Chapter 1

Introduction

1.0 Introduction

Petroleum is the most valuable natural resource in the world\(^1\). The petroleum industry is very diversified and is split into the upstream and downstream sector, both of which, involves huge resources and technological capabilities to be competitive in the market. Acquiring the needed capabilities is by no means an easy task. There are many literatures regarding technological capabilities\(^2\) and other capabilities but, acquiring them and putting it to proper use on the field is a different aspect altogether. This study attempts to find out how Malaysia’s National Oil Corporation (NOC) which is PETRONAS, has managed to acquire and develop its technological capabilities in a relatively short period of time, 28 years to be exact. PETRONAS is now a global oil corporation with interests all over the world and is listed in the Fortune 500 companies listing and also is ASEAN’s

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\(^1\) The author supports this opinion with facts such as fuels made from petroleum propel automobiles, airplanes, factories, farm equipment, trucks, trains, ships, and much more. Petroleum also generates electricity for many houses and business places. So it is appropriate to say that without petroleum we wouldn’t be where we are today economy wise

\(^2\) In chapter 2, literature regarding capabilities are discussed in detail.
largest industrial company\textsuperscript{3}. Deliberate and sustained efforts by PETRONAS' management were the key to such success.

This chapter provides an overview of the thesis. It begins with an introduction to Malaysia's NOC, which is PETRONAS and then the objective of the study is discussed. The significance of this study is described and followed by the scope of the study. A brief review of the research methodology used for this study is described and followed by a brief introduction of Malaysia. The definition of petroleum is presented next followed by the difference between oil and gas.

1.1 Introduction to PETRONAS

The petroleum industry is one of the richest industries in the world. The wealth obtained from the 'black gold' is huge and thus contributes heavily to a nation's economy. In Malaysia, the petroleum industry is under the stewardship of Petroleam Nasional Berhad (PETRONAS). This company, which was initiated by the government, holds the sovereign rights of the hydrocarbon resources, which is found in Malaysia. PETRONAS is engaged in a wide range of activities, which includes upstream exploration, and production of oil and gas to downstream oil refining; marketing and distribution of petroleum products; trading and so much more. Over the years, 28 to be exact, it has grown to be an integrated international oil and gas company with business interests in more than 20 countries. Its capability to conduct exploration and production in other

\footnote{See: Petromin (2000) p.12}
countries under PETRONAS Carigali (Overseas) through various subsidiaries has been truly remarkable and outstanding. The accumulation of human resources and indigenous technology over the years is something that has been systematically planned and strategically managed very well even from the outset.

1.2 Objective of the Study

This study’s main objective is to find out how PETRONAS acquired and developed its technological capabilities in the upstream sector of the oil industry. It is also aimed to find out the method for the learning processes, which helped acquire and develop capabilities for PETRONAS. Besides that, this study will examine the strategic measures taken by PETRONAS that have helped its transition from being a technological novice to global player in a relatively short period of time.

1.3 Significance of the Study

This study will be able to show how PETRONAS has been able to develop and acquire its technological capabilities. These technological capabilities, have been well acquired through deliberate and conscious move by the management to compete itself in the global market. Its importance in managing and diffusing the technology throughout the upstream sector of PETRONAS efficiently over the years have made it excel and compete internationally. This study is also aimed at exploring how PETRONAS has been
expanding its operations all over the world successfully, which has made it a world player.

From this study, it is hoped to show the approach that PETRONAS undertook to gather technological capabilities in its effort to expand and compete with the bigger players in the market.

1.4 Scope of the study

This study will focus strictly on the upstream sector of the oil industry. The upstream sector is broken down to the exploration and production division. Exploration involves the use of seismic and aerial survey with the help of geologist and geophysicist to help determine the areas with oil or gas. Production involves the setting up of the oilrig for drilling purposes and bringing up the crude oil from the ground. Besides that, this study will also concentrate on the role of PETRONAS, especially its subsidiary company PETRONAS Carigali Sdn. Bhd. (PSCB) in the upstream petroleum sector. It will also cover the areas of the use of the production sharing contracts (PSC) involvement in Malaysia and also overseas.

1.5 Research Methodology

The case study method will be employed in this study. The case studies will cover aspects on the upstream sector specifically on the exploration and production of oil and
gas. These areas are selected because they constitute the most important aspect of the upstream sector in the petroleum industry. The case studies are hoped to give a better and clearer picture on how technology and capabilities are acquired through deliberate efforts done by PETRONAS. Beside that, an unstructured interview was also conducted with senior personnel of PETRONAS. The purpose of this interview was to elicit, among other things, the problems encountered during development, the methods that were used to gather skilled human resource and as well as technological capabilities, the management practices adopted and the key factors to PETRONAS’ success.

1.6 A Brief Introduction of Malaysia

Malaysia is a developing country that is rapidly transforming itself into a newly industrialized country. It is located at the center of Southeast Asia, and is strategically positioned as a major commercial link between the East and the West. Several decades of political stability and rapid economic growth have made Malaysia one of the most buoyant and wealthy countries in the region. The Malaysian government has effectively implemented fiscal and monetary policies that are conducive for economic growth. It is vigorously undertaking core infrastructure projects to improve road, rail, and air links to the business capital, Kuala Lumpur. Since the early 1980s its economy, which was commodity-dependent during the 60s and 70s, has since diversified to include light industrial manufacturing and heavy industries. Today, the country boasts state-of-the-art infrastructure and communications network, and the capital city, Kuala Lumpur, has become one of Asia's prime urban attractions for business. The country is now gearing
towards a new phase of development based on the multimedia and information technology.

1.6.1 Geography

Malaysia is located near the equator between 1°71' N and 100°-119° E. It has a total land area of about 330,400 km² straddled 650 km across the South China Sea. The country has two distinct parts. At the tip of mainland Southeast Asia is Peninsular Malaysia, which comprises 11 states, while on Borneo there are two states, Sabah and Sarawak. Peninsular Malaysia has a mountainous spine known as the Main Range (Banjaran Titiwangsa).

Malaysia's offshore areas total 332,300 km². These include parts of the Straits of Melaka, South China Sea, Sulu Sea and Celebes (Sulawesi) Sea. Malaysia's continental shelf is divided into six major sedimentary basins, the Malay Basin, Penyu Basin, Sarawak Basin, Sabah Basin, Northeast Sabah Basin and Southeast Sabah Basin. These basins are grouped into three main regions of Peninsular Malaysia, Sarawak and Sabah⁴ (refer Fig 1.1).

About 60% of these offshore areas have water depths of less than 200m. Petroleum is produced from the sedimentary basins offshore Terengganu, Sarawak and northwestern Sabah, in water depths of between 25 and 180 m. The deeper water areas in the northern parts of offshore Sarawak and Sabah are now being actively explored for petroleum.

1.6.2 Economy and Industry

In the last two decades Malaysia has sustained a high growth rate, averaging 6.7% per annum. Prior to the financial crisis in 1997, the federal government achieved five consecutive years (1993 – 1997) of budgetary surplus. From 1998 to 2000, the federal government budgetary position incurred deficit, largely because of expansionary fiscal policy designed to support economic recovery. For 2001, GDP growth decelerated sharply due to export slowdown and weak domestic demand conditions. In the first half of the year, the global plunge in demand for ICT products, which led to a protracted and

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synchronized slowdown in the world economy, contributed to slow domestic GDP growth of less than 1%. Refer to table 1.1 for a comparison of economic indicators for Malaysia since 1999-2003.

Table 1.1

Major Economic Indicators

<table>
<thead>
<tr>
<th>Item</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP growth</td>
<td>6.1</td>
<td>8.3</td>
<td>0.4</td>
<td>4.2</td>
<td>5.8</td>
</tr>
<tr>
<td>Gross domestic investment/GDP</td>
<td>22.3</td>
<td>26.8</td>
<td>24.8</td>
<td>25.9</td>
<td>26.4</td>
</tr>
<tr>
<td>Gross domestic savings/GDP</td>
<td>47.3</td>
<td>46.8</td>
<td>42.3</td>
<td>41.8</td>
<td>41.0</td>
</tr>
<tr>
<td>Inflation rate (consumer price index)</td>
<td>2.8</td>
<td>1.6</td>
<td>1.4</td>
<td>2.3</td>
<td>2.8</td>
</tr>
<tr>
<td>Money supply (M2) growth</td>
<td>13.7</td>
<td>5.2</td>
<td>5.3</td>
<td>6.9</td>
<td>8.5</td>
</tr>
<tr>
<td>Fiscal balance/GDP</td>
<td>-3.2</td>
<td>-5.8</td>
<td>-6.7</td>
<td>-5.2</td>
<td>-3.0</td>
</tr>
<tr>
<td>Merchandise export growth</td>
<td>16.8</td>
<td>17.0</td>
<td>-8.8</td>
<td>7.0</td>
<td>11.9</td>
</tr>
<tr>
<td>Merchandise import growth</td>
<td>12.8</td>
<td>26.2</td>
<td>7.6</td>
<td>10.0</td>
<td>16.1</td>
</tr>
<tr>
<td>Current account balance/GDP</td>
<td>15.9</td>
<td>9.4</td>
<td>7.8</td>
<td>5.3</td>
<td>2.6</td>
</tr>
<tr>
<td>Debt service ratio</td>
<td>5.6</td>
<td>5.4</td>
<td>6.0</td>
<td>6.3</td>
<td>6.1</td>
</tr>
</tbody>
</table>

Malaysia is rich in natural resources. Malaysia is one of the world's largest producers of natural rubber, tin, palm oil, timber and pepper. Malaysia has now largely diversified from a resource-based economy, which was dependant on agricultural products and commodities and now has progressed to manufacturing and heavy industry. Great emphasis has been given to value-added and high technology industries with strong research and development (R&D) backing. Increased local and foreign investments in capital-intensive projects and the manufacturing sector, contributes strongly towards the GDP and total exports. Manufacturing is now the single largest component of Malaysia's

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economy, with electrical and electronic products contributing about a fifth of the total production. The rapid growth in the manufacturing sector has made Malaysia the largest exporter of semiconductor components to the United States.

In the petroleum sector however, for the whole of 2001, export volume of crude petroleum is expected to almost stagnate at 16,750 tonnes (2000: 16,670 tonnes). Coupled with lower prices, export earnings from crude petroleum are expected to decline by 14.5% to RM12,243 million (2000: RM14,240 million). Export unit value is envisaged to decrease by 14.5% to RM731 per tonne or approximately USID25.30 per barrel (2000: USD29.58 per barrel).8

Export unit value and volume of LNG are expected to decline by 5.6% and 2.1% respectively as a result of slowdown in industrial activities of importing countries, particularly Japan, the Republic of Korea and Taiwan. Consequently, export earnings are expected to decline by 7.6% to RM10,440 million in 2001 (2000: RM11,300 million).9

1.6.3 Natural Gas

In the first eight months of 2001, the production of natural gas increased by 5.1% to 1,103,800 mmmscf compared with 1,050,200 mmmscf in the same period of 2000. For the whole of 2001, in anticipation of higher demand, its production is expected to record an increase of 4.7% to 4,586 mmmscf per day (2000: 4,367 mmmscf/d). Domestic consumption

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9 Ibid, p.74
of natural gas is expected to increase by 7.6% to 1,709 mmscf/d in 2001 (2000: 1,589 mmscf/d), with 79.9% consumed as energy, 7.4% by the industrial sector, 8.8% export market and others, 3.9%\textsuperscript{10}.

1.6.4 Crude Oil

In the first eight months of 2001, the production of crude oil (including condensates) declined by 2.5% to 667,300 barrels per day (bpd) (January to August 2000: 684,700 bpd). Consequently, crude oil production in 2001 was scaled back by 0.2% to 679,500 bpd (2000: 680,800 bpd) from 42 oil fields (2000: 39 oil fields) in line with Petronas Nasional Berhad's (PETRONAS) production target. Peninsular Malaysia is expected to contribute to 59.3% of output while Sarawak, 25.8%, and Sabah, 14.9%. Efforts to increase the nation's oil reserves include focusing on exploration of deep-sea oil fields and gathering three dimension (3D) seismic data onshore in Sarawak. An estimated 11 oil exploration wells and 13 development and production wells were explored in 2001 as compared to 26 oil exploration wells and 56 oil development and production wells in 2000. In the first six months of 2001, four new oil fields were found (January-June 2000: five new oil fields)\textsuperscript{11}.

\textsuperscript{10} Source: Economic report 2001/2002, Ministry of Finance Malaysia, pg 74
\textsuperscript{11} Ibid, pg 45
1.7  What is Petroleum?

The term petroleum originated from the ancient Greeks, where ‘petra’ means rocks or stones and ‘oleum’ is a Latin word which means oil. Most of the oil, which is found, is usually contained under rocks and that is why it is known as petroleum\textsuperscript{12}.

Generally, the word petroleum is used widely for crude oil and natural gas. Oil and natural gas are also known as hydrocarbons because its chemical composition comprises of 2 elements, which are hydrogen and carbon. Crude oil is liquid hydrocarbon and natural gas is hydrocarbon in the form of gas. Besides hydrogen and carbon, crude oil also consists of other chemical compounds such as sulfur in various quantities. Crude oil with a low sulfur content is known as sweet crude, and if the sulfur content is high then it is known as sour crude. Crude oil and gas that are sour typically have an odor of rotten eggs if the concentration of sulfur is low. At high concentrations, sulfur is odorless and deadly. The facilities to handle sweet crude are significantly cheaper than those required for other potentially corrosive types of crude oil.

Crude oil from different parts of the world or from different areas in a country may differ in its form and characteristics. The crude oil from Malaysia is different than the crude oil produced from the Middle East in the sense of texture and the smell. The color can also vary, from green to yellow to dark brown or even black. Certain crude oil is sticky and has a very high viscosity and some are very diluted and has a low viscosity.

\textsuperscript{12} Source: PETRONAS Brochure, 1988 p.1
Natural gas is often found together with crude oil. Natural gas, which is found in its natural state, contains many different types of compounds and elements. The highest content of a compound or element found in natural gas is methane followed by ethane, propane, butane, pentane and other heavy hydrocarbons, which exists in smaller quantities. In its natural state, which is under very high temperature and pressure, natural gas and its other hydrocarbon components are naturally found in gaseous form. But when it is brought up to the surface, where it is not subdued to high pressure and temperature, the chemically heavier components turn to liquid, which is known as condensate.

1.8 Differences between oil and gas

Normally a field contains a mixture of oil and natural gas as well as water. For example, if the field consists mainly of oil, then the gas that is extracted will be flared (burned offshore). Sometimes, if the amount of gas is significant, a pipeline using separators offshore will collect it. The main difference between oil and natural gas is that natural gas is bulky and difficult to store, and therefore not easily transportable. Gas pipelines are normally much bigger than oil pipelines.

Natural gas has to be in great quantity before it can be economically extracted and has to be near the location that can utilize it such as a population center or petrochemical/industrial areas. Petrochemical plants are normally built at the shore.

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13 Lee Chong Fong, ‘Offshore Oil and Gas Construction Industry in South East Asia’, School of Postgraduate Management Studies, National University of Singapore, 1993/1994, p.16-17
nearest to the gas field, so that the gas can be used as feedstock. In Malaysia petrochemical plants can be found in Kertih and Gebeng.

Otherwise, Liquefied Natural Gas (LNG) plants are built nearby to convert natural gas into liquid form before being transported elsewhere. Sale of LNG is normally on a long-term contract basis such as for 10 or 20 years. It is normally not sold in the open market the way that oil is. The price of oil is normally quoted to represent the price for oil and gas as it represent the current situation and is traded openly worldwide.

However, in terms of construction, there is no significant difference between oil and gas. Pipelines for oil and gas are installed in the same manner. Although for the same diameter pipelines, the concrete weight coating is thicker thus heavier for the gas pipeline. The equipment for the production platforms may be different but the platforms themselves are installed in the same manner.

1.9 Organization of Thesis

As a background to this study, Chapter 2 addresses pertinent theoretical issues while Chapter 3 describes the methodology of the study. Chapter 4 describes about PETRONAS and its involvement in the petroleum industry while Chapter 5 provides the case studies. Chapter 6 reviews the findings of the case studies while Chapter 7 concludes summarizes the main findings of the study. Each of the chapters is briefly reviewed as follows:-
Chapter 1. Introduction

This chapter provides a summary of the thesis.

Chapter 2. Literature Review

This chapter provides the theoretical framework for this study. It begins with a discussion of how technology has become a key aspect to the competitiveness of businesses and the economic growth of nations and a vital strategy to a company's success. The types of technology and how tacit knowledge is able to develop technological capabilities to help a firm's growth is also discussed. The discussion then proceeds to technological capabilities accumulation. Accumulation of capabilities is not an easy task and does not happen in a matter of days. It takes a lot of time and strategic planning to ensure that the needed capabilities are acquired and used effectively. Besides that, the performance of a firm based on the accumulation of capabilities is also discussed. The core competence of a firm is discussed as it shows how companies direct and control their capabilities. Next the technological embodiment is also described, as it is the next step after acquiring capabilities. Technological capabilities are made up of several key abilities which include seeking opportunities, selecting appropriate solution and implementing change effectively. The last part of this chapter discusses the technology capability development mechanism, where different mechanisms are listed to help acquire capabilities effectively and efficiently.
Chapter 3. Research Methodology

This chapter details the procedures employed in gathering the empirical material for this study. It emphasizes that a case study approach was adopted for this study as it afforded more detailed understanding of the effort taken by the PETRONAS management to acquire and develop technological capabilities. The research limitation of this study is also described.

Chapter 4. An Overview of PETRONAS

The chapter gives a brief account of the Malaysian petroleum policies and its history of oil discoveries in Malaysia. The birth of PETRONAS and its history are also described in this chapter. Besides that, the company profile and its operations in the upstream and downstream are discussed. The last part of the chapter describes the evolution of the Malaysian Production Sharing Contracts (PSC) and the differences of each PSC system.

Chapter 5. Case Studies

This chapter provides an overview of the activities, which PETRONAS adopted to show its effort in acquiring and developing its technological capabilities. The four case studies provide various approaches taken by PETRONAS to strengthen its capabilities. These case studies are obtained through various sources and articles, and are further discussed in Chapter 6.
Chapter 6. Analysis and Lessons Learned

This chapter provides the analysis for the case studies as well as examining PETRONAS’ deliberate methods in acquiring technological capabilities. Strategies used to obtain capabilities and its core competencies are also discussed. The role of the management, which is very flexible and responsive, was also one of the key themes, which was analyzed in this chapter.

Chapter 7. Summary

This chapter provides a summary of the key findings of this study. PETRONAS’ future is also discussed as well as the recommendations for future studies that can be done to improve this study.