the in-house

information system that has no future use in the company, as shown in the analysis section using the McFarlan-Peppard model (see Chapter Six).

7.1.4 Research Question 4: How can information systems deployment in Libyan oil companies be assessed using existing models?

This research suggests that a hybrid framework could be used to assess the information systems deployment in other oil companies in Libya and the developing world. The hybrid framework will take the following six steps for assessment:

1. Apply top level process mapping to define business processes

    This step applies the concept of process mapping to the information system deployment. The following main process bubbles should be used by the oil companies: Crude Oil Exploration, Forecasting, Crude Oil Trading, Financial Management, Human Resource Management and Distribution/Inventory/Logistics Management. Thereafter, sub-processes under each process should be identified and made as sub-bubbles in the main process bubbles.

2. Develop Systems Portfolio Map

    A systems portfolio map of the information systems deployed in the company should be developed. This should highlight system functions, package versus bespoke, technologies used in the application and database technology. The communication technology (if any) linking the information systems should be shown. The communication medium or media among the information systems, for example, can be one or combination of the following: Application Programming Interface (API), Bespoke Link, Data and Information File Exchange, etc. When there is no communication medium or media among the information systems, the space between them in the system portfolio map should be left blank.

3. Allocate information systems to process/sub-process areas and undertake RAG analysis

    As a sequel to the first two steps in this hybrid framework, the information system or systems for each sub-process should be mapped to its sub-bubble and classified as Red, Amber, or Green (RAG). RAG analysis should be undertaken by

giving one of the RAG colours to the information system mapped to each sub-bubble. Based on the system profiling developed in Wynn et al., (2009):

    a. The G (Green colour) should be used to indicate an information system that is effective and warrants continued deployment and support.

    b. The A (Amber colour) should be used to indicate an information system that is functioning but is not effective and may need replacement.

    c. The R (Red colour) should be used to indicate an information system that is defective and needs to be replaced.

4. <u>Assess IS function against Nolan's model</u>

      Richard Nolan's Stage of Growth Model, as exemplified in Nolan (1979), should then be used as a pivot to assess the functions of the individual systems that comprise the entire information system in the company. The year in which the information system functions started should be noted and the stage of the information system's functions in the company at that year should be identified, as stated in Nolan's Model. In addition, the current year and the stage of the information system's functions should also be identified (see figure 6.1). The deployed information systems should be checked against the following stages of Nolan's model:

    2. The initiation stage.

    3. The contagion stage.

    4. The control stage.

    5. The integration stage.

    6. The data adminstration stage.

    7. The maturity stage.

The above mentioned stages of Nolan's model were reviewed and presented in chapter three.

5. <u>Apply Zuboff's model at process level</u>

      At process level, the three phases of Zuboff's model - Automate, Informate and Transformate – should be applied. There is scope to usefully identify the current Zuboff phase to which each process of the company belongs. The automate phase implies that human labour has been replaced by the information system in the process. The informate phase entails the availability of reliable information for the company's

empowerment by the information system. At the last phase – the transformate phase, the traditional business processes in the company are transformed into sophisticated business processes.

The use of the CPIT "Publish, Interact and Transform" model is not suggested in this framework. The basic analysis provided in Chapter six on e-business adoption at WOC and PCC using CPIT revealed that Zuboff's model could actually cover the analysis expected of the CPIT model. At a process level, Zuboff's model is able to provide a clear analysis of the deployed information system in three groups: "Automate, Informate and Transformate", and encompass e-business within the analysis.

6. Apply Mcfarlan-Peppard analysis

Application of Mcfarlan-Peppard analysis is the final step of the hybrid framework. Each of the information systems is considered as a whole and categorised as either high or low into a quadrant created with intersections of:

i. The strategic importance of the information system in its current environment.

ii. The strategic importance of the information system in its future/predicted environment.

This allows an assessment of the company's perception of a system's strategic significance which feeds into an analysis of IS strategy development and deployment.

This framework for assessing information system deployment has its foundations in six existing models that provide evaluation possibility for information system deployment. The six existing models are: Process mapping, system portfolio mapping, RAG Analysis, Nolan Model, Zuboff Model and Macfarlan-Peppard model. The application of the existing models will be carried out as explained in section 7.1.4 and exemplified in terms of application across chapters five and six of this thesis. Shown below in figure 7.1 is a diagrammatic representation of the comprehensive framework for assessing information systems deployment in Libyan oil companies:

Figure 7.2: Proposed Framework for assessing information system deployment in Libyan-based oil companies
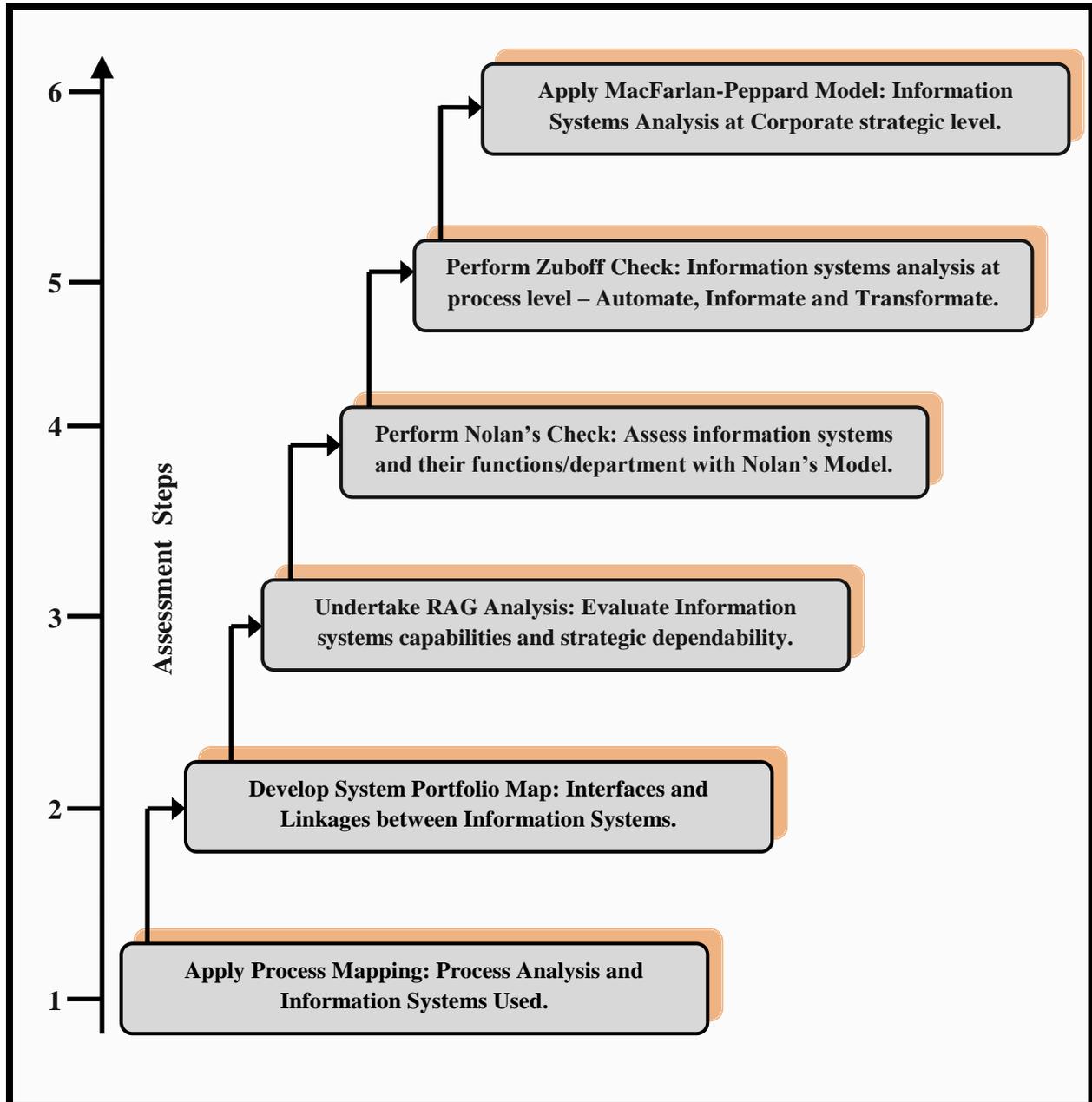
The six steps will provide appropriate evaluations as explained below:

1. The application of process maps to the information systems deployed in the company will give a broad diagrammatic overview of the main processes and sub-processes in the company, thereby providing an avenue for proper understanding of all business activities and functions in the company. Apart from the analysis of the information

systems that will be derived at this level, information systems for managing each processes (or sub-processes, as the case may be) will be identified.

2. The second step has to do with the development of system portfolio analyses within the information systems deployment along the interfaces and linkages, and among the information systems in the company. It provides a clearer view of how reliable information exchange can be between different information systems. It also makes it clear whether or not the linkages between different information systems of different functional departments are automated or not.

3. The third step creates an analytical check on effectiveness of the information systems for each process and sub-process. It recommends replacement in two ways when the information system is not effective. The recommendation will be that the information system may be replaced when the information system is not effective but it is still manageable. On the other hand, it may recommend that the information system must be replaced when the information system could lead to a catastrophic problem.

4. Nolan's check is used to analyse the progress in the competitive benefits expected of the information system that the company has achieved. The analysis of the information system against Nolan's model reveals the different stages of an information system and information system functions in the organisation.

5. Zuboff's check, which is built upon Zuboff's Automate-Informate-Tranformate model, clearly defines the process level business benefit that the information in the company has provided.

6. The final assessment phase in this new framework for assessing information systems in Libyan oil companies takes cognisance of the sequence of outputs at the five previous assessment stages. It therefore provides a quadrant grid for the information systems in the company. The quadrant grid, which is known as the Macfarlan-Peppard Model, gives as its output a critical analysis of the information systems in the company at corporate strategic level.

7.2   Contribution to Knowledge

This thesis contributes to the knowledge of information systems and information system strategies adopted in oil companies in Libya. The following are the contributions of this study to knowledge:

1. An analysis of the level of adoption of Information System Strategies in Oil companies in Libya is provided in this research work. It provides a qualitative research and investigative study of deployed information systems and adopted information system strategies of oil companies in Libya. The deployed information systems and adopted information system strategies can be said to be vital tools that support the business strategies of the oil companies in Libya and ensure that short-term and long-term decisions are made based on timely and reliable information.

2. Several studies have been carried out on a new assessment framework for deployment of information systems in oil companies in other countries. This study, to the best of the researcher's knowledge, is the first major study on developing a new framework for assessing deployment of information systems in Libyan based oil companies.

3. The study provides a comparative case study of deployed information systems and information system strategies between a domestic oil company and a foreign oil company in Libya. Hence, it gives an insight into information system deployment and information system strategy implementation that are obtainable in the two types of oil companies in Libya. The domestic oil company (Waha Oil Company) has its COBOL based in-house system that is not really flexible in terms of enhancement to accommodate the evolving business process activities of the company's adopted SAP R/3 ERP information system. Meanwhile, the foreign oil company (Petro Canada Company) decided to pursue an in-house developed system in the main and overhaul its functioning VB6.0/SQL in-house system, as it still meets their business needs. It is flexible for enhancements to cover the new business activities of the company and it provides a less expensive option for the company's information system needs.

4. The findings and analysis provide a framework for Libyan oil companies that are having problems with their information systems. It allows them to assess their deployed information systems. It also provides a knowledge guide for new oil companies in Libya for planning and adopting suitable information systems.

5. This study also shows that the level of adoption of e-business procedures among oil companies in Libya is comparatively low, as neither company is embracing many of the benefits that e-business procedures can offer their businesses.

Although the level of e-business procedures adoption in Libyan based oil companies is poor, there appears to be progressive interest within the companies in e-business, but only if its cost can be financially justified over time. However, at present it can still be said that not much attention is given to the adoption of e-business procedures by the oil companies. More of the benefits of e-business capabilities can still be embraced by the Libyan oil companies, which still have a long way to go to take advantage of e-business procedures in their businesses.

6. Information system strategies to be adopted by the oil companies should be properly assessed to suit the business processes of the respective oil companies. Proper integration of all information systems adopted, avoidance of human intervention in data and information flows across different information systems, as well as inclusiveness of all levels of staff in the enlightenment and change plan of the deployed information systems and adopted information system strategy are needed for the success of the deployed information systems and adopted information system strategy.

7.3   Limitations and Further Research

This study is limited to two oil companies in Libya. There is an opportunity to further explore the deployment of information systems and adopted information system strategy in Libyan based oil companies by considering other oil companies in the country. It was a painstaking task going through the bureaucratic process of extracting information for this study, and only the data successfully gathered have been worked upon. There was a limitation to the amount of information that each company was ready to provide due to the companies' privacy policies. In addition to the bureaucratic related problems that hampered the gathering of the data required , the war in Libya that started in February 2011 made the data gathering process even more difficult, as the company staff were under a strong obligation of maintaining the confidentiality of most of the individual companies' information, and it was difficult to have access to the top authority of the companies to get the required approvals. The new framework established in this research work for assessing the information system deployment in Libyan based oil companies has been based on the data gathered.

7.4 Summary

This chapter concludes this research thesis. Based on the previous chapters and using the analyses and discussions documented in Chapter Six on the research findings presented in Chapter Five, along with the initial research questions, this chapter provides the conclusion and answers on each of the research questions as presented in Section 7.1, 7.1.1, 7.1.2, 7.1.3 and 7.1.4. As presented in Chapter One, the purpose of this research is to develop a comprehensive framework with which deployed information systems in Libyan based oil companies can be assessed. The comprehensive framework was planned to be built on the existing standard models in the field of computing, for assessing information system deployment. The case studies chosen in this study are two Libyan oil companies as presented in Section 4.8.

With the motivation for conducting this research and the importance of this study arising from the need to introduce and develop a comprehensive framework that is more specific for the needs of Libyan based oil companies, as a tool to assess the deployed information systems in line with adopted information system strategy in the oil companies, the assessment models as reviewed in the Literature Review of Chapter Three, presented in Chapter Six during analysis and discussion of the research findings of the fifth Chapter have been used to finally build the comprehensive framework. This framework for assessing information system deployment has its foundations in six existing models that provide evaluation possibility for information system deployment. The six existing models are: Process mapping, system portfolio mapping, RAG Analysis, Nolan Model (with integration of Gottschalk's model), Zuboff Model and Macfarlan-Peppard model.

The application of the existing models was carried out in Section 7.1.4 and exemplified in terms of application across chapters five and six. Hence, the comprehensive framework has finally been developed for assessing information system deployment in Libyan oil companies. This Chapter Seven contains a summary of the contribution of this research work to knowledge. It discusses the limitations of the study and also suggests further research that may be undertaken by researchers in the same field.

REFERENCES

Addo-Tenkorang, R. and Helo, P. (2011). Enterprise Resource Planning (ERP): A Review Literature Report. *In Proceedings of the World Congress on Engineering and Computer Science 2011 Vol II*, WCECS 2011, October 19-21, 2011, San Francisco, USA.

Akeel, H., Wynn, M. and Zhang, S. (2013). Information systems deployment in Libyan oil companies: two case studies. *Electronic Journal of Information Systems in Developing Countries*, Volume 59, Issue 4, pp. 1-18.

Al-Aboud, F. N. (2011). Strategic Information Systems Planning: A Brief Review. *International Journal of Computer Science and Network Security*, 11(5), pp. 179 - 193.

Al-Ashban, A., A. and Burney, M., A. (2001). Customer Adoption of tele-banking technology: the case of Saudi Arabia. *International Journal of Bank Marketing*, 19(5), pp. 191 -201.

Al-Fawaz, K., Al-Salti, Z. and Eldabi, T. (2008). Critical success factors in ERP implementation: A review. *European and Mediterranean Conference on Information Systems*. 25th to 26th May 2008, Dubai, UAE.

Al-Mabrouk, K. and Soar, J. (2009). A delphi examination of emerging issues for successful information technology transfer in North Africa: A case of Libya. *African Journal of Business Management*, 3(3), 107 – 114.

Allen, J. P. (2005). Value Conflicts in Enterprise Systems. *Information Technology and People*, 18(1), 33 – 49.

Alter, S. (2006). *The work system method: connecting people, processes, and IT for business results.* Larkspur, CA: Work System Press.

Amoako-Gyampah, K. (2007). Perceived usefulness, user involvement and behavioural intention: an empirical study of ERP implementation. *Computers in Human Behavior*, 23(1), 1232 – 1248.

Ansoff, H., I. (1965). *Corporate Strategy: An analytic approach to business policy for growth and expansion.* New York: McGraw-Hill.

Ansoff, H., I. (1984). *Implanting Strategic Management.* USA: Prentice/Hall International Inc.

Arab.Net (2011). Libya: Oil Exploration Potentials. Available from: http://www.arab.net/libya/la_industry.htm [Date accessed: 14th February, 2011].

Atkinson A. (2009). Country Review: Libya. Available from: http://www.eulerhermesaktuell.de/de/dokumente/country-review-libya-20090605.pdf [Accessed: 14th October 2010].

Avgerou, C. (2008). Information systems in developing countries: a critical research review. Journal of Information Technology 23, pp. 133 – 146.

Bechor, T., Neumann, S., Zviran, M., and Glezer, C. (2009). A contingency model for estimating success of strategic information systems planning. *Information and Management,* 47(1), pp. 17 - 29.

Behnia, A., Abd Rashid, R., Chaudhry J., A. (2012). A Survey of Information Security Risk Analysis Methods. *Smart Computing Review*, 2(1), pp. 79 - 94.

Benbasat, I., Dexter, A. S. and Mantha, R. W. (1980). Impact of organizational maturity on information system skill needs. *MIS Quarterly*, 4(1), 21 - 34.

Benchmark Index (2011). Improving Business Performance. Available from: http://www.benchmarkindex.com/ [Accessed: 7th October, 2011].

Bendoly, E. and Jacobs, F., R. (2005). *Strategic ERP: Extension and Use*. Stanford, CA: Stanford University Press.

Bendoly, E. and Kaefer, F. (2004). Business technology complementarities: impacts of the presence and strategic timing of ERP on B2B e-commerce technology efficiencies. *Omega*. 32(5), pp. 395 - 405.

Beynon-Davies P. (2004). *E-Business*. Palgrave, Basingstoke: Macmillan.

Blanchard, C. M. (2006). Libya: Background and U.S. Relations. Available from: http://fpc.state.gov/documents/organization/68810.pdf [Accessed: 1st November 2010].

Blanchard, C. M. (2008). CRS Report for Congress. Available from: http://www.fas.org/sgp/crs/mideast/RL33142.pdf [Accessed: 11th September 2010].

Bocij, P., Chaffey, D., Greasley, A., and Hickie, S. (2006). *Business Information Systems: Technology, Development and Management for the E-Business (3rd ed).* London: Pitman.

Boddy, D., Boonstra, A. and Kennedy, G. (2005). *Managing Information Systems: An Organisational Perspective (2nd ed.).* Harlow: Pearson.

Bouma, G. D. and Ling, R. (2004). *The Research Process (5th ed.).* Oxford: Oxford University Press.

Boyd, D. T. (2002). Oklahoma Oil: Past, Present and Future. *Oklahoma Geology Notes*, 62(3), pp. 97 - 106.

Boynton, A. and Zmud, R. (1984). An assessment of critical success factors. *Sloan Management Review*, 25(4), pp. 17 - 27.

Brett, D. (2007). *Doing a Successful Research Project: Using Qualitative and Quantitative Research Methods.* Palgrave, New York: Macmillan.

British Broadcasting Corporation (2011). Libya: Barack Obama announces Gaddafi sanctions. Available from: http://www.bbc.co.uk/news/world-us-canada-12435110 [Accessed: 27th February 2011].

Brown, J. D. and Rodgers, T. S. (2002). *Doing Second Language Research*. Oxford: Oxford University Press.

Bryman, A. (1984). The debate about quantitative and qualitative research: A question of method or epistemology? *British Journal of Sociology*, 35(1), pp. 78 - 92.

Bryman, A. (2001). *Social Research Methods*. Oxford: Oxford University Press.

Bryman, A. and Bell, E. (2003). *Business Research Methods.* Oxford: Oxford University Press.

Burn, J. M. and Szeto, C. A. (2000). A comparison of the views of business and IT management on success factors for strategic alignment. *Information and Management*, 37(4), pp. 197 - 216.

Caglio, A. (2003). Enterprise resource Planning systems and accountants: towards hybridization? *European Accounting Review*, 12(1), 123 – 154.

Caldeira, M., M. and Ward, J., M. (2002). Understanding the successful adoption and use of IS/IT in SMEs: an explanation from Portuguese manufacturing industries. *Information Systems Journal*, 12(2), pp. 121 - 152.

Capaldo G., Iandoli L., Rippa P., Mercanti S. and Troccoli G. (2008). An AHP Approach to Evaluate Factors Affecting ERP Implementation Success. *Proceedings of the World Congress on Engineering and Computer Science 2008 (WCECS 2008).* 22nd to 24th October 2008, San Francisco, USA.

Carmona, S. (2003). Vogues in management accounting research. *Scandinavian Journal of Management*, 19(2), 213 – 231.

Cassidy, A. and Guggenberger, K. (2001). *A Practical Guide to Information Systems Process Improvement*. Boca Raton, FL: St. Lucie.

Central Intelligence Agency (2009). The World Factbook: Africa - Libya**.** Available from: https://www.cia.gov/library/publications/the-world-factbook/geos/ly.html   [Accessed: 7th July 2009].

Central Intelligence Agency (2011). The World Factbook: Country Comparison – Oil Proved Reserves**.** Available from: https://www.cia.gov/library/publications/the-world-factbook/rankorder/2178rank.html [Accessed: 17th July 2011].

Chan, J., O. (2005). Enterprise information systems strategy and planning. *Journal of American Academy of Business*, 6(2), pp. 148 - 153.

Chatterjee, D., Richardson, V., J. and Zmud, R. W. (2001). Examining the Shareholder Wealth Effects of New CIO Position Announcements. *MIS Quarterly, March 2001.* 25 (1), pp. 43 - 70.

Chong, W. K., Man, K. L., Chen, C. and Lai, H. Y. (2011). Design and Development of B2B e-Commerce Framework for Malaysian SMEs. In: *Proceedings of International Multi-Conference of Engineers and Computer Scientists, 2011 Vol. II, IMECS 2011,* March 16 – 18, 2011, Hong Kong

Clarke, J. and Turner, P. (2003). The Business Model Concept and Information Systems Strategy: developing a heuristic tool for exploring knowledge-based SMEs. *Paper 56, 7th Pacific Asia Conference on Information Systems (PACIS) 2003 Proceedings, Adelaide, Australia.*

Cooper, R. B. and Zmud, R. W. (1990). Information technology implementation research: a technological diffusion approach. *Management Science.* 36(1), pp. 123 - 139.

CPS Activity Based Costings Team (2011). A guide to process mapping and improvement. Available from http://www.cps.gov.uk/publications/finance/process_mapping.html#a02 [Accessed: 21st September 2011].

Currie, W., L. and Galliers, R., D. (1999). *Rethinking management information systems: An interdisciplinary perspective.* Oxford: Oxford University Press.

Daniel, E., Wilson, H. and Myers, A. (2002). Adoption of e-commerce by SMEs in the UK: Towards a stage model. *International Small Business Journal*, 20(3), 253 - 270.

Danowitz, A., Nassef, Y. and Goodman, S. (1995). Computing in North Africa. *Communications of the ACM*. 38(12), pp. 23 - 28.

Davenport, T. H. (1998). Putting the enterprise into the enterprise system. *Harvard Business Review July-August*, 76(4), pp. 121 – 131.

Davenport, T. H. (2000). The future of enterprise system-enabled organizations. *Information Systems Frontiers*. 2(2), pp. 163 – 180.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly,* 13(3), 318 – 346.

Dawson, C. (2002). *Practical Research Methods*. New Delhi: UBS Publishers.

DeLone, W. H. and McLean E. R. (1992). Information systems success: the quest for the dependent variable. *Information Systems Research* 3(1), 60 – 95.

Department of Trade and Industry (2001). *Business in the Information Age: International Benchmarking Study 2001*. London: Booz Allen Hamilton.

D'Cruz, H. and Jones, M. (2004). *Social Work Research: Ethical and Political Contexts*. London: Sage Publications Ltd.

Earl M. J. (1983). Emerging Trends in Managing New Information Technologies. In N. Piercy (Ed), The Management Implications of New Information Technology. Oxford Centre for Management Studies London.

Earl, M. J. (1989). *Management Strategies for IT*. Englewood Cliffs, New Jersey: Prentice Hall.

Economy watch (2010). Libyan Oil and Gas Industry. Available from: http://www.economywatch.com/world-industries/oil/libya-oil-gas.html [Accessed: 13 July 2010].

ElBaradei, M. (2006). Addressing Verification Challenges. *Proceedings of an International Safeguards Symposium Vienna*, 16th – 20th October.

Elky, S. (2007). An Introduction to Information System Risk Management. Bethesda, Maryland: Maryland, USA. Available from: http://www.sans.org/reading_room/whitepapers/auditing/introduction-information-system-risk-management_1204 [Accessed: 15th November 2010].

Encyclopaedia of the Nations (2009). Libya - Political Background. Available from http://www.nationsencyclopedia.com/World-Leaders-2003/Libya-POLITICAL BACKGROUND.html [Accessed: 14th October 2010].

Energy Information Administration (2011). Country Analysis Briefs: Libya. Available from: http://www.eia.gov/emeu/cabs/libya/pdf.pdf [Accessed: 13th March 2011].

Eom, S. B. (2005). An introduction to inter-organizational information systems, in: *Inter-Organizational Information Systems in the Internet Age.* Hershey: Idea Group Publishing, pp. 1 - 30.

E-Tech International (2011). Overview of the oil and gas exploration and production process [Website]. Available from: http://www.etechinternational.org/new_pdfs/lessImpact/AttAoverview.pdf [Accessed: 13th February 2011].

Fattouh, B. and Darbouche, H. (2010). North African oil and foreign investment in changing market conditions. *Energy Policy*, 38(1), pp. 1119 - 1129.

Feld, L. (2004). Libya. Available from http://www.eia.doe.gov/emeu/cabs/libya.html [Accessed: 26th February 2011].

Fishbein, M. and Ajzen, I. (1975). *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*. Reading: Addison-Wesley.

Fowler F. J. (1993). *Survey Research Methods (2nd ed.).* Newbury Park: Sage Publications.

Frynas, J. G. and Paulo, M. (2007). A New Scramble For African Oil? : Historical, Political, And Business Perspectives. *African Affairs*, 106 (423), pp. 229 – 251.

Galliers, R. D. and Sutherland, A. R. (1994). Information Systems Management and Strategy Formulation: Applying and Extending the 'Stages of Growth' concept. In R. D. Galliers and B.S.H. Baker (Eds) Strategic Information Systems. pp. 921 - 1117. Butterworth-Heinemann Ltd. Oxford.

Gelderman, M. (2002). Task difficulty, task variability and satisfaction with management support systems. *Information and Management*, 39(7), 593 – 604.

Ghnia, A., Iles, P., and Li-Hua, R. (2004). Examining HRM Aspects of Knowledge Transfer in the Libyan Oil Industry. *Paper presented at the British Academy of Management (BAM) Annual Conference*. 30 August to 1 September 2004, St. Andrews, UK.

Gloor, P. (2000). *Making the e-Business Transformation.* London: Springer-Verlag.

Gomm, R. (2004). *Social Research Methodology: A Critical Introduction.* Basingstoke, Palgrave: Macmillan.

Gomez, R., and Pather, S. (2010). ICT evaluation: are we asking the right questions? Available from:http://faculty.washington.edu/rgomez/conferences/2010%20Evaluating_ICT%20IDIA2010%20Cape%20Town.pdf [Accessed: 20 September, 2011].

Goodchild, A., Herring, C and Milosevic, Z. (2000) Business Contracts for B2B. In: *Proceedings of the CAiSE2000 Workshop of Infrastructures for Dynamic Business-to-Business Service Outsourcing (IDSO 2000) Stockholm*, 5 - 6 June 2000; pp. 63-74.

Gottschalk, P. (2002). Toward a model of growth stages for knowledge management technology in lawfirms. *Informing Science.* 5(2), pp. 79 − 93.

Grant, K., Ownby, D. and Peterson, S., R. (2006). Understanding Today's Crude Oil and Product Markets. *Lexecon for the American Petroleum Institute.* 26, pp. 1 - 29.

Grix, J. (2001). *Demystifying Postgraduate Research: From MA to PhD.* Birmingham: University of Birmingham Press.

Gutierrez, A., Orozco, J. and Serrano, A. (2009). Factors affecting IT and business alignment: A comparative study in SMEs and large organizations. *Journal of Enterprise Information Management,* 22(1), pp. 1 - 2.

Haag, S., Cummings, M. and Dawkins, J. (2004). *Management information systems for the information age.* Boston: Irwin/McGraw-Hill.

Ham A. (2002). *Lonely Planet: Libya.* Libya: Lonely Planet Publications.

Harry, M. (2001). *Business Information: A Systems Approach.* Essex: Pearson Education.

Hart, M., Berkowitz, S., Ryan, J. and Waspe, K. (2004). Key information systems management issues: a comparative study in South Africa. *South African Journal of Business Management*, 35(4), pp. 49 - 59.

Hawedi, H. S., Haron, H., Nordin, A. and Ahmed, A. A. (2011). Current Challenges and Future Perspective: The Influence of Organizational Intelligence on Libyan Oil and

Gas Industry. *International Journal of Computer Science and Network Security,* 11(1), pp. 145 – 147.

Heeks R. (2002). Information Systems and Developing Countries: Failure, Success, and Local Improvisations. The Information Society, 18, pp. 101 – 112.

Henderson, J., C. and Venkatraman, N. (1999). Strategic Alignment: Leveraging information technology for transforming organizations. *IBM systems journal*, 32(1), pp. 4 - 16.

Hevner, A. R., March, S. T., Park, J. and Ram, S. (2004). Design Science in Information Systems Research. *MIS Quarterly*, 28(1), 75 – 105.

Hicks Jr, J., O. (1992). *Management information systems: A user perspective*. St. Paul, MN: West Publishing Co.

Hochman, D. (2006). Rehabilitating a rogue: Libya's WMD reversal and lessons for US policy. *Parameters (Spring).* 36(1), pp. 63 - 78.

Hogan, P., T. and Raja, M. (1997). Information Engineering Implementation in Organizations: A Study of Factors Affecting Success. *Journal of Information Technology Management*. 8, pp. 33 - 44.

Holmes, B. and Gardner, J. (2006). *E-learning: Concepts and practice*. London: Sage Publications Ltd.

Hussain, R., Assavapokee, T. and Khumawala, B. (2006). Supply chain management in the petroleum industry: challenges and opportunities. *International Journal of Global Logistics and Supply Chain Management.* 1(2), pp. 90 - 97.

Infoplease (2010). Libya. Available from: http://www.infoplease.com/ipa/A0107722.html [Accessed: 17th September 2010].

Internet World Stats (2012). Internet Usage Statistics for Africa: African Internet Usage and Population Stats. Available from: http://www.internetworldstats.com/stats1.htm [Accessed: 5th February 2011].

Issa-Salwe, A., Ahmed, M., Aloufi, K. and Kabir, M. (2010). Strategic Information Systems Alignment: Alignment of IS/IT with Business Strategy. *Journal of Information Processing Systems*. 6(1), pp. 121 - 128.

Ives, B. and Learmonth, G., P. (1984). The information system as a competitive weapon. *Communications of the ACM*. 27(12), pp. 1193 - 1201.

Johnson, G. and Scholes, K. (1999). *Exploring Corporate Strategy: Text and Cases (5th ed.).* Hemel Hempstead: Prentice Hall.

Kalakota, R. and Whinston, A. B. (1997). *Electronic Commerce-a Manager's Guide.* Reading, MA: Addision-Wesley.

Kearns, G. and Lederer, A. (2001). Strategic IT alignment: A model for competitive advantage. *Information Systems Journal*, 3(1), pp. 1 - 12.

Kellen, V. (2003). Business Performance Measurement: At the Crossroads of Strategy, Decision-Making, Learning and Information Visualization. Available from: http://www.performance-measurement.net/assets/bluewolf/Article_0502.pdf [Accessed: 23rd September 2010].

Kenneth, C. and Laudon, J., P. (2006). *Management Information Systems: Managing the Digital Firm (6th ed.).* Englewood Cliffs, N.J.: Prentice-Hall.

Kent, P. (2004). North Somerset Council: Information System. Available from: http://www.nsomerset.gov.uk/NR/rdonlyres/A6D81572-611F-4721-A50280BE087D3D32/0/strategy_InformationSystems2004.pdf [Accessed: 23rd September 2010].

Ketchen, D., J. and Bergh, D., D. (Eds.). (2006). *Research Methodology in Strategy and Management (Volume 3).* Oxford, UK: Elsevier.

King, J. L. and Kraemer, K. L. (1987). Evolution and organizational information systems: An assessment of Nolan's stage model. In Somogyi, E. K. and Galliers, R. D. (Eds.), Towards strategic information systems, pp. 127 - 144. Abacus Press, Cambridge: USA.

King, W., R. (1995). Creating a strategic capabilities architecture. *Information System Management*. 12(1), pp. 67 - 69.

Kothari, C. R. (1985). *Research Methodology - Methods and Techniques.* New Delhi: Wiley Eastern Limited.

Kumar, R. (2005). *Research Methodology: A Step-by-Step Guide for Beginners (2nd ed.).* Singapore: Pearson Education.

Kutay, A. and Finger, S. (1990). A Methodology to Assess the Strategic Benefits of New Production Technologies. *Technical Report*. Carnegie-Mellon University Robotics Institute.

Lacher, W. (2012). Regional Repercussions of Revolution and Civil War in Libya. In Asserburg M. (ed.), Protest, Revolt and Regime Change in the Arab World: Actors, Challenges, Implications and Policy Options. *SWP Research Paper, German Institute for International and Security Affairs.*

Laudon, K. C. (1996). *Management Information Systems - Managing the Digital Firm.* London: Pearson Ltd.

Laudon, K. C. and Laudon, J. P. (2002). *Management information Systems.* New Jersey: Prentice Hall.

Laudon, K. C. and Laudon, J. P. (2005). *Essentials of management information systems (6th ed.).* New Jersey: Person Prentice Hall.

Laudon, K. C. and Laudon, J., P. (2009). *Management Information Systems: Managing the digital firm*. Upper Saddle River, New Jersey: Pearson Education, Inc.

Lederer, A., L. and Sethi, V. (1996). Key Prescriptions for Strategic Information Systems Planning. *Journal of Management Information Systems*. 13(1), pp.35 - 62.

Lee, A. (1999). *Rethinking Management Information Systems: An Interdisciplinary Perspective.* Oxford: Oxford University Press.

Magalhaes, R., M. (1999). *The organizational implementation of information systems: towards a new theory*. Ph.D Thesis, London School of Economics and Political Science (LSE).

Mahmud, M., B. and Russell, A. (1999). An analysis of Libya's revenue per barrel from crude oil upstream activities, 1961-93. *OPEC Review*. 23(3), pp. 213 - 249.

Mateus, M., Watson, I., Aouad, G. and Grilo, A. (1996). An Interpretive Methodology For Information Systems Strategy Development In Project Management. In: *Proceedings of Construction on the Information Highway*. Slovenia, pp. 369 - 382.

Mikail, B. (2012). The Multiple Challenges of Libya's Reconstruction. Available from: www.fride.org/download/PB_114_Libya_reconstruction.pdf   [Accessed: 23rd December 2012].

Mintzberg, H. (1994). *The Rise and Fall of Strategic Planning: Reconceiving Roles for Planning, Plans, Planners*. New York, NY: Free Press.

Mintzberg, H. (1994). The Rise and Fall of Strategic Planning. *Havard Business Review*, 72(1), pp. 107 – 114.

Nah, F. F. H., Lau, J. L. S. and Kuang, J. (2001). Critical factors for successful implementation of enterprise systems. *Business process management journal*, 7(3), pp. 285 - 296.

Net News Publisher (2008). Libya to enhance its oil and gas production capacity. Available from: http://www.netnewspublisher.com/libya-to-enhance-its-oil-and-gas-production-capacity [Accessed: 10th September, 2010].

New Nations (2006). Libya: Oil Companies Should Get Ready to Pay More. Available from: http://www.newnations.com/Archive/2006/October/ly.html [Accessed: 1st September 2010].

Nnadili, B. N. (2006). Supply and Demand Planning for Crude Oil Procurement in Refineries. MS Thesis, Massachusetts Institute of Technology, Cambridge, MA.

Nolan, R. and McFarlan, F., W. (2005). Information technology and the board of directors. *Harvard Business Review*, 83(10), pp. 96 - 106.

Nolan, R. (1979). Managing the Crisis In Data Processing. *Harvard Business Review*. 57 (2), pp. 115 – 126.

Nolan, R. (1973). Managing the Computer Resource: A Stage Hypothesis. *Communications of the ACM*, 16(7), pp. 399 - 405.

Norton, L. (2001). The expanding universe: Internet adoption in the Arab region. *World Markets Research Centre Report*. Waltham, MA.

O'Brien, J. A. (1993). *Management Information System, A Managerial End User Perspective. (2nd ed.).* Homewood, IL: Irwin.

Organisation of Petroleum Exporting Countries (2005). Annual Statistical Bulletin. Available from: http://www.opec.org/library/annual%20statistical%20bulletin/interactive/2005/filez/fwpage.htm [Accessed: 17th October 2010].

Pant, S. and Hsu, C. (1995). Strategic Information Systems Planning: A Review. *Information Resource Management Association International Conference*, May 21-24, Atlanta, Georgia.

Papp, R. (1999). Business-IT alignment: productivity paradox payoff. *Industrial Management and Data Systems*, 99(8), pp. 367 - 373.

Paradzayi, C. and Ruther, H. (2002). Evolution of Environmental Information Systems in Africa. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Services.* XXXIV(6), pp. 73 - 77.

Pearlson, K. and Saunders, C. (2010). *Managing and Using Information Systems: A Strategic Approach (4th ed.).* Hoboken, New Jersey: John Wiley and Sons, Inc.

Perez-Barahona, A. and Zou, B. (2004). A comparative study of Energy Saving Technical Progress in a Vintage Capital Model. *IRES Discussion* Paper, (poner n´umero).

Petro Canada (2011). Corporate Profile. Available from: http://lubricants.petro-canada.ca/en/about/213.aspx [Accessed: January 2011].

Petter, S., DeLone, W. and McLean, E. (2008). Measuring information systems success: models, dimensions, measures, and interrelationships. *European Journal of Information Systems,* 17(1), 236 – 263.

Porter, M. E. (1980). *Competitive strategy: Techniques for analyzing industries and competitors*. New York, NY: The Free Press.

Prananto, A., McKay, J. and Marshall, P. (2003). A study of the progression of e-business maturity in Australian SMEs: Some evidence of the applicability of the stages of growth for e-business model. *7th Pacific Asia Conference on Information Systems, 10-13 July 2003, Adelaide, South Australia*, 68 – 80.

Prananto, A., McKay, J., and Marshall, P. (2003). The spectrum of e-business maturity in Australian SMEs: A multiple case study approach to the applicability of the stages of growth for e-business model. Paper presented at the 11th European Conference on Information Systems (ECIS) 2003, Universita di Napoli Frederico Il, Napoli, Italy.

Rivlin, P. (2011). The Libyan Economy and Oil Prospects as War Ends. *Middle East Economy,* 1(6), pp. 1 – 6.

Rosenkranz, C. and Holten R. (2007). Measuring the Complexity of Information Systems and Organizations - Insights from an Action Case. *15th European Conference on Information Systems (ECIS 2007), St. Gallen, Switzerland,* pp. 2026 - 2037.

Sadagopalan, S. (2004). *Management Information Systems.* India: Prentice Hall.

Salomon, G. (1991). Transcending the qualitative-quantitative debate: The analytic and systemic approaches to educational research. *Educational Researcher*, 20(6), pp. 10 – 18.

Smythe, W. E. and Murray, M. J. (2000). Owning the Story: Ethical Considerations in Narrative Research. *Ethics and Behavior*, 10(1), pp. 311 - 336.

Snow, N. (2011). General Interest. *Oil and Gas Journal*, 109(2), pp. 16 - 19.

Sproull, N. (1988). *Handbook of Research Methods: A Guide for Practitioners and Students in the Social Sciences (2nd ed.).* Lanham, MD: Scarecrow Press.

St. John, R. B. (2012). Transatlantic Perspective on the Future of Libya. *Mediterranean Paper Series 2012,* The German Marshall Fund of the United States.

Stewart, G., Milford, M., Jewels, T., Hunter, T. and Hunter, B. (2000). Organizational Readiness for ERP Implementation. In: *Proceedings of 6th American Conference on Information Systems,* Long Beach, pp. 966 - 971.

Stoneburner, G., Goguen, A., and Feringa, A. (2002). Risk management guide for information technology systems. *NIST special publication.* 19(800-30), pp. 1 - 41.

Strassmann, P.A. (1998). What is Alignment? *Cutter IT Journal*, 11(8), pp. 4 - 9.

Subramanian, G., H. and Hoffer, C., S. (2005). An exploratory case study of enterprise resource planning implementation. *International Journal of Enterprise Information Systems (IJEIS).* 1(1), pp. 23 - 38.

Swanson, K. (2009). *Kaplan AP Human Geography*. New York, NY: Kaplan Publishing.

Taylor, M. and Murphy, A. (2004). SMEs and the take-up of e-business. *Urban Geography.* 25(4), pp. 315 - 331.

Teo, T., S., H. and Ang, J., S., K. (1999). Critical success factors in the alignment of IS plans with business plans. *International Journal of Information Management*, 1(19), pp. 173 - 186.

Terterov, M. and Wallace, J. (2002). *Doing Business With Libya*. Kogan Page.

Thoben, K., Kirisci, P., Kicin, S., Eschenbaecher, J. and Higgins, P. (2002). Holistic Approach for Structuring the Various facets of e-business in Enterprise Networks. *The 8ᵗʰ International Conference on Concurrent Enterprising. Rome, Italy, 17 – 19 June, 2002.*

Twati, J., M. (2008). The Influence of Societal Culture on the Adoption of Information Systems: The Case of Libya. *Communications of the IIMA,* 8(1), pp. 1 - 11.

Van Akkeren, J. and Cavaye, A.L.M. (1999). Factors affecting entry-level internet technology adoption by small business in Australia – evidence from three cases. *Journal of Systems and Information Technology.* 3(2), pp. 33 - 48.

Van der Veen, M. (2004). Explaining e-business adoption: Innovation and entrepreneurship in Dutch SMEs. Enschede, University of Twente.

Waha Oil Company. (2007). About us: Company Profile. Availble from: http://www.wahaoil.net/profile.htm [Accessed: 13th October, 2011].

Ward, J. M. and Peppard, J. (2002). *Strategic Planning for Information Systems (3rd ed.).* Chichester: Wiley.

Ward, J. and Griffiths, P. (1996). *Strategic Planning for Information Systems (2nd ed.).* Chichester: John Wiley and Sons.

Webster, J. and Watson, R.T. (2002). Analyzing The Past To Prepare The Future: Writing a Literature Review. *MIS Quarterly*. 26(2), pp. xiii - xxiii.

Windsor, L. and Kessler, K. (2007). Technical and political assessment of peaceful nuclear power program – assessment in North Africa and Middle East. *Pacific Northwest Center for Global Security; September 2007.*

Wynn, M., Turner, P., Abbas, H. and Shen, R. (2009). Employing Knowledge Transfer to support IS implementation in SMEs. *Journal of Industry and Higher Education*. 23(2), pp. 111 - 125.

Yavas, U., Luqmani, M. and Quraeshi, Z., A. (1992). Facilitating the adoption of information technology in a developing country. *Information and Management*. 23(2), pp. 75 - 82.

Yin, R. K. (2003). *Case Study Research: Design and Methods (3rd ed.).* London: Sage Publications.

Zain, M., Rose, R., C., Abdullah, I. and Masrom, M. (2005). The relationship between information technology acceptance and organizational agility in Malaysia. *Information and Management*. 42(6), pp. 829 - 839.

Zuboff, S. (1988). *In the age of the smart machine: The future of work and power*. New York: Basic Books.

APPENDICES

APPENDIX – 1: The First Questionnaire

APPENDIX – 2: The First Set of Interview Questions (Post-First Questionnaire)

APPENDIX – 3: The Second Questionnaire

APPENDIX – 4: The Second Set of Interview Questions (Post-Second Questionnaire)

APPENDIX – 1: The First Questionnaire

PCC-1

INFORMED CONSENT FORM

QUESTIONNAIRE ON INFORMATION SYSTEMS (IS) DEPLOYMENT AND IS STRATEGY IMPLEMENTATION: JANUARY, 2010.

Brief/Purpose:

The purpose of this questionnaire is to collect data on information systems (IS) deployment and IS strategies for Petro Canada Company by investigating the information systems deployed in the company and their associated technologies, the business processes and factors associated with information system strategies of the company. This questionnaire is part of the PhD thesis being carried out at the University of Gloucestershire, UK.

The information provided will be used for a research dissertation. This will help to analyse the companies' information systems and information system strategies as well as trying to establish an effective methodology for assessing the IS strategy/strategies that are to be adopted by oil companies in developing countries of the world with a a focus on Libya.

All the responses and subsequent reports of the results will be kept strictly confidential. Thank you for your support.

I can confirm that these are real and genuine responses provided by the named participant from Petro Canada Company.

Participant ID: PCC-1

Participant Signature:

Date:

Section A: The Company information and business	
Q1.	**How long has the company been in the business of crude oil?**
A1.	Since 1975.
Q2.	**What are the areas of crude oil business that the company deals with?**
A2.	Upstream sector.
Q3.	**Who are the main customers of the company?**
A3.	Halliburton and Harouge.
Q4.	**Is the company using only one information system or more than one? (If only one, go to Q6.)**
A4.	Yes
Q5.	**Kindly explain how the information systems communicate, if they do.**
A5.	Import and export functionalities for Excel files exist in the IM and the In-house information systems. Hence, the import and export of the files are used to move data and information across different information systems.

Q6.	**Please rate the following objectives according to the priority that is given to each by your company on the scale values: 1) Very important. 2) Important.3) Not important. (Please, specify "Not Applicable" if the objectives are not applicable to the company)**
	    1. **Continuous enhancement and maintenance of information systems in the company.**
	    2. **Increasing usage of e-business in the company's business activities.**

	3. **Periodic evaluation of adopted information system strategy.** 4. **Automation of all manual business processes in the company.** 5. **Usage of information to drive decision-making.**
A6.	1. Very Important. 2. Important. 3. Important. 4. Important. 5. Important.
Q7.	**What is the average annual turnover of the company in the last 5 years?**
A7.	Not sure.
Q8.	**In total how many full time employees are working for all departments and subsidaries of the Company?**
A8.	Almost 6,000.
Q9.	**What are the business goals of the company?**
A9.	The company is committed to continuous improvement in all its operations, reduction of expenditure and costs without compromise of laws and industry standards, and increase business income.
Q10.	**How many staff is there in the IT department of the company?**
A10.	7 regular staff and some staff from the PCC's IT consultants.
Q11.	**What are the main skills and qualifications that the IT staff must have?**
A11.	Minimum of High Diploma or Bachelor's degree and required professional

	certification.
Q12.	**Does the company have a committee that periodically evaluates the information systems/information system strategies of the company?**
A12.	Yes.
Q13.	**How many oil wells does the company have at present?**
A13.	From the record on the information system, there are 1,500.
Q14.	**How do you rate the overall IT literacy of the staff – Excellent, Very Good, Good, Fair, Poor?**
A14.	Good.
Q15.	**Is there any further information on your business?**
A15.	None.
Section B: The Company Processes and The Information Systems	
Q1.	**What are your company's main business processes?**
A1.	Forecasting, oil production, trading, financial matters handling, distribution/transportation/inventory/logistics and human resources.
Q2.	**Kindly state some activities of the business processes of the company.**
A2.	Oil production deals with mining of the crude oil, distribution/transportation/inventory/logistics handle purchases of the company, storage and movement of the crude oil. The trading relates to the customers selling

	the mined and stored crude oil and the financial activities are managed by the finance department. Forecasting provides a guide for sales activities and pricing of crude oil.
Q3.	**What are the main responsibilities of IT department in supporting the business processes of the company?**
A3.	Enhancement and upgrade of the in-house information system as well as the package from Microsoft Access and Excel, support and maintenance of both the information systems and the hardware components, liaising with the IT consultants of the company and so on.
Q4.	**What are the main benefits of the information systems of the company?**
A4.	Keeping an up-to-date record of all business activities of the company and provision of required information via reports for managers and other top management staff to make decisions.
Q5.	**What are the company's main business functional areas and the information system(s) for the each function?**
A5.	Forecasting uses Access/Excel, oil production is managed by the in-house system, trading and financial matters handling use both the in-house system and the Access/Excel system, distribution/transportation/inventory/logistics uses both the in-house system and the IM system and human resources uses the in-house system.
Q6.	**Is the company IT department suppoprted by IT consultants?**
A6.	Yes.
Q7.	**Are all business processes in the company automated?**
A7.	No.

Q8.	**What are the key business goals of the company and how are they supported by the IT resources?**
A8.	Continuous progress in the capacity, sales and profit of the company. IT resources manage all business operations that are required for improved capacity, sales and profit.
Q9.	**Which information system is used most in the company? If any, why?**
A9.	The VB in-house information system covers most of the business operations and it is the most widely used information system here in PCC. The system is well upgraded and effectively manages business operations with utmost userfriendliness.
Q10.	**Do you have any improvement suggestion on the existing information systems based on your experience in the company?**
A10.	There is need for a well established requirement specification across all the business functions of the company and a once-and-for-all main upgrade of the in-house information system.
Section D: Current Information Systems, Strategies and other Related Issues	
Q1.	**What are the current information system(s) in the company?**
A1.	The in-house system, the IM system and the Access/Excel system.
Q2.	**What are the technologies used for the current information system(s) in the company?**
A2.	VB6.0 with SQL is used for the in-house system, the IM system is Java and the Access/Excel system is on Microsoft platform.
Q3.	**On the information system(s), how do you rate the users' attitudes in using it (them)? – Excellent, Very Good, Good, Fair, Poor**

A3.	Averagely good for all the information systems.
Q4.	**On the information system(s), what is the top-management commitment to its (their) usage? – Excellent, Very Good, Good, Fair, Poor**
A4.	They are very committed to all things that have to do with the in-house system, I can rate this as excellent. The same can be said of the IM system. The Access/Excel system can be said to be fair.
Q5.	**Does the company have a website/application? If no, goto Q9.**
A5.	Yes, but we depend on Suncor Energy website/application – Suncor is our parent company.
Q6.	**What is the URL of the website/application?**
A6.	www.suncor.com
Q7.	**Is the website/application integrated with any other information systems in the company?**
A7.	No.
Q8.	**Kindly mention the benefits of the website/application to the business of the company.**
A8.	It provides information for existing and prospective customers, it serves as a medium for exchange of information between the company and some stakeholders, e.g. the investors. It also makes intranet communication available.
Q9.	**Kindly tell us about the beginning of the current information system strategy. When it started and the strategy itself.**

A9.	2005 is on record.
Q10.	**How do you improve on the information systems and the information system strategies?**
A10.	IS strategy team which comprises top-management staff and the IT manager are always working on the improvement of the strategy. We are responsible for the improvement of the information systems.
Q11.	**What are the main challenges in the current information systems strategy of the company?**
A11.	The requirements specification of different business functions are always added to, by the heads of functions when the upgrade and enhancement is already in progress.
Q12.	**Are there any plans to bring improvement or change to the current information system(s)? If yes, please provide details.**
A12.	The in-house information system is efficient and provides plug-in points; it is being extended to cover all the main business functions of the company.
Q13.	**Are there any plans to bring improvement or change to the current information systems strategy? If yes, please provide details.**
A13.	It will likely still remain the in-house/bespoke approach cum application package.

PCC-2

INFORMED CONSENT FORM

QUESTIONNAIRE ON INFORMATION SYSTEMS (IS) DEPLOYMENT AND IS STRATEGY IMPLEMENTATION: JANUARY, 2010.

Brief/Purpose:

The purpose of this questionnaire is to collect data on information systems (IS) deployment and IS strategies for Petro Canada Company by investigating the information systems deployed in the company and their associated technologies, the business processes and factors associated with information system strategies of the company. This questionnaire is part of the PhD thesis being carried out at the University of Gloucestershire, UK.

The information provided will be used for a research dissertation. This will help to analyse the companies' information systems and information system strategies as well as trying to establish an effective methodology for assessing the IS strategy/strategies that are to be adopted by oil companies in developing countries of the world with a a focus on Libya.

All the responses and subsequent reports of the results will be kept strictly confidential. Thank you for your support.

I can confirm that these are real and genuine responses provided by the named participant from Petro Canada Company.

Participant ID: PCC-2

Participant Signature:

Date:

Section A: The Company information and business	
Q1.	**How long has the company been in the business of crude oil?**
A1.	Our company began operations in 1975. That is 35 years ago.
Q2.	**What are the areas of crude oil business that the company deals with?**
A2.	All upstream areas of business in the Libyan oil and gas industry.
Q3.	**Who are the main customers of the company?**
A3.	We have Halliburton and Harouge as our customers with large purchase performances. We have some other customers with relatively small purchase powers.
Q4.	**Is the company using only one information system or more than one? (If only one, go to Q6.)**
A4.	Yes, we have two main information systems, our in-house system and IM system that was acquired from a vendor. We also use other basic software packages like adobe reader, Microsoft words, etc to support our works.
Q5.	**Kindly explain how the information systems communicate, if they do.**
A5.	Excel files is the medium of communication among them.
Q6.	**Please rate the following objectives according to the priority that is given to each by your company on the scale values: 1) Very important. 2) Important.3) Not important. (Please, specify "Not Applicable" if the objectives are not applicable to the company)** 　　**3. Continuous enhancement and maintenance of information systems in the company.**

	4.	Increasing usage of e-business in the company's business activities.
	5.	Periodic evaluation of adopted information system strategy.
	6.	Automation of all manual business processes in the company.
	7.	Usage of information to drive decision-making.
A6.	1.	Very Important.
	2.	Not Important.
	3.	Important.
	4.	Important.
	5.	Very Important.
Q7.	**What is the average annual turnover of the company in the last 5 years?**	
A7.	Three hundred and sixty-five million LYD (where 1 LYD = 0.80 USD, LYD = Libyan Dinar and USD = United States Dollar).	
Q8.	**In total how many full time employees are working for all departments and subsidaries of the Company?**	
A8.	Six thousand.	
Q9.	**What are the business goals of the company?**	
A9.	- Annual increase of turn-over values. - Customer Satisfaction. - Improvements in the Company's Operations. - Compliance with the industry standards. - Remaining a top foreign oil company in Libya.	
Q10.	**How many staff is there in the IT department of the company?**	

A10.	We have seven regular employees and an average of 10 staff from our IT consultant companies in the IT department.
Q11.	**What are the main skills and qualifications that the IT staff must have?**
A11.	The minimum qualification is set by the Human Resources department but I think the minimum qualification for our regular IT staff is High Diploma.
Q12.	**Does the company have a committee that periodically evaluates the information systems/information system strategies of the company?**
A12.	The company has.
Q13.	**How many oil wells does the company have at present**
A13.	One thousand and five hundred wells.
Q14.	**How do you rate the overall IT literacy of the staff – Excellent, Very Good, Good, Fair, Poor?**
A14.	They are on the average. So, averagely good.
Q15.	**Is there any further information on your business?**
A15.	The company has been making significant progress in the upstream oil company in Libya.
Section B: The Company Processes and The Information Systems	
Q1.	**What are your company's main business processes?**

A1.	Our business is structured into six broad processes. They are: Financial Management, Human Resources Management, Oil Exploration Management, Forecasting Management, Oil Trading Management and Distribution, Inventory and Logistics Management.
Q2.	**Kindly state some activities of the business processes of the company?**
A2.	In summary, • Financial Management is in charge of all financial related issues in the company. • Human Resources Management manages employees' records and their payments. • Oil Exploration Management deals with sourcing and mining the crude oil. • Forecasting Management gives us guides on envisaged price, sales, demands, etc on the crude oil. • Oil Trading Management takes care of sales relationships with our customers. • Distribution, Inventory and Logistics Management is used for the company's purchases, storage and management of inventory, transportation of crude oil.
Q3.	**What are the main responsibilities of IT department in supporting the business processes of the company?**
A3.	They work hand-in-hand with our company's IT consultants to ensure the smooth running of the company's business with the use of information systems, IT networks and infrastructure as well as other IT devices.
Q4.	**What are the main benefits of the information systems of the company?**
A4.	It is a fundamental tool for steering the business strategy of the company to success with provision of accurate and timely information for short-term and long-term decision making.

Q5.	**What are the company's main business functional areas and the information system(s) for the each function?**
A5.	Financial Management – in-house system supported by Microsoft packages, Human Resources Management – in-house system, Oil Exploration Management - in-house system, Forecasting Management – Microsoft packages, Oil Trading Management - in-house system supported by Microsoft packages, and Distribution, Inventory and Logistics Management in-house system and IM system.
Q6.	**Is the company IT department suppoprted by IT consultants?**
A6.	Yes.
Q7.	**Are all business processes in the company automated?**
A7.	Not yet.
Q8.	**What are the key business goals of the company and how are they supported by the IT resources?**
A8.	IT is a vital tool for management of the company's data and it provides appropriate information whenever needed. So, it is a tool for all managers, supervisors and other top echelons of the management of this company.
Q9.	**Which information system is used most in the company, if any, why?**
A9.	In some years to come, Petro Canada business activities should be managed only with the in-house information system. Its usage is more now and it will still be enhanced to cover other business areas.
Q10.	**Do you have any improvement suggestions on the existing information systems based on your experience in the company?**

A10.	There appears to be some weaknesses in authorisation and protection of users' profiles in the in-house system unlike that obtained in the IM system. Hence, that aspect of the in-house information system should be improved.
Section D: Current Information Systems, Strategies and other Related Issues	
Q1.	**What are the current information system(s) in the company?**
A1.	The in-house system and the IM system along with other packages like Adobe reader and Microsoft Office packages.
Q2.	**What are the technologies used for the current information system(s) in the company?**
A2.	Visual Basic is used for the in-house system, the IM system is from a vendor.
Q3.	**On the information system(s), how do you rate the users' attitudes in using it (them)? – Excellent, Very Good, Good, Fair, Poor**
A3.	They have been good.
Q4.	**On the information system(s), what is the top-management commitment to its (their) usage? – Excellent, Very Good, Good, Fair, Poor**
A4.	On the in-house system and the IM system: Excellent.
Q5.	**Does the company havea website/application? If no, goto Q9.**
A5.	The merger of Petro Canada and Suncor make us inherit the website of Suncor Energy.
Q6.	**What is the URL of the website/application?**

A6.	www.suncor.com
Q7.	**Is the website/application integrated with any other information systems in the company?**
A7.	Not yet.
Q8.	**Kindly mention the benefits of the website/application to the business of the company.**
A8.	It provides information to communicate with the company and it also provides a medium for making official document available for authorised stakeholders.
Q9.	**Kindly tell us about the beginning of the current information system strategy. When it started and the strategy itself.**
A9.	In 2005, we had some changes in management structure and the new structure decided to overhaul the IT support for the business success of this company. That was when the information system strategy was formally established and is being driven till date.
Q10.	**How do you improve on the information systems and the information systems strategies?**
A10.	There is a team that is dedicated to reviewing the information systems and information systems' strategies. The team make recommendations for improvement by logging problems, evaluating staff complaints and requests and meeting with seasoned IT consultants.
Q11.	**What are the main challenges in the current information systems strategy of the company?**

A11.	Non-automated communication between the information systems.
Q12.	**Are there any plans to bring improvement or change to the current information system(s)? If yes, please provide details.**
A12.	We are making progress; the main thing is for us to continue with the enhancement of the information systems.
Q13.	**Are there any plans to bring improvement or change to the current information systems strategy? If yes, please provide details.**
A13.	There is no plan to change the information system strategy; all we are doing year in and out is to keep improving on the capability of our information systems.

WOC-1

<div align="center">

INFORMED CONSENT FORM

QUESTIONNAIRE ON INFORMATION SYSTEMS (IS) DEPLOYMENT AND IS STRATEGY IMPLEMENTATION: JANUARY, 2010.

</div>

Brief/Purpose:

The purpose of this questionnaire is to collect data on information systems (IS) deployment and IS strategies for Waha Oil Company by investigating the information systems deployed in the company and their associated technologies, the business processes and factors associated with information system strategies of the company. This questionnaire is part of the PhD thesis being carried out at the University of Gloucestershire, UK.

The information provided will be used for a research dissertation. This will help to analyse the companies' information systems and information system strategies as well as trying to establish an effective methodology for assessing the IS strategy/strategies that are to be adopted by oil companies in developing countries of the world with a focus on Libya.

All the responses and subsequent reports of the results will be kept strictly confidential. Thank you for your support.

I can confirm that these are real and genuine responses provided by the named participant from Waha Oil Company.

Participant ID: WOC-1

Participant Signature:

Date:

Section A: The Company information and business	
Q1.	**How long has the company been in the business of crude oil?**
A1.	Waha Oil has been in business since 1955.
Q2.	**What are the areas of crude oil business that the company deals with?**
A2.	Only the upstream business.
Q3.	**Who are the main customers of the company?**
A3.	Schlumberger, Halliburton, Landmark, HP, Ntrchal, Total, Zueitina and JNP.
Q4.	**Is the company using only one information system or more than one? (If only one, go to Q6.)**
A4.	More than one.
Q5.	**Kindly explain how the information systems communicate, if they do.**
A5.	Information files are extracted from a source information system and fed into the target information system.
Q6.	**Please rate the following objectives according to the priority that is given to each by your company on the scale values: 1) Very important. 2) Important.3) Not important. (Please, specify "Not Applicable" if the objectives are not applicable to the company)** 1 **Continuous enhancement and maintenance of information systems in the company.** 2 **Increasing usage of e-business in the company's business activities.** 3 **Periodic evaluation of adopted information system strategy.**

	4 **Automation of all manual business processes in the company.** 5 **Usage of information to drive decision-making.**
A6.	1 **Very Important.** 2 **Not Important.** 3 **Important.** 4 **Important.** 5 **Important.**
Q7.	**What is the average annual turnover of the company in the last 5 years?**
A7.	The last financial report put the turnover around 692million Libyan Dinars ($).
Q8.	**In total how many full time employees are working for all departments and subsidaries of the Company?**
A8.	There are over 3,100 full time employees.
Q9.	**What are the business goals of the company?**
A9.	The goals of Waha Oil Company include a strong focus on the upstream business in the oil and gas industry, a focus to improve business strategies to do better than just remaining relevant in the business.
Q10.	**How many staff is there in the IT department of the company?**
A10.	5 main staff and one expatriate. We are usually supported with IT consultants.
Q11.	**What are the main skills and qualifications that the IT staff must have?**
A11.	Minimum of a bachelor's degree or its equivalent and appropriate world-recognised professional certification and skills like SAP R/3 ERP systems usage, database

	management, internet usage, networking, server administration, Microsoft office usage, etc.
Q12.	**Does the company have a committee that periodically evaluates the information systems/information system strategies of the company?**
A12.	Yes.
Q13.	**How many oil wells does the company have at present**
A13.	Roughly 1,000 plus.
Q14.	**How do you rate the overall IT literacy of the staff – Excellent, Very Good, Good, Fair, Poor?**
A14.	Good
Q15.	**Is there any further information on your business?**
A15.	The upstream oil sector has a very complex business structure that appropriate usage of information systems is vital to the success of the business.
Section B: The Company Processes and The Information Systems	
Q1.	**What are your company's main business processes?**
A1.	The main business processes include exploration and drilling of crude oil through the use of geophysical and geological formations and resources, conveying the crude oil to our storage facilities, selling the crude oil, financial management, human resources management and other upstream activities.
Q2.	**Kindly state some activities of the business processes of the company?**

A2.	The exploration includes setting up plans and sourcing for oil, when found, oil wells are dug and pumped to the surface. During the conveyance of the crude oil, records are taken on the chemical nature of the oil, volume, etc. The sales are done by taking orders of registered customers and transporting the oil to them based on confirmed orders. We also have contracts and tender issues for supply.
Q3.	**What are the main responsibilities of IT department in supporting the business processes of the company?**
A3.	The department looks after all the computer resources of the company, supports the hardware/network infrastructure and the information systems throughout the company, upgrades and maintains the IT resources as required.
Q4.	**What are the main benefits of the information systems of the company?**
A4.	To us, the information systems are crucial tools that are used to drive the business strategies of the company. They improve operational efficiencies and business processes, reduce wastage of transaction times, provide the essential reports needed by different sections of the company to make decisions, among other things.
Q5.	**What are the company's main business functional areas and the information system(s) for each function?**
A5.	Finance – SAP Human Resources – SAP Sales – SAP Logistics, Inventory and Distribution – Spreadsheet and the COBOL system. Exploration – The COBOL system with Spreadsheet. Forecasting – Spreadsheet and Microsoft Access
Q6.	**Is the company IT department suppoprted by IT consultants?**

A6.	Yes, especially with our SAP ERP system.
Q7.	**Are all business processes in the company automated?**
A7.	Most, but not all at present, but we are working towards that.
Q8.	**What are the key business goals of the company and how are they supported by the IT resources?**
A8.	The key business goals in Waha Oil are to increase its customer base and level of sales, reduce overhead costs, improve operational efficiencies in all business functions of the company. The IT helps in monitoring the purchase performances of the customers, thereby guiding the company on how to maintain good relationships with the customers. It also makes the business activities and operation faster and easy, bringing more satisfaction to the customer and the company staff. The IT resources support and provide assistance to all the company's operations.
Q9.	**Which information system is used most in the company, if any. Why?**
A9.	The SAP ERP system. Basically because it is easy to understand and use. It also covers all business activities of the business areas where it is used. E.g.: In finance. And additionally, it is in line with the current adopted information system strategy in the company.
Q10.	**Do you have any improvement suggestion on the existing information systems based on your experience in the company?**
A10.	The SAP appears to be good but further simplicity of its complex usage and support will help so many users. The interfaces of the COBOL system need to be improved, the system also needs to be extended to cover all business activities in the functional areas where they are used. The Excel and Access are fine but appear to require a lot of manual support; they should be improved to totally eliminate the required manual support.

Section D: Current Information Systems, Strategies and other Related Issues

Q1.	**What are the current information system(s) in the company?**
A1.	We have three; they are SAP ERP, In-house system and a blend of Microsoft Excel and Access.
Q2.	**What are the technologies used for the current information system(s) in the company?**
A2.	The ERP system is SAP R/3, the in-house system is developed by COBOL and The Excel/Access system is obviously with Microsoft technology.
Q3.	**On the information system(s), how do you rate the users' attitudes in using it (them)? – Excellent, Very Good, Good, Fair, Poor**
A3.	SAP – Very Good In-house – Good Access/Excel – Good
Q4.	**On the information system(s), what is the top management commitment to its (their) usage? – Excellent, Very Good, Good, Fair, Poor**
A4.	SAP – Excellent In-house – Fair Access/Excel – Fair
Q5.	**Does the company have a website/application? If no, goto Q9.**
A5.	Yes

Q6.	What is the URL of the website/application?
A6.	http://www.wahaoil.net/ar/index.htm - Arabic. http://www.wahaoil.net/index.htm - English.
Q7.	Is the website/application integrated with any other information systems in the company?
A7.	No, for now.
Q8.	Kindly mention the benefits of the website/application to the business of the company.
A8.	Showcases the company business, provides e-mail communication, serves as a medium for uploading and downloading official documents by authorised users, supports communication with the suppliers, among others.
Q9.	Kindly tell us about the beginning of the current information system strategy. When it started and the strategy itself.
A9.	The information system strategy that we embraced at present was adopted in 2007. The strategies work towards having a centralised business information system for the company via an ERP system, eliminating all manual processes, reduce dependence on the in-house COBOL information system because of its non-flexibility on upgrades and maintenance and making the process more efficient. Hence the strategy, at present can be seen as a blend of both In-house and Enterprise Resource Planning (ERP) approach.
Q10.	How do you improve on the information systems and the information systems strategies?
A10.	We have a register for users' complaints and suggestions, and we have a committee on information systems strategy appraisal. The register is reviewed quarterly and the

	committee gives recommendations twice in a year – Both medium and our observations are the improvement guides that we use for our information systems and strategies.
Q11.	**What are the main challenges in the current information systems strategy of the company**
A11.	Continual effort in aligning the information system strategy with the dynamic business strategy of the company and the exchange of data/information across the information systems in the company.
Q12.	**Are there any plans to bring improvement or change in the current Information system(s)? If yes, please provide details.**
A12.	In-house system – Proper maintenance until it is finally replaced as planned by the management with SAP ERP. SAP – Continuous maintenance, improvement, support and wider coverage of the company's businesses. Excel/Access – Proper maintenance until there is necessity for its replacement.
Q13.	**Are there any plans to bring improvement or change to the current information systems strategy? If yes, please provide details.**
A13.	Yes, the information system strategy is expected to finally achieve complete coverage of the business management with the SAP ERP and provides timely and reliable access to required information.

WOC-2

INFORMED CONSENT FORM

QUESTIONNAIRE ON INFORMATION SYSTEMS (IS) DEPLOYMENT AND IS STRATEGY IMPLEMENTATION: JANUARY, 2010.

Brief/Purpose:

The purpose of this questionnaire is to collect data on information systems (IS) deployment and IS strategies for Waha Oil Company by investigating the information systems deployed in the company and their associated technologies, the business processes and factors associated with information system strategies of the company. This questionnaire is part of the PhD thesis being carried out at the University of Gloucestershire, UK.

The information provided will be used for a research dissertation. This will help to analyse the companies' information systems and information system strategies as well as trying to establish an effective methodology for assessing the IS strategy/strategies that are to be adopted by oil companies in developing countries of the world with a focus on Libya.

All the responses and subsequent reports of the results will be kept strictly confidential. Thank you for your support.

I can confirm that these are real and genuine responses provided by the named participant from Waha Oil Company.

Participant ID: WOC-2

Participant Signature:

Date:

Section A: The Company information and business	
Q1.	**How long has the company been in the business of crude oil?**
A1.	55 years.
Q2.	**What are the areas of crude oil business that the company deals with?**
A2.	From the search for right areas to dig, digging of wells, pumping and transfer to our storage area and subsequent sales to our downstream customers.
Q3.	**Who are the main customers of the company?**
A3.	We have 7 main customers: Schlumberger, Zueitina, JNP, Total, Halliburton, Landmark and Ntrchal. We also have some other customers too.
Q4.	**Is the company using only one information system or more than one? (If only one, go to Q6.)**
A4.	We are using more than one.
Q5.	**Kindly explain how the information systems communicate, if they do.**
A5.	The IT people should tell you better, but I know we get files from our information systems as output and we can use the files as input to other information systems.
Q6.	**Please rate the following objectives according to the priority that is given to each by your company on the scale values: 1) Very important. 2) Important.3) Not important. (Please, specify "Not Applicable" if the objectives are not**

	applicable to the company)
	1. **Continuous enhancement and maintenance of information systems in the company.** 2. **Increasing usage of e-business in the company's business activities.** 3. **Periodic evaluation of adopted information system strategy.** 4. **Automation of all manual business processes in the company.** 5. **Usage of information to drive decision-making.**
A6.	1 Very Important. 2 Not Important. 3 Very Important. 4 Very Important. 5 Very Important.
Q7.	**What is the average annual turnover of the company in the last 5 years?**
A7.	Approximately 689,850,000 Libyan Dinars ($).
Q8.	**In total how many full time employees are working for all departments and subsidaries of the Company?**
A8.	At present, we have 3,200 full time employees.
Q9.	**What are the business goals of the company?**
A9.	To remain the leading upstream oil company in Libya with continuous improvement on business processes, customer management, staff management and return on investments.
Q10.	**How many staff is there in the IT department of the company?**

A10.	6 full time staff with many contract staff/consultants.
Q11.	**What are the main skills and qualifications that the IT staff must have?**
A11.	Minimum of a achelor's degree or its equivalent and professional certification with required skills by the IT department.
Q12.	**Does the company have a committee that periodically evaluates the information systems/information system strategies of the company?**
A12.	We do.
Q13.	**How many oil wells does the company have at present**
A13.	Precisely 1,100 at present.
Q14.	**How do you rate the overall IT literacy of the staff – Excellent, Very Good, Good, Fair, Poor?**
A14.	Between very good and good.
Q15.	**Is there any further information on your business?**
A15.	There is much information; it depends on what you want to know. But in summary, we are a business organisation of upstream sector of crude oil in the oil and gas industry of Libya.
Section B: The Company Processes and The Information Systems	
Q1.	**What are your company's main business processes?**
A1.	Exploration, Logistics and Distribution, Sales and Forecasting, Finance, Human

	Resources, Marketing and Customer Managemen,t among other general business activities.
Q2.	**Kindly state some activities of the business processes of the company?**
A2.	As highlighted above, Exploration – getting the crude oil, Logistics and Distribution – Movements of oil, Sales and forecasting – selling the oil, Finance – managing financial activities of the company, human resources – staff management, marketing and customer management – managing existing customers and seeking new ones, among other activities.
Q3.	**What are the main responsibilities of IT department in supporting the business processes of the company?**
A3.	The IT people maintain the computers, servers and network of the company. They also provide support for the information systems. They decide when to call on consultants and which consultant to call upon. They also decide on the IT assets to acquire. And some other roles as permitted by the organisation.
Q4.	**What are the main benefits of the information systems of the company?**
A4.	Easy and reliable management of complex official information and data to provide timely reports to drive the business strategy of the organisation.
Q5.	**What are the company's main business functional areas and the information system(s) for the each function?**
A5.	At Finance, we use an ERP along with the sales and human resources people. We collect files from Exploration and logistic/Distribution people from their COBOL system.
Q6.	**Is the company IT department suppoprted by IT consultants?**

A6.	Whenever needed.
Q7.	**Are all business processes in the company automated?**
A7.	Our plan is to achieve complete automation of all functions in the company but we are not there yet.
Q8.	**What are the key business goals of the company and how are they supported by the IT resources?**
A8.	At Waha, we strive at all times to increase our return on investments while keeping the standards (quality, health and safety, etc) of the company. IT is a vital tool that analyses the company's data and information to produce reports that we use in making decisions that are crucial to achieving our business goals.
Q9.	**Which information system is used most in the company? If any, why?**
A9.	The ERP system because we are working towards centralisation of all our business activities to make complete information accessible with a click or two on our computers.
Q10.	**Do you have any improvement suggestion on the existing information systems based on your experience in the company?**
A10.	I think the information systems are okay, the staff only need to be more committed to their usage.
Section D: Current Information Systems, Strategies and other Related Issues	
Q1.	**What are the current information system(s) in the company?**
A1.	ERP, COBOL and Microsoft Office packages.

Q2.	**What are the technologies used for the current information system(s) in the company?**
A2.	I think the ERP is SAP, COBOL is COBOL and Microsoft Office packages . (I think the IT people will be the best people to tell you this.)
Q3.	**On the information system(s), how do you rate the users' attitudes in using it (them)? – Excellent, Very Good, Good, Fair, Poor**
A3.	Their attitudes to the ERP are really encouraging, that is very good. To COBOL, fair and to microsoft office packages, good.
Q4.	**On the information system(s), what is the top management commitment to its (their) usage? – Excellent, Very Good, Good, Fair, Poor**
A4.	SAP – Very Good In-house – Good Access/Excel – Good
Q5.	**Does the company have a website/application? If no, goto Q9.**
A5.	Yes
Q6.	**What is the URL of the website/application?**
A6.	Ask the IT department.
Q7.	**Is the website/application integrated with any other information systems in the company?**
A7.	I do not think so.
Q8.	**Kindly mention the benefits of the website/application to the business of the company.**
A8.	It presents us to the world.
Q9.	**Kindly tell us about the beginning of the current information system strategy.**

	When it started and the strategy itself.
A9.	The management in consultation with the IT Manager and our consultants adopted the current information system strategy that will aid our business strategy in February, 2007.
Q10.	**How do you improve on the information systems and the information systems strategies?**
A10.	We have a committee on information systems strategy appraisal.
Q11.	**What are the main challenges in the current information systems strategy of the company?**
A11.	The staff attitude to the usage of the information systems in the company.
Q12.	**Are there any plans to bring improvement or change in the current Information system(s)? If yes, please provide details.**
A12.	We are planning to extend the ERP to all our business operations.
Q13.	**Are there any plans to bring improvement or change to the current information systems strategy? If yes, please provide details.**
A13.	We are working towards the ERP in all our business operations.

APPENDIX – 2:

The First Set of Interview Questions (Post-First Questionnaire)

PCC

INFORMED CONSENT FORM

INTERVIEW ON INFORMATION SYSTEMS (IS) DEPLOYMENT AND IS STRATEGY IMPLEMENTATION

Brief/Purpose:

The purpose of this interview is to collect data on information systems (IS) deployment and IS strategies for Petro Canada Company by investigating the information systems deployed in the company and their associated technologies, the business processes and factors associated with information system strategies of the company. This interview is part of the PhD thesis being carried out at the University of Gloucestershire, UK.

The information provided will be used for a research dissertation. This will help to analyse the companies' information systems and information system strategies as well as trying to establish an effective methodology for assessing the IS strategy/strategies that are to be adopted by oil companies in developing countries of the world with a focus on Libya.

All the responses and subsequent reports of the results will be kept strictly confidential. We will also be willing to contact you on phone for further interview as the research work progresses. Thank you for your support.

Company: Petro Canada Company.

Participant ID: PCC-1

Participant Signature:

Date:

Q1. What is your position and years of experience in the Petro Canada Company?

Q2. What can you say about the users' satisfaction derived from using information systems to carry out their duties?

Q3. Are there any logs or registers for the complaints or problems that the PCC staff are having about the information systems of the company?

Q4. Do you use the complaints and problems registers to improve the functionalities of the information systems?

Q5. How are the complaints and problems registers used to make the improvement recommendations?

Q6. What is the PCC position among the foreign upstream oil companies in Libya?

Q7. What can you say about the current ownership of your company?

Q8. Which company is Suncor Energy?

Q9. Which information systems strategy is adopted in PCC?

Q10. Why did the top-management of the company prefer the in-house strategy among various other available strategy options?

Q11. What can you say about the information system strategy satisfying the business needs of the company?

Q12. What improvements or suggestions can you offer the company on the currently implemented information systems strategy?

Q13. How do you think your suggestions can be channelled to the appropriate

quarters for implementation?

Q14.   What are the problems that are affecting the current information system strategy in the company?

Q15.   From the data gathered with the questionnaire, it was observed that the in-house information system is being expanded to cover all the processes of the company, but can you please let us know what is the sequence in which other processes will be taken or will all other remaining processes be taken at once?

Q16.   Why is the sequence likely to be going to be like that?

Q17.   Are all the processes that are managed with the in-house systems having no problems in providing the desired reports for management decision-making?

Q18.   What about the processes managed by the Access/Excel information systems?

Q19.   What are the problems with the Access/Excel information systems?

Q20.   Are there measures in place to eradicate problems with the Access/Excel information systems, or alleviate the problems?

Q21.   Kindly explain how?

Q22.   Are there problems with the IM system?

Q23.   If there are no problems with the IM system, why will the management of the company want to replace it with an in-house system?

Q24.   Are there any reasons to integrate the currently existing information systems in the company?

Q25. Is the staff strength of the IT department good enough to support the information systems in the company?

Q26. How does the IT department staff prioritise the support requests from the company staff who are the users of the information systems?

Q27. How does the company decide on the IT staff functions to outsource?

Q28. Why is it that the Financial management process is managed by a combination of the in-house information systems and the Access/Excel information systems?

Q29. From your working experience at Petro Canada Company, can you give a general overview of the core business processes in the company and the information systems deployed for each process?

Q30. How is the required information shared among the information systems in the company?

Q31. Has there been problem(s) with the file exchange among the information systems?

Q32. Can you please describe some problem cases and how they were managed?

Q33. Is the file exchange as good as the case would have been with an automated integration?

Q34. So, why is the integration not done yet?

Q35. Let us take the core processes one by one. Do you think the oil exploration process and the sub-processes you mentioned are well managed with the information systems deployed for the sub-processes?

Q36. Considering the deployed information systems, kindly discuss how well managed the sub-processes of the following processes are: Trading, Financial Management,

Human Resources management, Logistic/Distribution/Transportation and Forecasting?
Q37. **Please explain the concept of upstream sector in the oil industry.**
Q38. **In summary, can you describe the supply chain flow of the upstream sector?**
Q39. **Can you state some reports required by different business functions in the company?**
Q40. **How are the reports generated with the current information systems?**
Q41. **How do you think the report generation can be improved?**
Q42. **What is your understanding of the concept of e-business?**
Q43. **How is the e-business system used at Petro Canada Company?**
Q44. **What are the ways and manners in which more benefits can be derived from the e-business functions?**
Q45. **What are the likely limitations that can hinder the progress of adopting more e-business procedures in the company?**
Q46. **At PCC, who or which group of staff decides on the information systems strategies that are being implemented currently in the company?**
Q47. **How many people make up the decision team? And what are their positions in the company?**
Q48. **Is the decision team also responsible for giving directives on implementing improvement suggestions on the deployed information systems?**
Q49. **What factors are usually considered by the decision team when deciding on how**

the existing information systems strategy can be improved? And why?
Q50. Between 2005, when Petro Canada Company adopted its current information systems strategy, and this year (2012), what are the improvements in the business processes in the company?
Q51. What are the factors that are used by Petro Canada Company annually to measure the progress of the information systems strategy in supporting the business functions of the company?
Q52. Can you explain in clear terms the statistics that confirm that these factors indicate improvements in the information systems strategy support for the business processes?

WOC

<p align="center">**INFORMED CONSENT FORM**</p>

<p align="center">**INTERVIEW ON INFORMATION SYSTEMS (IS) DEPLOYMENT AND IS STRATEGY IMPLEMENTATION**</p>

Brief/Purpose:

The purpose of this interview is to collect data on information systems (IS) deployment and IS strategies for Waha Oil Company by investigating the information systems deployed in the company and their associated technologies, the business processes and factors associated with information system strategies of the company. This interview is part of the PhD thesis being carried out at the University of Gloucestershire, UK.

The information provided will be used for a research dissertation. This will help to analyse the companies' information systems and information system strategies as well as trying to establish an effective methodology for assessing the IS strategy/strategies that are to be adopted by oil companies in developing countries of the world with a focus on Libya.

All the responses and subsequent reports of the results will be kept strictly confidential. We will also be willing to contact you on phone for further interview as the research work progresses. Thank you for your support.

Company: Waha Oil Company.

Participant ID: WOC-2

Participant Signature:

Date:

Q1. **What is your position and years of experience at Waha Oil Company?**
Q2. **Which body is responsible for implementing information systems strategy at Waha Oil Company?**
Q3. **Who are the members of the information system strategy team, and what are their positions in the company?**
Q4. **How is the team improving on the information systems strategy adopted by the Waha Oil Company?**
Q5. **What are the problems that prevent smooth progress in improving the information systems strategy at Waha Oil Company?**
Q6. **What are the factors that make the information systems strategy of Waha Oil to be built around ERP information system, the SAP R/3 ERP system?**
Q7. **Why is Waha Oil Company moving towards using ERP systems for all its business functions?**
Q8. **What can you say about the usability satisfaction of staff on each information systems in the company?**
Q9. **Are there logs or registers for the support activities on the information systems in the company?**
Q10. **What are the logs/registers used for?**
Q11. **What can you say about the adopted information system strategy satisfying the business needs of Waha Oil Company?**
Q12. **What are the problems that are affecting the current information system**

strategy in the company?

Q13. **What improvements or suggestions can you offer that the company should consider on the currently implemented information systems strategy?**

Q14. **From the data gathered with the questionnaire, it was observed that there are plans to extend the SAP R/3 ERP information systems to cover all the core processes of the company. Do you think this is a right step? Kindly explain why for your answer.**

Q15. **Are all the processes that are managed with the SAP R/3 ERP systems having no problems in providing the desired reports for management decision-making?**

Q16. **Are there any problem with other information systems, the COBOL and the Access/Excel? Or why are there moves in the information strategy plan of the company to replace them?**

Q17. **What are the maintenance problems that plague the COBOL oriented information systems? Kindly explain with examples.**

Q18. **Are there measures in place to eradicate problems with the COBOL oriented information systems, or to alleviate the problems?**

Q19. **Kindly explain with examples problems with Excel/Access information systems.**

Q20. **Are there measures in place to eradicate problems with the Excel/Access information systems, or to alleviate the problems?**

Q21. **What is the staff strength of the IT department?**

Q22. **Are the staff in the IT department enough to support the entire company?**

Q23. **Why does Waha Oil Company prefer to hire IT staff from IT consultants to complement the company's IT department as against employing them?**

Q24. **Among the domestic oil companies in Libya, how do you rate Waha Oil Company in terms of its strength as a player in Libya oil industry?**

Q25. **What do you mean by the concept of upstream sector of the oil industry as you mentioned?**

Q26. **What can you say about the current ownership of Waha Oil Company?**

Q27. **Have there been any changes in the ownership of the company over the years, since its establishment?**

Q28. **Which information systems strategy is adopted in PCC?**

Q29. **Can you give a general overview of the core business processes and sub-processes in the company and the information systems deployed for each sub-process?**

Q30. **Are the information systems for the core processes across the company well integrated?**

Q31. **Are there no reasons to integrate all the information systems in the company?**

Q32. **What are the ways in which the integration is achieved?**

Q33. **Is this exchange of files among the information systems better than automated integration?**

Q34. **Why is automated integration not in place yet?**

Q35. **Is the staff strength of the IT department good enough to support the information systems across the entire company?**

Q36. Are there preferences in the IT department staff attendance to the needs of the company's staff?
Q37. Why does the company outsource some of its IT staff functions to IT consultancy firms?
Q38. Let us take the core processes of the company as gathered in the questionnaire one by one; do you think that each of the sub-processes are well managed with the information systems deployed for the it?
Q39. What are the improvement suggestions that you can give on each information system for each sub-process?
Q40. In summary, can you describe the business activities flow across the company?
Q41. Are the information systems meeting the business functional needs of each process?
Q42. Between 2007 when Waha Oil Company adopted its current information systems strategy, and this year (2012), what are the improvements in the business processes in the company?
Q43. Do you have assessment criteria for measuring the improvements in the business processes with the deployed information systems and the adopted information systems strategy?
Q44. What are the assessment criteria?
Q45. Can you kindly provide some statistical figures of this assessment criteria over the years, between 2007 and 2012?
Q46. Can you state some decision-making reports required by different business

functions in the company?
Q47.   Are they all provided by the current information systems?
Q48.   What is your understanding of the concept of e-business?
Q49.   To what extent are the e-business procedures being embraced by Waha Oil Company?
Q50.   What are the future e-business functions that Waha Oil Company is planning to embrace in line with the information systems strategy of the company?

APPENDIX – 3: The Second Questionnaire

PETRO CANADA COMPANY

<u>INFORMED CONSENT FORM</u>

<u>QUESTIONNAIRE ON INFORMATION SYSTEMS (IS) DEPLOYMENT AND IS STRATEGY IMPLEMENTATION: March, 2012.</u>

Brief/Purpose:

The purpose of this questionnaire is to collect data on information systems (IS) deployment and IS strategies for Petro Canada Company by investigating the information systems deployed in the company and their associated technologies, the business processes and factors associated with information system strategies of the company. This questionnaire is part of the PhD thesis being carried out at the University of Gloucestershire, UK.

The information provided will be used for a research dissertation. This will help to analyse the companies' information systems and information system strategies as well as trying to establish an effective methodology for assessing the IS strategy/strategies that are to be adopted by oil companies in developing countries of the world with a focus on Libya.

All the responses and subsequent reports of the results will be kept strictly confidential. Thank you for your support.

I can confirm that these are real and genuine responses provided by the named participant from Petro Canada Company.

Participant ID: PCC-1

Participant Signature:

Date:

Q1. Does the following figure actually represent the company processes, sub-processes and associated information systems? If NO, kindly explain the right processes, sub-processes and associated information systems. If any information systems are missing, please add them to the revised figure below.

PETRO CANADA COMPANY

EXPLORATION

Petroleum Engineerin
G: In-house

R: Manual

Plannin

Oil Production
G: In-house

FORECASTING

Sales Forecasting

A: Access/Excel

Price Modelling

TRANSPORT AND DISTRIBUTION LOGISTICS

Inventory Managemen
G: IM System

Distribution Management
G: In-house

FINANCIAL MANAGEMENT

P and L Manageme

Asset Managemen

R: Access and Excel

CRUDE OIL TRADING

CRM

A: In-house/Excel

Sales Management

HR MANAGEMENT

Personnel Managemen

Payroll Svstem

G: In-house

Keys:

→ **Process**

: **Information System**

Sub-processes

Section B: The Exploration Process

Q2. What have been the main changes in the "Oil Production" and "Petroleum Engineering" sub-processes with the introduction of information systems?

Q3. Are the bespoke in-house software systems meeting all the business needs of the "Oil Production" and "Petroleum Engineering" sub-processes (in terms of functionality, performance, management information and integration)? If No, please tell us how.

Q4. Are the in-house software systems in line with corporate information systems strategy? If No, Please explain and suggest if an upgrade or complete change of the IS is required, with reasons.

Q5. Are there any parts of the "Oil Production" and "Petroleum Engineering" sub-process that are yet to be automated? If Yes, Please explain.

Q6. Can you give improvement suggestions that could improve the existing in-house software systems for the "Oil Production" and "Petroleum Engineering" sub-processes?

Q7. Why is it that "Planning" sub-process is not automated?

Q8. What is the relationship of the "Planning" sub-process with "Oil Production" and "Petroleum Engineering" sub-processes?

Q9. Will automation help the "Planning" sub-process? If yes, kindly explain how.

Q10. What are the main changes that will happen to the "Oil Production" and "Petroleum Engineering" sub-processes if "Planning" is automated?

Q11. Do you use online technology/internet for any of the "Planning", "Oil Production" and "Petroleum Engineering" sub-processes? If no, go to Q14.

Q12. What information is made available via the online technology/internet? And for whom (if any)?

Q13. Kindly mention the information that is available online to support the Exploration process and its usage.

Section C: Forecasting

Q14. Are there any systems or information problems with "Sales Forecasting" sub-process using Access/Excel? If Yes, please explain.

Q15. Are there any main changes you would like in the way the "Sales Forecasting" sub-process is structured?

Q16. Why is it that an in-house software was not developed for "Sales Forecasting"?

Q17. Are the "Access/Excel" meeting the strategic targets expected of the "Sales Forecasting" sub-process? If No, Please explain and suggest upgrade or complete change of the IS with reason.

Q18. Would you like the "Sales Forecasting" process to be fully automated? If Yes, Please explain.

Q19. What are the business activities of "Price Modelling" process that are not automated?

Q20. What is the relationship between "Price Modelling" process and "Sales Forecasting" process?

Q21. Will automation helps the "Price Modelling" process? If yes, kindly explain how.

Q22. Will there be any main changes to "Sales Forecasting" process if "Price Modelling" process is automated.

Section D: Financial Management

Q23. Are there any problems with "P and L Management" and "Asset Management" processes using Access/Excel? If Yes, please explain.

Q24. Are financial reports and other IS needs readily available for decision making with the Access/Excel system? If No, Please explain and suggest an upgrade or complete change of the IS with reasons.

Q25. Why is it that an in-house information system was not developed for "P and L Management" and "Asset Management"?

Q26. Is there any problem with the financial management process with Access/Excel? If yes, please explain.

Q27. Are there plans for complete automation of the financial management process?

Q28. What improvements would you suggest on the Access/Excel system used to manage financial management process?

Section E: Human Resources Management

Q29. Are there any problems with "Personnel Management" and "Payroll Management" sub-processes using the in-house system? If Yes, please explain.

Q30. Are real-time Human Resources reports readily available for decision making with the information systems? If No, please explain.

Q31. What improvement has the in-house software system provided for the Human

Resources Management process?
Q32. **What is the information provided by the in-house system to facilitate the company's relationship with its employees?**
Q33. **With reason, what suggestions would you like to give on the existing information system for "Personnel Management" and "Payroll Management" sub-processes – leaving it the way it is, a replacement or an upgrade of the information system?**
Section F: Crude Oil Trading
Q34. **What are the positive impacts of the current information system with the "Sales Management" and "CRM" sub-processes?**
Q35. **Why is it that the Excel package has to be used along with the in-house information system to manage the "crude oil trading" process?**
Q36. **What are the problems with the "crude oil trading" process (if any)?**
Q37. **Are there any main changes you would like in the way the "crude oil trading" process is structured?**
Q38. **What improvement suggestions would you give on the current information system for the "crude oil trading" process? If any, would you appreciate an upgrade of the existing system or a complete replacement?**
Q39. **How effective is the "CRM" sub-process in terms of customer satisfaction at present?**
Q40. **Is there any e-business application for the CRM? If yes, kindly explain how it works.**

Section G: Transport and Distribution Logistics

Q41. **A.** **What is IM information system?**

B. **How it is maintained and supported?**

Q42. **What differences exist between the IM information system and the in-house information system? Kindly expatiate and list them.**

Q43. **Why is the choice of IM information system over In-house development for the "Inventory Management" process?**

Q44. **Are the IM information system and the in-house information system completely satisfactory in managing the "Inventory Management" and "Distribution management" respectively? If No, kindly explain why.**

Q45. **Please list the problems you observed in the existing information system for both "Inventory Management" and "Distribution management" processes (if any).**

Q46. **For the list in Q41, kindly give suggestions on how the problem can be solved or improved upon.**

Q47. **Do you use online technology/internet for any of the "Inventory Management" and "Distribution Management" processes? If yes, kindly explain.**

Q48. **If online technology/internet is used for the "Inventory Management" and "Distribution Management" processes, kindly list the information you can retrieve online to facilitate the processes in the company.**

Section H: The Company Information Systems Strategy

Q49. **What is the Information Systems strategy for Petro Canada Company?**

Q50. In each process area, when were information systems developed and/or implemented? What have been the main changes made on the Information Systems over time, if any. Why?

Q51. Is there any relationship between the company's business strategy and the information systems strategy?

Q52. What are the reasons why the company adopted its present information system strategy?

Q53. What changes if any are needed to the information systems strategy of the company?

Q54. Are there new ways of doing things as a result of information availability via the information systems in the company? Have processes improved? Are things done more efficiently?

Q55. What kind of online technology/internet facilities are used for the business transactions of the company?

Q56. Is the company using e-business technologies to interact with its customers and vendors (suppliers)? If No, go to Q64.

Q57. Is information made available online to the customers, vendors (suppliers) and staff of the company? If yes, please explain how.

Q58. Are the customers and vendors (suppliers) able to give information online to the company? If yes, please explain how.

Q59. Is the staff of the company able to retrieve information online from the customers and vendors (suppliers)? If yes, please explain how.

Q60. Are the different processes in the company able to send, retrieve, share and use online information among themselves? If yes, please explain how.

Q61. What are some other business activities carried out with the e-business technologies?

Q62. What are the main challenges and limitations of the e-business technologies in the business?

Q63. What are the transformational effects of e-business strategy adoption by the company?

Q64. What computer languages are used for the in-house information systems?

Q65. Are there links across the information systems in the company for central management reporting? If yes, please explain how the linking is achieved.

Section I: Evaluation of PCC Deployed Information Systems

Kindly answer the following with one of the following four answering options: A = Agree, S A = Somewhat Agree, D = Disagree, N A = Not Applicable.

Sub-Processes/ Business functions	The information system provides good management information and essential reports.	The information system is technically up-to-date.	The information system is easy to understand and use.	The information system automates all the sub-process activities.	The information system is well integrated or has a good mode of exchange of data/information with other information systems in the company.
Planning					

Petroleum Engineering				
Oil production				
Sales Forecasting				
Price Modelling				
Financial Accounting				
Management Accounting				
Personnel Management				
Payroll System				
Sales Management				
Customer Relationship Management				
Distribution Management				
Inventory Management				

WAHA OIL COMPANY

INFORMED CONSENT FORM

QUESTIONNAIRE ON INFORMATION SYSTEMS (IS) DEPLOYMENT AND IS STRATEGY IMPLEMENTATION: March, 2012.

Brief/Purpose:

The purpose of this questionnaire is to collect data on information systems (IS) deployment and IS strategies for Waha Oil Company by investigating the information systems deployed in the company and their associated technologies, the business processes and factors associated with information system strategies of the company. This questionnaire is part of the PhD thesis being carried out at the University of Gloucestershire, UK.

The information provided will be used for a research dissertation. This will help to analyse the companies' information systems and information system strategies as well as trying to establish an effective methodology for assessing the IS strategy/strategies that are to be adopted by oil companies in developing countries of the world with a focus on Libya.

All the responses and subsequent reports of the results will be kept strictly confidential. Thank you for your support.

I can confirm that these are real and genuine responses provided by the named participant from Waha Oil Company.

Participant ID: WOC-2

Participant Signature:

Date:

Section A: Overview of the Company Processes/Sub-processes and Information Systems

Q1. Does the following figure represent the company processes, sub-processes and associated information systems? If NO, kindly explain the right processes, sub-processes and associated information systems. If any information systems are missing, please add them to the revised figure below.
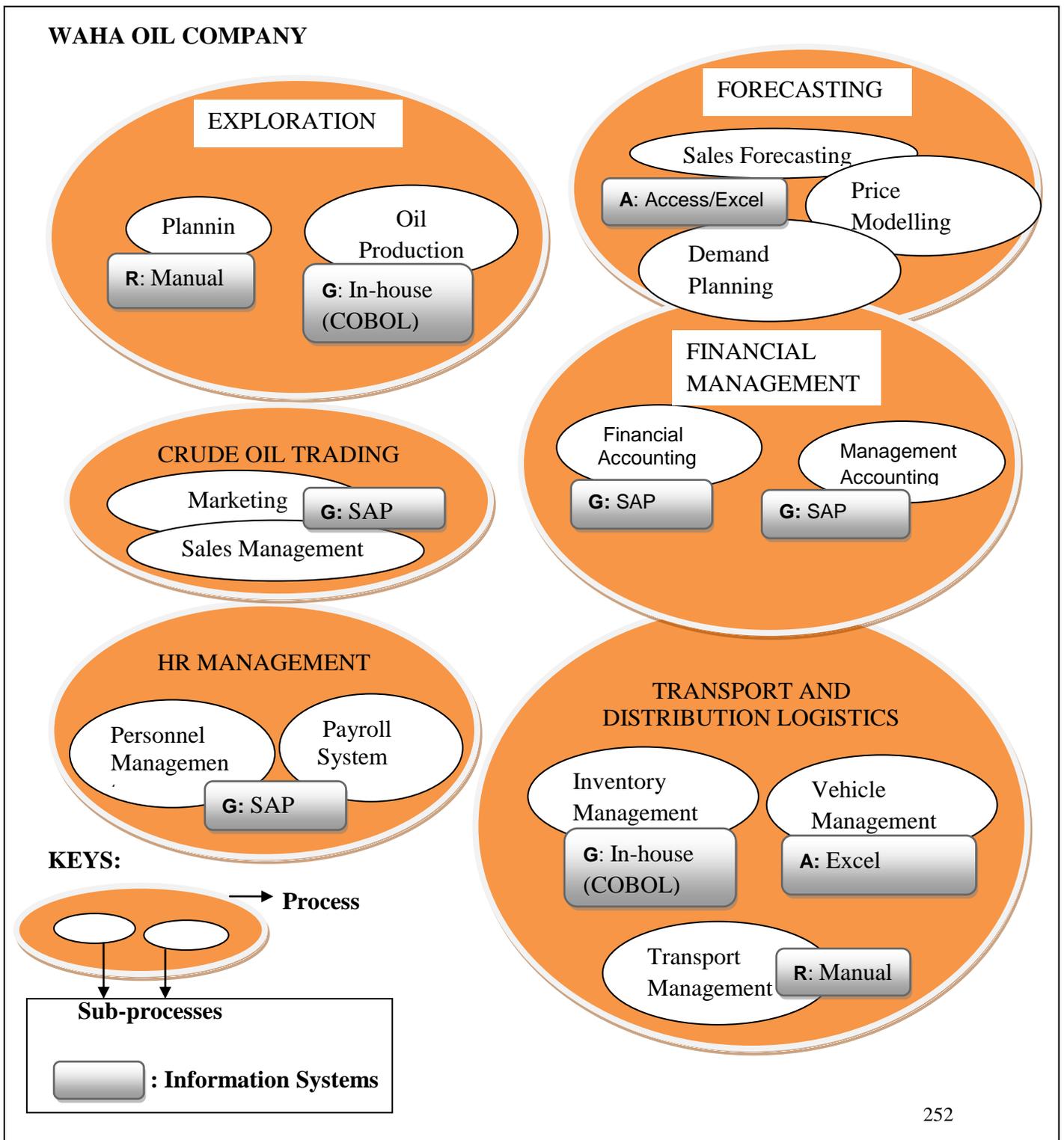
Section B: The Exploration Process

Q2. What are the main changes in "Oil Production" sub-process with the introduction of information systems?

Q3. Is the in-house system meeting all the business needs of the "Oil Production" sub-process (in terms of functionality, performance, management information and integration)? If No, please tell us how.

Q4. Are the in-house information systems in line with corporate information systems strategy? If No, Please explain and suggest if an upgrade or complete change of the IS is required, with reasons.

Q5. Is there any part of the "Oil Production" sub-process that is yet to be automated? If Yes, Please explain.

Q6. Can you give improvement suggestions that could improve the existing in-house software systems for the "Oil Production" sub-process?

Q7. Why is it that the "Planning" sub-process is not automated?

Q8. What is the relationship of the "Planning" sub-process with the "Oil Production" sub-process?

Q9. Will automation help the "Planning" sub-process? If yes, kindly explain how.

Q10. What are the main changes that will happen to the "Oil Production" sub-process if "Planning" is automated?

Q11. Do you use online technology/internet for any of the "Planning" and "Oil Production" sub-processes? If no, go to Q14.

Q12.   What information is made available via the online technology/internet? And for whom (if any)?

Q13.   Kindly mention the information that is available online to support the Exploration process and its usage.

Q14.   Are there any systems or information problems with "Price Modelling", "Demand Planning" and "Sales Forecasting" sub-processes using Access/Excel? If Yes, please explain.

Q15.   Why is it that Access/Excel information system is preferred over In-house information system for "Price Modelling", "Demand Planning" and "Sales Forecasting"?

Q16.   Are there any major changes you would like in the way "Price Modelling", "Demand Planning" and "Sales Forecasting" processes are currently structured in the company?

Q17.   Are the "Access/Excel" systems meeting the strategic targets expected of the "Price Modelling", "Demand Planning" and "Sales Forecasting" sub-processes? If No, Please explain and suggest upgrade or complete change of the IS with reason.

Q18.   Would you like the "Price Modelling", "Demand Planning" and "Sales Forecasting" sub-processes to be fully automated? If Yes, Please explain why.

Q19.   What main changes would you suggest if "Price Modelling", "Demand Planning" and "Sales Forecasting" sub-processes are to be automated as against using the Excel/Access package?

Q20.   Why are some of the business activities of "Price Modelling", "Demand Planning" and "Sales Forecasting" sub-processes not automated?

Q21. Will automation with a dedicated information system as against Excel/Access package improve the "Price Modelling", "Demand Planning" and "Sales Forecasting" sub-processes? If yes, kindly explain how.

Q22. Will there be any major changes to the "Sales Forecasting" process if the "Price Modelling" process is automated.

Section D: Financial Management

Q23. Are there any problems with "Financial Accounting" and "Management Accounting" sub-processes using Access/Excel? If Yes, please explain and suggest improvements.

Q24. Are financial reports and other IS needs readily available for decision making with the SAP R/3 ERP information systems? If No, please explain and suggest upgrade or complete change of the IS with reasons.

Q25. How is the SAP R/3 ERP system and the in-house information system linked to aid the business functions of "Financial Accounting" and "Management Accounting" sub-processes?

Q26. Are there observed integration problems within the financial management processes of the company? If yes, please explain.

Q27. What improvements would you suggest on the existing information systems used to manage the financial management process in the company?

Q.28 What processes in the company give data or information to the Financial Management process?

Section E: Human Resources Management

Q29. Are there any problems with "Personnel Management" and "Payroll Management" sub-processes using the SAP R/3 ERP system? If Yes, please explain.

Q30. Are real-time human resources reports readily available for decision making with the information systems? If No, please explain.

Q31. What improvement has the SAP R/3 ERP system provided for the Human Resources Management process?

Q32. What is the information provided by the SAP R/3 ERP system to facilitate the company's relationship with its employees?

Q33. With reason, what suggestions would you like to give on the existing information system for "Personnel Management" and "Payroll Management" sub-processes – leaving it the way it is, a replacement or an upgrade of the information system?

Section F: Crude Oil Trading

Q34. What are the positive impacts of the current information system with the "Sales Management" and "Marketing" sub-processes?

Q35. Why is it that the SAP R/3 ERP system was considered over the in-house information system to manage the "crude oil trading" process?

Q36. What are the problems with "crude oil trading" process (if any)?

Q37. Are there any main changes you wouldlike in the way the "crude oil trading" process is structured?

Q38. With reasons, what improvement suggestions would you give on the current information system for the "crude oil trading" process? If any, would you appreciate an

upgrade of the existing system, a complete replacement or it should be left as it is because it is good?

Q39. How effective is the "Marketing" sub-process in terms of customers' relationship and satisfaction at present?

Q40. Is there any e-business application for the Marketing sub-process? If yes, kindly explain how it works.

Section G: Transport and Distribution Logistics

Q41. Is there any problem with the "Excel" information system used for the "Vehicle Management" sub-process? If yes, please explain.

Q42. Is there any problem with the "In-house" information system used for the "Inventory Management" sub-process? If yes, please explain.

Q43. Can you please explain in detail the business procedures involved in WOC's usage of third parties for its "Transport Management" sub-process?

Q44. Is there any need to automate the "Transport Management" sub-process? If yes, please explain.

Q45. If online technology/internet is used for the "Inventory Management" and "Transport Management" and "Vehicle Management" sub-processes, kindly list the information are available online to facilitate the sub-processes in the company.

Section H: The Company Information Systems Strategy

Q46. What are the reasons for why the company chose the SAP R/3 ERP system for managing some of the company's processes?

Q47. **What are the main differences in the business solutions offered by the SAP R/3 ERP system and the in-house information systems?**

Q48. **Is there any relationship between the company's business strategy and the information systems strategy?**

Q49. **Who maintains and supports the:**
   a. **The in-house information system.**
   b. **The SAP R/3 ERP system.**
   c. **The Access/Excel system.**

Q50. **What are the main changes made on the Information Systems of the company over time? And if any, why?**

Q51. **What are the reasons why the company adopted its present information system strategy?**

Q52. **What suggested changes, if any, would you give on the information systems strategy of the company?**

Q53. **Is the company using e-business technologies to interact with its customers and vendors (suppliers) along with other important groups to the company? If No, go to Q61.**

Q54. **Is information made available online to the customers, vendors (suppliers) and staff of the company? If yes, please explain how.**

Q55. **Are the customers and vendors (suppliers) able to give information online to the company? If yes, please explain how.**

Q56. **Is the staff of the company able to retrieve information online from the customers and vendors (suppliers)? If yes, please explain how.**

Q57. Are the different processes in the company able to send, retrieve, share and use online information among themselves? If yes, please explain how.

Q58. What other business activities are carried out with the e-business technologies?

Q59. What are the main challenges and limitations of the e-business technologies in the business?

Q60. What are the transformational effects of e-business strategy adoption by the company?

Q61. What computer languages are used for the in-house information systems?

Q62. Are there links across the information systems in the company for central management reporting? If yes, please explain how the linking is achieved.

Section I: Evaluation of PCC Deployed Information Systems

Kindly answer the following with one of the following four answering options: A = Agree, S A = Somewhat Agree, D = Disagree, N A = Not Applicable.

Sub-Processes/ Business functions	The information system provides good management information.	The information system is technically up-to-date.	The information system is easy to understand and use.	The information system automates all the sub-process activities.	The information system is well integrated or has a good mode of exchange of data/information with other information systems in the company.
Planning					
Oil					

production				
Sales Forecasting				
Price Modelling				
Demand Planning				
Financial Accounting				
Management Accounting				
Personnel Management				
Payroll System				
Sales Management				
Marketing				
Inventory Management				
Vehicle Management				
Transport Management				

The Second Set of Interview Questions (Post-Second Questionnaire)

PCC

INFORMED CONSENT FORM

INTERVIEW ON INFORMATION SYSTEMS (IS) DEPLOYMENT AND IS STRATEGY IMPLEMENTATION

Brief/Purpose:

The purpose of this interview is to collect data on information systems (IS) deployment and IS strategies for Petro Canada Company by investigating the information systems deployed in the company and their associated technologies, the business processes and factors associated with information system strategies of the company. This interview is part of the PhD thesis being carried out at the University of Gloucestershire, UK.

The information provided will be used for a research dissertation. This will help to analyse the companies' information systems and information system strategies as well as trying to establish an effective methodology for assessing the IS strategy/strategies that are to be adopted by oil companies in developing countries of the world with a focus on Libya.

All the responses and subsequent reports of the results will be kept strictly confidential. We will also be willing to contact you on phone for further interview as the research work progresses. Thank you for your support.

Company: Petro Canada Company.

Participant ID: PCC-1

Participant Signature:

Date:

Q1. The in-house information system is used for multiple sub-processes; is the information on different sub-processes that use the information system accessible to other sub-processes that use the in-house information system?

Q2. Kindly give some examples of information that are easily shared among the sub-processes that are using the in-house information systems.

Q3. Are there measures to prevent risks of unauthorised access to confidential company information in the in-house information system?

Q4. In case it happens, what are the likely effects on the company?

Q5. In the previous information gathering, it was observed that Petro Canada Company had set up an overhauling committee for its information systems strategy in 2005. Has there been review of the information systems strategy since then?

Q6. How are the reviews done and at what intervals?

Q7. What are the successes in the information systems deployment that comes from the reviews?

Q8. Can you kindly give some typical examples of the improvements / successes in the business processes of the company?

Q9. What do you think is / are the key / keys to the successes of the deployed information systems at Petro Canada Company?

Q10. Which one do you think is the most vital to the successes as you mentioned?

Q11. How regularly are the deployed information systems in the company upgraded?

Q12. For each sub-process in the company (as I mentioned one by one), what

managerial reports are generated?

Q13. For each sub-process in the company (as I mentioned one by one), what improvement suggestions would you give on the information systems deployed for the sub-process?

Q14. For each sub-process in the company (as I mentioned one by one), what e-business procedure supports the sub-process?

Q15. What do you think is responsible for the general low level of adoption of e-business in the sub-processes of the company?

Q16. How ready is the company to invest in Information Technology?

Q17. Do you think there is need for more qualified IT staff to drive the information systems of the company?

Q18. What are the contributions of the deployed information systems and adopted information systems strategy in boosting business performance of the company?

Q19. How do you measure the improvements in accuracy of information from the information systems?

Q20. If you have similar statistics for other improvements, kindly mention them.

Q21. What are the problems and challenges that are preventing the company from improving its deployed information systems?

Q22. How do you think the problems can be eradicated so as to get the required improvements on the deployed information systems?

Q23. What is the estimated year that you think that the deployed information systems in the company will need basic maintenance and support and not a major upgrade?

Q24.   What information do you think you can still give about the deployed information systems and implemented information systems strategy in the company?

WOC

<p align="center">**INFORMED CONSENT FORM**</p>

<p align="center">**INTERVIEW ON INFORMATION SYSTEMS (IS) DEPLOYMENT AND IS STRATEGY IMPLEMENTATION**</p>

Brief/Purpose:

The purpose of this interview is to collect data on information systems (IS) deployment and IS strategies for Waha Oil Company by investigating the information systems deployed in the company and their associated technologies, the business processes and factors associated with information system strategies of the company. This interview is part of the PhD thesis being carried out at the University of Gloucestershire, UK.

The information provided will be used for a research dissertation. This will help to analyse the companies' information systems and information system strategies as well as trying to establish an effective methodology for assessing the IS strategy/strategies that are to be adopted by oil companies in developing countries of the world with a focus on Libya.

All the responses and subsequent reports of the results will be kept strictly confidential. We will also be willing to contact you on phone for further interview as the research work progresses. Thank you for your support.

Company: Waha Oil Company.

Participant ID: WOC-2

Participant Signature:

Date:

Q1. In the previous information gathered, it was observed that Waha Oil Company has a team which was inaugurated in 2007 to define and manage its information systems strategy. What are the jobs that the team has been doing since then to date?

Q2. Can you kindly give some typical examples of the improvements / successes in the business process of the company since the adoption of the current information systems strategy?

Q3. For each sub-process in the company (as I mentioned one by one), what improvement suggestions would you give on the information systems deployed for the sub-process?

Q4. How regularly are the deployed information systems in the company upgraded?

Q5. What are the main reasons for why the information systems strategy of the company is built around the SAP R/3 ERP information systems?

Q6. Kindly give some examples of information that are shared among the SAP R/3 ERP information system and other information systems in the company.

Q7. Are there measures to prevent risks of unauthorised access to confidential company information with the centralisation of information by the SAP R/3 ERP information system?

Q8. What are the main risks associated with each information system?

Q9. How are the risks being avoided?

Q10. Should any of the risks happen, what are the management measures put in place to protect the business interests of Waha Oil Company?

Q11. What is the main progress that you think the company has made because of the

deployed information systems, since the adoption of the current information systems strategy in 2007?

Q12. You appear to be so convinced that the employees of the company are much happier with the usage of the SAP R/3 ERP information system- why do you think so?

Q13. Since the COBOL oriented information system is managing its sub-processes well enough for business continuation at present, why is the company planning to change it?

Q14. What are the factors that are considered for reviewing the deployed information systems in the company?

Q15. Who are those that are responsible for the reviews of the deployed information systems and implemented information systems strategy in the company?

Q16. How are the reviews done and at what intervals?

Q17. Can you kindly mention some of the positive outcomes that the reviews have ever produced?

Q18. Can you mention the statistics of accuracy with the error rates that you mentioned, and the statistics of other factors too?

Q19. What are the successes in the information systems deployment that come from the reviews?

Q20. For each sub-process in the company (as I mentioned one by one), what managerial reports are generated?

Q21. What do you think is / are the key / keys to the successes of the deployed information systems at Waha Oil Company?

Q22. Which one do you think is the most vital to the successes as you mentioned?

Q23.   For each sub-process in the company (as I mentioned one by one), what e-business procedure supports the sub-process?

Q24.   How do you rate the adoption of e-business procedures at Waha Oil: Poor, Fair, Good, Very Good or Excellent?

Q25.   What do you think is responsible for the 'fair' rating as you mentioned on the adoption of e-business procedures as you mentioned?

Q26.   What are the contributions of the deployed information systems and adopted information systems strategy in boosting business performance of the company?

Q27.   Is the top-management team of the company ready to invest more in information technology to keep the company ahead of business competition in the Libyan oil and gas industry?

Q28.   In what ways can you justify that they are ready to do so?

Q29. What are the problems and challenges that are preventing the company from improving its deployed information systems?

Q30. How do you think the problems can be eradicated so as to achieve the needed improvements on the deployed information systems?

Q31. What information do you think you can still give about the deployed information systems and implemented information systems strategy in the company?