

# **Value Chain Analysis along the Petroleum Supply Chain**

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## **Declaration**

I declare that “Value Chain Analysis along the Petroleum Supply Chain” is my own work, both in concept and execution. It has not been submitted for examination in any other university, and all sources that I have used or quoted from have been indicated and acknowledged by complete references.

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## **ABSTRACT**

The wide range of the petroleum industry's products as well as the varied value of these products coupled with the global nature of the petroleum industry presents both challenges and opportunities within the petroleum supply chain. It is along this supply chain that challenges for creating value for the customer exist as well the opportunities for reaching this goal. Value chain analysis methodology has been hailed as being capable to lend itself to process improvement challenges faced along supply chains. To achieve this objective, a case study method was used to collect and analyse data. This dissertation identifies and follows one of the supply chains of a petroleum company operating in South Africa to investigate how value chain analysis can be implemented along its supply chain.

The study confirms the key findings in the value chain analysis literature, especially the issues around strategic value chain activities and their importance in conferring competitive advantage in the context of the oil industry. In addition, the study reflects the challenges that oil companies that are integrated all the way to the retail end of the supply chain face.

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## Chapter 1

### Introduction

In recent years, developments in the dynamic global economic environment have caused many businesses to modify their strategies in order to remain competitive. One of the most significant drivers of change in the business environment in the world today is globalisation. A notable result of this phenomenon in business has been the opening up of new markets that were previously closed due to cost, regulations or indirect barriers such as the ability to tap labour and knowledge resources on a world wide scale (Kraemer, 2002). In the process, businesses have opportunities to reap higher incomes and also the improved availability of better quality and increasingly differentiated final product by trading on a global scale (Gereffi *et al.*, 2001). Benefiting from these opportunities however, requires a fundamental restructuring of organisational strategy and processes (Bradley *et al.*, 1993) to cope with the global competition.

Many firms around the world have had to come up with advanced manufacturing technologies to keep up with competitors in order to curb waste and increase the “speed to market”. Furthermore, due to the increase in competitive pressures, many companies are using new technologies to extend their products and operations to achieve new innovative transactional organisational forms (Boudreau *et al.*, 1998).

An example of new technology is the advent of e-commerce. This phenomenon has posed various concerns for many organizations as the world has become a global market place where firms need to be more streamlined and efficient while simultaneously extending the geographic reach of their operations (Kraemer, 2002). The adoption of the new technology such as the internet makes it cheaper and easier for firms to extend their markets, manage their operations and coordinate value chains across borders (Cavusgil, 2002; Williams *et al.*, 2001; Globerman *et al.*, 2001). As a result of firms’ globalisation of services, the ability to reach a wide variety of customers has been increased and thus giving consumers a wider choice of products. Thus technology has both been driven and

has been a driver of globalisation, as both forces continually reinforce one another (Bradley *et al.*, 1993).

Given the many choices of product available to the customer, the advances in technologies described above have also increased customer's expectation of better product functionality and quality. In past year's firms succeeded by focusing on a limited product range but all has changed due to businesses shifting in focus to customer satisfaction rather than low cost production. Today many of the critical success factors for any business are customer oriented (Blocher *et al.*, 2005). The challenge now for business is to provide quality products, exceptional service, timeliness of delivery, and flexibility so as to respond to customer's desire for specific features but at the same time maintaining competitive advantage.

In addition to all these challenges faced by businesses, operating in a global economy means providing services to customers from different societal and cultural backgrounds. This new business environment requires firms to be sensitive to these differences and to that extent, firms are also required to focus on the external environment in which they operate and the society in which the customer lives.

These changes to the global economic business environment have affected the operations of many industry sectors and the petroleum industry is no exception. This is particularly true because the increase in business activity around the world has resulted in an increase in the demand for petrochemical products. Due to the steady increase in global demand for oil and its derivatives, oil and petrochemical companies have managed to increase their market share and profitability through reaching a wider customer base (Hussain *et al.*, 2006). However, due to the rigidity in the petroleum industry's supply chain, this boom in the global demand and the ease of international trade has made the petroleum industry's supply chains more complex and challenging to manage (Coia, 1999). Hussain *et al.*, (2006) ascribed this rigidity to the constraints such as long lead-times, manufacturing capacity, and limited means of transportation along the supply chain, which are in most cases beyond the control of the petroleum companies. At first glance,

one way that appears to be feasible to reduce the lead time and transportation costs, is opening distribution centres closer to the dispersed customers. However, the inventory and operating costs of acquiring the facilities are often substantial (Hebert, 2004)<sup>1</sup>. Under these circumstances, oil and petrochemical companies either pass on the costs to the already overburdened customers or absorb the cost.

Furthermore, due to the global nature of the petroleum business, the transportation of oil and its products between locations which in most cases are continents apart presents a huge challenge. The modes of transport which are normally used in the transportation of crude oil and its derivatives are mainly by ships, trucks, pipelines or by rail. In some instances, a shipment can utilise all transportation modes before reaching the final consumer. The long distances between parties along the oil supply chain, coupled with the slow modes of transport increase transportation and inventory costs. These transportation challenges require that entities along the supply chain devise innovative ways of meeting the highest levels of service and still be cost-effective. A true solution recognizes the broad range of entities making up the supply chain and views it as a whole rather than individual links in order to enable efficient and profitable operations across the entire business (Clark, 2005).

The supply chain of the petroleum industry is therefore, extremely complex compared to other industries (Hussain *et al.*, 2006). It is much bigger than procurement and logistics; it is an entirely new way of thinking and organising the total lifecycle from raw materials to use of a final product or service by an ultimate consumer/user. It comprises of two major segments: the upstream and downstream supply chains. The upstream supply chain involves the acquisition of crude oil, which is the specialty of the oil companies. The upstream activities also include 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 converted into consumable products that are the specialty of refineries and petrochemical companies. The downstream supply chain also involves demand forecasting, production and the

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<sup>1</sup> <http://www.azstarnet.com/dailystar/starmedia/31783>.

logistics management of delivering the crude oil derivatives to customers. It is within these two segments of the supply chain that the challenges in creating value for the customer exist as well the opportunities in reaching this goal.

Hussain *et al.* (2006) identified numerous challenges that the petroleum industry faces. These include logistical challenges, integrated process management, information systems and information sharing, organisational restructuring and cultural reorientation. Improved supply chain efficiency in the petroleum industry will help in addressing these challenges. Given that both challenges and opportunities lie within the entire oil supply chain, it follows therefore that improving the supply chain processes does have potential to confer competitive advantage via creating value for the customer.

Supply chain management (SCM) is one of the business models that many industries are turning to as a strategic response to intense competition, to help transform their operations to become more responsive to ever-changing customer needs ( Poirier, 1999). Supply chain management involves the flow of the entire organization's set of activities, materials and other resources required to produce and deliver the product to the final customer. SCM can be defined as;

“An integrative approach to manage the total flow of a distribution channel from the supplier to the ultimate user”, (Schary and Skjott-Larsen, 2001; p. 25).

Companies can not afford to ignore what other parts of the chain are doing, as actions by any one firm in the supply chain will influence the profitability of others. Hence, firms now look to compete as part of a supply chain against other supply chains, rather than a single business against other firms (Johnson and Pyke, 1999). One example of successful implementation of SCM is in the automobile industry as described by Albright and Davis (1999). Thus, the holistic view that supply chain management adopts requires that value is added along each stage of the chain in order to maintain competitive advantage. In order to achieve this, the management accounting literature argues that it is necessary for supply chains to effect process improvement using various techniques or methodologies.

These approaches are all bandied under the term strategic cost management as propounded by Shank and Govindarajan (1992). Some of the common techniques that constitute strategic cost management include Activity - based Costing (ABC) and Activity- based Management (ABM) target costing, value chain analysis, etc. Of these techniques or methodologies, the value chain analysis methodology has been hailed as capable of lending itself so easily to process improvement challenges faced along supply chains (Chivaka, 2007). Thus one way of enhancing value creation along the supply chain is the application of a value chain analysis methodology in order to ensure that all activities performed create value for the end-user.

The concept of the value chain was developed by Porter (1985) as a concept to describe a sequence of stages of value-adding activities for product flow within the firm, namely; inbound logistics, operations, outbound logistics, sales and marketing and service. Understanding the cost structure of each activity enables the firm to understand the whole organizations cost structure, which in turn allows the firm to formulate a competitive strategy. The value chain can be defined as” a linked set of value creating activities” (Shank and Govindarajan, 1992; p14). The focus of the value chain is both internal and external to the firm (Thompson and Strickland, 1996), thus it focuses on all the overall value creating activities of which the firm is a part, from basic raw materials to end-use customer.

The value chain concept differs from the traditional management accounting system which is largely internal to the firm and takes a value-added perspective because of its focus which starts with purchases and ends with charges to customers. In contrast, the strategic insights yielded by value chain analysis, however, differ significantly from, and are superior to those suggested by value added analysis. Value chain analysis describes the activities the organization performs and links them to the organizations’ competitive advantage.

Porter, (1980) noted that for any business to compete and survive in today’s highly competitive environment, a company must achieve and maintain a sustainable

competitive advantage. This can be done by following any one of three strategies; low cost, differentiation or focus. The concept of the value chain aims to provide a break down of the whole supply chain into value creating activities and non-value creating activities. This enables the organization to focus on value creating activities and minimize or eliminate non-value creating activities (Shank and Govindarajan, 1992). Value chain analysis has been used to analyse the airline industry, manufacturing industry with great success (Shank and Govindarajan, 1992). However, apart from Porter's work (1985) and a few other scholars (Shank and Govindarajan, 1992; Donelan and Kaplan 1998; Tagoe 2001 and Hoque 2005), there is very little literature on value chain analysis as a tool to assist in the effective management of supply chains in order to support strategic cost management efforts.

This research therefore aims at analysing how value chain analysis can be applied along the petroleum supply chain to support value creation for the firm by answering the following question:

*How is value chain analysis applied along the supply chain to support value creation within the South African petroleum industry?*

### **Research objectives**

The focus of this research is to gather information about the petroleum value chain with the intention of illustrating how the value chain analysis methodology is applied along the petroleum supply chain and in what ways it confers competitive advantage. To this end, the dissertation seeks to analyse the extent to which value chain analysis influence and informs management strategy. In addition, the research aims to identify existing linkages between activities along the chain with particular emphasis on activities performed around the core assets employed along the value chain.

Lastly, an analysis of the costs associated in performing activities and categorizing all activities into non-value adding and value- adding activities along the value chain aims to

provide insights into the areas of process improvement. In so doing the research aims to identify areas where operational efficiency can be achieved.

### **Organization of the dissertation**

Chapter 2 discusses value chain analysis in the context of strategic cost management. The work by Michael Porter in the 1980s among other scholars will feature prominently in this chapter. Chapter 3 details a case study methodology followed in gathering and analysing data from the research site. The chapter provides the motivation for the case study and how this choice assisted the researcher in achieving the study's objectives.

In chapter 4 the research findings are discussed and a final analysis presented using both qualitative and quantitative data. Finally Chapter 5 concludes with the major findings, as well as outlines some limitations of the current study and potential future research areas.

## **Chapter 2**

### **Literature review**

#### **2.1 Introduction**

In this chapter the concept of strategic cost management is defined and examined through the brief description of a number of tools employed by management in formulating and achieving strategic objectives with particular focus on value chain analysis.

#### **2.2 Strategic cost management**

In the face of increased pressures of global competition, managers have had to think of different strategies to maintain competitive advantage. As discussed earlier a company can choose to employ any one of the three strategies; cost leadership, differentiation and focus. The successful implementation of these strategies requires management to have cost information that supports their chosen strategy. Strategic cost management can be used to support managerial use of cost information to formulate and communicate strategy (Govindarajan and Shank, 1992). A number of strategic cost management tools can be used by managers to generate cost information for use in process improvement, these include, target costing, life-cycle costing, balanced scorecard, just in time, theory of constraints, benchmarking, continuous improvement, total quality management, activity based costing, activity based management, and value chain analysis.

#### **2.3 Strategic Cost Management – definition and explanation**

Strategic cost management can be defined as the use of cost information to do the following:

“.....formulate and communicate strategies; carry out tactics that implement those strategies and then develop and implement controls that monitor success at achieving strategic objectives.” (Govindarajan and Shank, 1992; pg 295)

Cost information is critical on all these stages in strategic cost management. The explicit attention of management to strategy is what distinguishes strategic cost management.



### **Target costing**

Target costing can be defined as "... a cost management tool for reducing overall cost of a product over its entire life cycle with the help of the production, engineering, R&D, marketing, and accounting departments" (Reeve, 2003; pg 385). The logic of target costing is that of looking at tomorrow's market and determining what level of quality and functionality will succeed within each segment, given a predetermined price (Cooper and Chew, 1996). The focus of target costing is reducing costs not only at the production stage but also at the planning and design stages (Sakurai, 1984).

Delivering products customers want at a price they are willing to pay is a fundamental premise of target costing (Cooper, 1995). To achieve this target costing practices treat selling prices and margins as uncontrollable variables because the markets determine the prices and companies must earn adequate margins to remain in business over the long term, thus the only variable that management can control is cost. Thus target costing focuses management attention to cost management with the goal to produce products that meet customers' acceptable standards for quality, functionality and price. Success in managing these three elements ensures companies gain competitive advantage (Albright, 1998). To this end, target costing ensures that success with customers will yield economic success for the company. Albright (1998) highlighted such success in developing the Mercedes M-Class in 1998.

### **Kaizen costing**

Another management tool which can be used with target costing is a management process called *Kaizen* costing or continuous improvement which was developed by the Japanese. *Kaizen* costing starts at the manufacturing stage and thus begins where target costing ends. The role of cost reduction at this phase is to continuously develop new manufacturing methods and to use new operational controls such as total quality management to further reduce costs (Blocher *et al*, 2003).

### **Life-cycle costing**

Life -cycle costing provides a long term perspective because it considers the costs of the product from concept to customer after sales service. It therefore provides a complete perspective on product costs and products profitability throughout their life-cycle. For instance poor design of a product can lead to high costs in customer after sales costs due to returns and defective products. Poor product quality and functionality will in turn lead to loss of customers. Therefore lifecycle costing provides management with insights into the consequences of developing a product and possible areas for improvement and likely areas of concerns that will require careful monitoring (Blocher *et al*, 2003).

### **The balanced scorecard**

The balance scorecard is an accounting report that focuses not only on the financial aspects of the business but also incorporates the strategic aspects of the business. The rationale behind the balanced scorecard is that as much as financial information is vital for business survival, a clear strategic focus is equally important and should complement the financial aspect of the business (Kaplan and Norton, 1996). The balanced scorecard does more than measure performance; it can communicate, provide feedback, create learning and help managers align strategic objectives with daily operational control, (Clinton and Hsu, 2003). Therefore, the use of the balanced scorecard is a crucial ingredient in the overall strategy of the business in its bid to remain competitive.

### **Just-in-time (JIT)**

JIT can be described as a set of manufacturing techniques and concepts or a philosophy of doing business that minimizes inventory levels and enjoys the commensurate effects of doing so. Japanese companies have been very successful in implementing JIT (Clinton and Hsu, 2003). JIT exposes any manufacturing problems because there is no buffer stock in inventory. As a result delays in the manufacturing process ensue. These delays will inevitable lead to increased manufacturing costs. Therefore, JIT is quality oriented and emphasizes simplicity in the manufacturing process and prevention of future problems.

### **Theory of constraints**

The theory of constraints (TOC) is a systems-management philosophy developed by Goldratt in the 1980s. The idea behind TOC is that constraints determine the performance of any system and any system has a few constraints. TOC advocates that management focus on these constraints rather than product costs. TOC can be used to reduce production lead times, improve product quality and dramatically improve profitability (Ruhl, 1996).

### **Total Quality Management (TQM) and Benchmarking**

The pursuit of high quality goods and continuous improvement of business processes has become the focus of many businesses. Quality ensures customer satisfaction and business success and ultimately profitability. If customers are satisfied then the business will grow its market share and maintain competitive advantage. TQM demands that all business processes make a concerted effort to continuously improve on quality in order to meet and exceed customer expectations. Quality has become one of the key competitive variables and this has created the need for businesses to focus on the elimination of inferior goods and services. This will in turn lead to substantial savings and higher revenues. Furthermore, companies can use benchmarking as a cost management tool in conjunction with TQM to achieve competitive advantage. Benchmarking is a process whereby a firm identifies its critical success factors and studies the best practices of other organizations and uses them as a standard for exceptional performance.

However, every organization is unique and best practices may not necessarily be relevant to the way the company operates. Thus, although benchmarking provides guidelines, companies still need to analyse their own operations and formulate a strategy that best suits their business and the way the business chooses to compete.

### **Activity- based costing (ABC)**

ABC is defined as

“the collection of financial and operational performance information tracing the significant activities of the firm to product costs”(Young, 2004; pg 59).

ABC assigns product costs based on the activities that a product draws upon. An activity may be defined as a particular operation in the production cycle, or it could be defined as the entire material acquisition process (Raffish, 1991). ABC approach assigns costs to activities because it is activities that consume resources which are necessary for the provision of products and services. This is achieved by using two classes of cost drivers; the underlying assumption of the first class of drivers is those related to the volume produced and the underlying assumption of the second class is those unrelated to the volume. There is no direct relationship between resources consumed and the volume produced (Cooper, 1988).

ABC is beneficial to firms because it provides more accurate costing information which means products can be priced more accurately when the cost of making them has been derived accurately. Furthermore, the accuracy of the product's profitability is also improved aiding management in decision-making. Coupled with the improved accuracy in costing there is improved cost management and more informed process improvement efforts.

However, allocating cost and determining relevant cost drivers can be difficult because not all costs have appropriate or unambiguous activities. Also some costs though not specific to the product are essential for the production of the product these include facility-sustaining costs for example warehouse insurance and security costs. It is also particularly difficult to ascertain how much advertising and marketing costs should be allocated to a particular product. Furthermore, an ABC system is very expensive to develop and time consuming to implement

### **Activity-based management (ABM)**

ABM manages activities to improve the value of products and services to customers as well as increasing the firms' profits (Blocher et al, 2005). ABM draws on ABC as a major source of financial information to inform management in strategies to improve operations, reducing costs or increasing value to customers. By identifying resources

spent on customers, products and activities, ABM improves management focus on the firms' critical success factors and enhances competitive advantage.

Cooper and Kaplan (1998) classify ABM applications into two categories namely operational ABM and strategic ABM with the former centred on enhancing operational efficiency and asset utilization. The latter's thrust is on altering the demand for activities and increasing profitability at the current or improved activity efficiency. Thus, strategic ABM focuses on choosing the right activity for the operation.

ABM also uses cost driver analysis, activity analysis and performance measurement to improve operation. However, ABM's reliance the ABC information will not aid managers when the activity analysis becomes difficult or if the cost drivers are not allocated appropriately.

### **Value chain analysis**

Porter (1980) outlines the need for businesses to have a competitive strategy in order to be profitable. Competitive strategy should lead a firm to either a cost or differentiation target. Porter (1980) argues that a firm should not attempt to both differentiate and be a low cost leader, as this can lead a firm to be caught in the middle and lose out to firms that do specialize (Ankli, 1992). These generic strategies are strategic approaches that firms can use to outperform others in the industry.

Porter argued that any organization can derive profitability from any one of two ways:

- i) the attractiveness of the industry in which it operates
- ii) the company's relative position within the industry

This means that if an organization has a strong relative position than its competitors then it has potential competitive advantage. "A competitive advantage is something a firm can do that rivals cannot match"<sup>2</sup>. The question then is *how does an organization attain*

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<sup>2</sup> <http://www.pcte.edu.in/site/OJMR/Marketing/devstg.pdf> "Developing Marketing Strategies to create competitive advantage", pg 2.

*competitive advantage?* Thus, as mentioned above, firms can choose any one of three strategies; cost leadership, differentiation or focus.

### **Cost leadership**

Cost leadership requires a high relative market share or other advantages such as easy access to raw materials. A cost leader must find and exploit all sources of cost advantage. Low cost producers typically sell a standard or no frills product and place considerable emphasis on reaping cost advantages from all sources (Porter, 1985). Low cost can be achieved through these approaches; economies of scale in production, experience curve, tight cost controls and cost minimization in such areas as design, service and advertising (Shank and Govindarajan, 1992).

### **Differentiation**

This strategy's primary focus is to produce a product that customers perceive as unique. Product uniqueness can be achieved through branding, superior customer service, product design and superior technology. In differentiation strategy a firm seeks to be unique in its industry along some dimensions that are widely valued by buyers. It selects one or more attributes that many buyers in an industry perceived as important and uniquely positions it to meet those needs. It is rewarded for its uniqueness with a premium price. A firm that can achieve and sustain differentiation will be an above average performer in its industry if its price premium exceeds the extra costs incurred in being unique. A differentiator therefore, must always seek ways of differentiating that lead to a price premium greater than the cost of differentiating (Porter, 1985).

### **Focus**

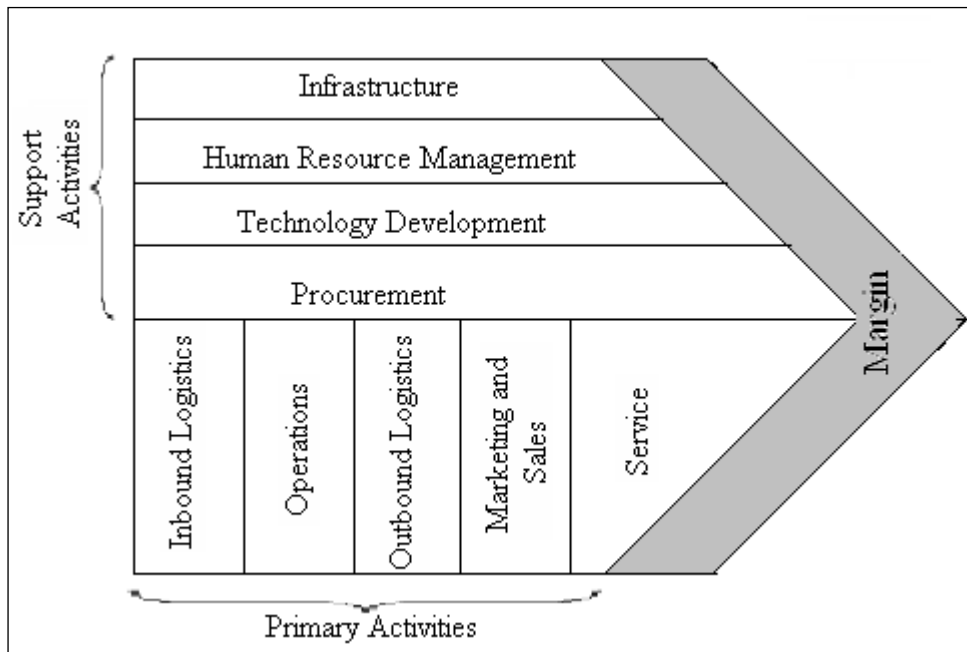
This strategy is significantly different to the other two because it rests on the choice of a narrow competitive scope within an industry. The focus strategy requires one to identify a segment or a group in an industry and tailor its strategy to serving that group or segment exclusively. By so doing the focuser will aim to optimize its strategy for the target group to achieve a competitive advantage in that particular segment even though it does not necessarily possess a competitive advantage overall.

There are two main variants to the focus strategy: cost focus and differentiation focus, in cost focus the firm aims to achieve cost advantage in its target market while in differentiation focus the firm seeks differentiation in its target segment (Porter, 1985). However, for the success of the strategy rests on the differences between the focuser's target market and other segments in the market. For instance, the target segments can either have buyers with unusual needs or a production and delivery system that are unique in the market. Cost focus will target cost behaviours' in the market and cost differentiation will aim at optimizing and exploit the special needs of buyers in certain segments.

In his next book, Competitive advantage in 1985, Porter introduced the concept of the value chain. Once a firm has established its competitive strategy, it can then develop competitive advantage by applying the value chain concept. The value chain is so called because each stage of the business processes should add **value** (Donelan and Kaplan, 1998). Shank and Govindarajan (1992) describe value chain analysis as one of the major themes in strategic cost management that enables managers to organize their thinking around managing costs because of its broad focus.

According to Porter, (1985) a value chain includes everything that contributes to a major organisational output. Value chain analysis describes the activities the organization performs and links them to the organizations competitive position. Therefore, it evaluates what value each particular activity adds to the organizations products or services. Porter argues that the ability to perform particular activities and to manage the linkages between these activities is a source of competitive advantage, as shown in Figure 1 below:

Figure 1: The basic model of Porters value chain



Adapted from Porter (1985)

Margin implies that an organization realizes a profit as a result of their ability to manage linkages between all activities in the value chain. The organization should be able to deliver a product/service for which the customer is willing to pay more than the sum of the costs of all activities in the value chain.

The focus of value chain analysis is on the products' total value chain, from design to manufacture to distribution and finally to the customer. In any industry a company can occupy selected parts within the industry value chain. It is unusual that a single company performs all activities from product design, production of components, and final assembly to delivery to the final user by itself. Most often, organizations are elements of a value system or supply chain. Hence, value chain analysis should cover the whole value system in which the organization operates. The business determines which part of the value chain to compete in depending on its strategy and core competencies. For instance in the paper manufacturing industry, one firm can decide to concentrate on the upstream activities which include forestry and milling. On the other hand another can focus on the



downstream activity which could incorporate the marketing and distribution of paper and sales. Although the areas of operation of the two organizations differ, they rely on each other's success, in the sense that the success of the paper sales ensures that the forestry and milling business remain operational. This means therefore that activities external to the firm have become critical as much as internal activities such that businesses need to have an external focus to be able to survive in the global environment. This is why value chain analysis has emerged as one of the useful techniques in understanding intra-organization and inter-organization processes to better identify sources of competitive advantage (Chivaka, 2007).

Whether an organization can develop and sustain their chosen strategy depends fundamentally on how the firm manages its value chain relative to its competitors. Ultimately competitive advantage is derived from being able to provide better customer satisfaction for a lower cost. Thus value chain analysis can assist business to identify where value can be enhanced and where costs can be reduced. An organization performs activities such as product/service design, production, marketing and delivery to support the strategy. Although these activities provide support to the strategy, they however fall short in providing an analysis of the business processes and their strategic importance to the business. Value chain analysis is then employed to assist in the decomposition of the business activities into strategically important activities and facilitating the understanding of the impact of these activities on the overall business processes.

This analysis of value chain activities enables management to understand the behaviour of costs across different activities and bring management focus to these activities. By conducting an activity analysis in the value chain, management is able to have an understanding of the interdependencies in processes across business units and activities. Furthermore, management can fully grasp the impact of suppliers and customers on the activities the business performs and their associated costs, and thus facilitates the identification of sources of differentiation.

### **Strategic cost management: A value chain perspective**

From a strategic cost management perspective value chain analysis has three key attributes that make it a very useful tool. These are;

- 1) A clear identification of the strategy chosen by the organization
- 2) Its emphasis on sources of sustainable competitive advantage
- 3) Its focus on the importance of complex linkages and interrelationships.

#### **1. Identification of a clear strategy chosen by the organization**

It is important for an organization to have a strategy in place in order to compete in the global economy. Value chain analysis emphasizes the need for organizations to manage costs, activities and processes in the context of the strategy selected by the organization. The companies' overall thinking should be in line with their strategy and in turn activities and processes should support the company's strategy. In other words, there should be a strong link between value chain activities and the organizations strategy. This leads to the determination of value chain activities which give the organization the potential of sustaining its competitive advantage thereby creating value for the consumer.

The organization needs to identify strategic and non-strategic value chain activities. Strategic value chain activities are those activities that are critical in the organizations' ability to provide products and services to their customers and are pertinent in the organizations ability to maintain a competitive advantage (Chivaka, 2007).

Non-strategic activities are those activities which are important in the overall provision of products and services for example within the oil industry's value chain, security services are important for the provision of a service but are not core activities that the business is about. These services do not offer competitive advantage and usually these activities are outsourced, reduced or streamlined. Failure to link value creating activities will result in huge wastage due to the performance of activities and processes that are not longer compatible with the organization strategy. Furthermore, continued emphasis on non-

strategic activities will result in the increase in costs and thus impact on the ability of the business to maintain competitive advantage.

## **2. Emphasis on sources of competitive advantage**

After identifying the strategic and non-strategic value creating activities, the focus should be firmly on strategic value creating activities (Chivaka, 2007). Each activity has a set of unique cost drivers that explain variations in costs in a particular activity (Shank, 1989). Thus each activity has its unique sources of competitive advantage.

Companies need to analyse value activities and their impact to the rest of the chain in order to understand the impact each activity has on the overall chain. Furthermore this analysis provides the efficient monitoring of the different activities and identification of the various challenges faced at each activity. It is clear that at each level of value activities the business faces different challenges and different competitors. For instance some competitors may be a fully integrated company and some are focused specialists. It is therefore critical for the business to approach these challenges differently and not adopt an across the board solution which will not yield success. Although the challenges are different for each activity, the impact is felt throughout the chain, therefore value chain activities should be managed bearing in mind the interrelation that exists within the chain.

## **3. Focus on the importance of complex linkages and interrelationships**

Value chain analysis emphasizes the importance of both internal and external linkages and interrelationships within the chain.

### **a. Internal linkages**

Internal linkages are typified by relationships between tasks and activities that form part of a process within the organization. For instance, in the oil industry there are linkages within business units to provide gasoline to the consumer at the service station. These would typically be from manufacturing – refinery to the distribution network which is usually done by the logistics segment of the business. It is of paramount importance for the business to identify value creating activities throughout the business processes. This

will give management a process view of their business and how each unit can contribute to the improvement in processes, cost reduction efforts, capacity utilization and overall business efficiency importantly.

### **b. External linkages**

The external linkages and interrelations are mainly between the suppliers and the customers. This represents the supply and demand interfaces of the business. Traditionally, the relationship between suppliers and customers has always been strained and hence the adoption of the value added approach which begins with purchases and ends with sales. However, this approach has two big disadvantages in that it starts too late and ends too soon (Shank and Govindarajan, 1992). Starting the cost analysis process with purchases misses the point of exploiting linkages with suppliers. This is an important linkage because the supplier has a strong effect on the cost of the business's product or service. Due to the broad analysis of the value chain the business is able to exploit its linkages with suppliers and customers.

Linkages with suppliers should be managed such that the relationship is beneficial to both parties. Suppliers not only produce and deliver products used in the business's value activities but in so doing they influence the cost structure of the company. It follows then that the suppliers indirectly affect the companies' differentiation position hence influence the companies' strategy. Furthermore, the activities of an organization's upstream value chain can affect the performance of the down stream activities. For instance, an outbreak of mad cow disease on a farm can have far reaching effects which will be felt right down the value chain by the customer at a fast food restaurant. It is thus very important for any organization to have a value chain approach to dealing with suppliers and strive for a collaboration approach. The success of such collaborative relationships can present dramatic results for the business. A case in mind is the success of a bulk chocolate supplier which introduced an innovative delivery system of transporting chocolate in liquid form thereby reducing packaging and moulding costs. These savings were in turn passed to the confectionary producer who also eliminated unpacking and melting costs (Porter, 1985).

Customer linkages are also equally important and again the relationship should be of mutual benefit to both parties. It is of paramount importance for the business to realize that maintaining customer loyalty ensures business sustainability. There are numerous examples where these linkages have proved beneficial to both parties. Hergert and Morris (1989) report of some container manufacturers that chose to locate their businesses next to beer producers and deliver their products directly to the assembly line of the beer producers. The result of this partnership was significant transport cost savings of transporting such bulky containers. It is apparent that if a firm product costs constitute a huge percentage of the customer's total costs then the firm should look for opportunities to exploit any linkages that might exist.

For any organization to gain and sustain competitive advantage requires an understanding of the entire value system and not only the portion of the value chain in which it operates. Suppliers and customers and suppliers' customers' customers have profit margins that are important in identifying a firm's positioning and its cost structure. An understanding of the entire value system also aids in decision-making for management in that all businesses in the value chain understand the overall performance of the industry in which they operate. Furthermore, as companies analyse their value activities they can decide to streamline or expand operations depending on their competencies in the value chain.

### **Value Chain and Cost analysis**

Once value activities have been identified then costs associated with performing these activities can be assigned to the respective activities. A firm's cost position results from the cost behaviour of its activities. Cost behaviour depends on the number of structural factors that influence cost, which Porter (1985) terms 'cost drivers'. Drivers often interact to determine the cost of an activity, therefore the impact of cost drivers can be the sole determinant of a firm's cost position. Understanding the nature of cost drivers of each activity allows a firm to gain a sophisticated understanding of the sources of its relative cost position and how it can be managed. Furthermore, early identification of cost dynamics can yield a significant cost advantage by directing a firm toward those value

activities that will have the greatest leverage for the future relative cost position but may not be currently receiving attention (Porter, 1985).

Cost driver analysis should be conducted to show management what is influencing the behaviour of their costs and this will in turn facilitate the development of strategies to sustain competitive advantage through controlling costs better than the competition. A firm gains cost advantage if its cumulative costs of performing all value activities is lower than competitors' costs. The strategic value of cost advantage hinges on its sustainability, i.e. when sources of a firm's cost advantage are difficult for competitors to imitate (Porter, 1985). It is important to understand that assigning costs and assets does not require the precision needed for financial reporting; estimates are more than adequate to highlight strategic cost issues (Shank and Govindarajan, 1992). However, cost advantage leads to superior performance only if the firm provides an acceptable level of value to the buyer so that its cost advantage is not nullified by the need to charge a lower price than competitors (Porter, 1985).

### **Developing a sustainable competitive advantage**

Having done an analysis of the costs and understood the cost drivers, a company can now begin to gain sustainable competitive advantage by either controlling cost drivers better than competitors or by reconfiguring the value chain. As discussed earlier, a company needs to know the costs, revenues and assets for each value activity in the chain, so as to gain competitive advantage by answering the following questions:

*Can costs be reduced while holding revenues constant or increasing revenues?*

*Can revenues be increased while holding costs constant?*

*Can assets employed in each activity be reduced while holding costs and revenues constant?*

### **Power of the Value Chain**

Walters and Lancaster (1999) acknowledge the importance of the value chain as the ideal vehicle when used to identify an organisation's strengths and weaknesses and to compare these with the opportunities posed by its external environment. An example of the superior insights which can be derived from the application of the value chain is Shank and Govindarajan (1992) analysis of a case study of the airline industry. The study discussed a comparison of insights from traditional cost accounting analysis with value chain analysis on the airline business. Traditional cost accounting suggested the airline should be able to raise revenues by aggressive pricing and filling up capacity while holding fleet cost, pilots, flight attendants, and ground personnel cost unchanged in the short run. However, value chain analysis showed that operating an aircraft does not involve purely a fixed cost because the study revealed that as seat miles flown increased, operating costs doubled.

To compensate for this increase in operating expenses, the airline then increased the price per seat mile without clearly considering the overall business strategy. The airline's strategy was to increase customer satisfaction with capital expenditure on advanced ticketing and reservation technologies to justify high prices in an ageing fleet. However, the increased operating costs offset most of the profits from the increase in revenue. It was noted that cost driver analysis is essential in order for a business to fully understand its costs and then develop an informed competitive strategy.

Another example of the successful application of the value chain analysis approach is a case study of the UK beef food service sector (Francis, *et al*, 2008). The approach proved useful in rapidly generating large amounts of data for any the specific focal problem areas. Furthermore, the study enabled the generation of useful training, induction and company public relations material.

Although there are benefits of value chain analysis as discussed above there have been a few shortcomings and limitations of the value chain analysis highlighted by some authors. The following section will briefly discuss these limitations.

### **Limitations of value chain analysis**

Francis, (2008) sites that the value chain approach proved time consuming for facilitators to catalogue and process all the generated information during the case of the UK beef foodservice sector. This tends to lead to the processing of data taking months to catalogue, resulting in the loss of some of the people on the specific projects as personnel changes within the organisation.<sup>3</sup> Fearne, *et al*, (2009) also agrees with this view that value chain analysis is essentially intensive in terms of the time required for interviews and the time interviewees have to spend discussing their business processes. Fearne (2009) believes, “value chain analysis is a relatively high cost diagnostic- rich in insight, across several dimensions, but expensive in terms of both research budget and stakeholder engagement” (p. 11). This barrier was clearly evident in the research reported in this dissertation as discussed at length in the methodology in Chapter 3. Value chains also constantly evolve and can rapidly change; therefore, any value chain analysis faces this limitation of providing a static picture at any point in time.

### **Conclusion**

An organization can attain competitive advantage in relation to its competitors by employing three generic competitive strategies; cost leadership, differentiation and focus. In order to achieve competitive advantage through the use of any of the three generic strategies, an organization performs, through its daily operations, activities which collectively support these strategies. Strategic cost management tools then assists management in formulating and developing controls that monitor the success of achieving of attaining competitive advantage.

Value chain analysis is one such tool that can help management diagnose potential areas for competitive advantage and finding ways to sustain it. Value chain analysis helps organizations by systematically decomposing the organization into strategically important activities and provides a framework that links an organization’s activities to its strategy.

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<sup>3</sup> Donor Interventions in value Chain Development, Working Paper, [www.informaworld.com/index/915259114.pdf](http://www.informaworld.com/index/915259114.pdf)



Furthermore, by focusing on activities, value chain analysis enables the organization to understand the complex interdependencies in processes, activities, business units, suppliers and customers as a way of identifying opportunities for optimization throughout the value chain.

It is in this context of the potential usefulness of value chain analysis in supporting competitive advantage that this research seeks to identify its application in the petroleum industry value chain. The approach adopted in investigating the application of the value chain analysis methodology is discussed in the research methodology chapter below.

## **Chapter 3**

### **Research methodology**

#### **Introduction**

In this chapter, the path followed to undertake this research, in order to best assist the researcher to answer the research question, is outlined. The chapter also discusses the motivation for choice of research method as well as limitations thereof.

#### **Research method**

A case study method was used to collect and analyse data. A case study can be defined as an inquiry that investigates a contemporary phenomenon within its real life context, especially when the boundaries between the phenomenon and the context are not clearly evident (Yin, 2003). Case research methodology is one of the empirical approaches that aim at developing our understanding of “real world” events (McCutcheon and Meredith, 1993, pp. 240-1) and has increasingly been used as a research tool (Hamel, 1992; Perry and Kramer, 1986). A case study was therefore chosen as the best approach to assist with achieving the objectives of this study.

#### **Motivation for case study method**

In general, case studies are the preferred strategy when “how” and “why” questions are being addressed. Another instance when case studies are preferred is when the subject matter needs to be addressed in its real life context. Yin (2003) noted that case study research is used in many instances when the investigator wants to learn more about a particular organization, group or individual. It is in this light that the case study method has been used in many fields of study including psychology and sociology (Gilgun, 1994). The case study method as a research strategy is an all-encompassing method – covering the logic of design, data collection techniques, and specific approaches to data analysis (Yin, 2003). In this sense, the case study is not either a data collection tactic or merely a design feature alone (Stoecker, 1991) but a comprehensive research strategy.

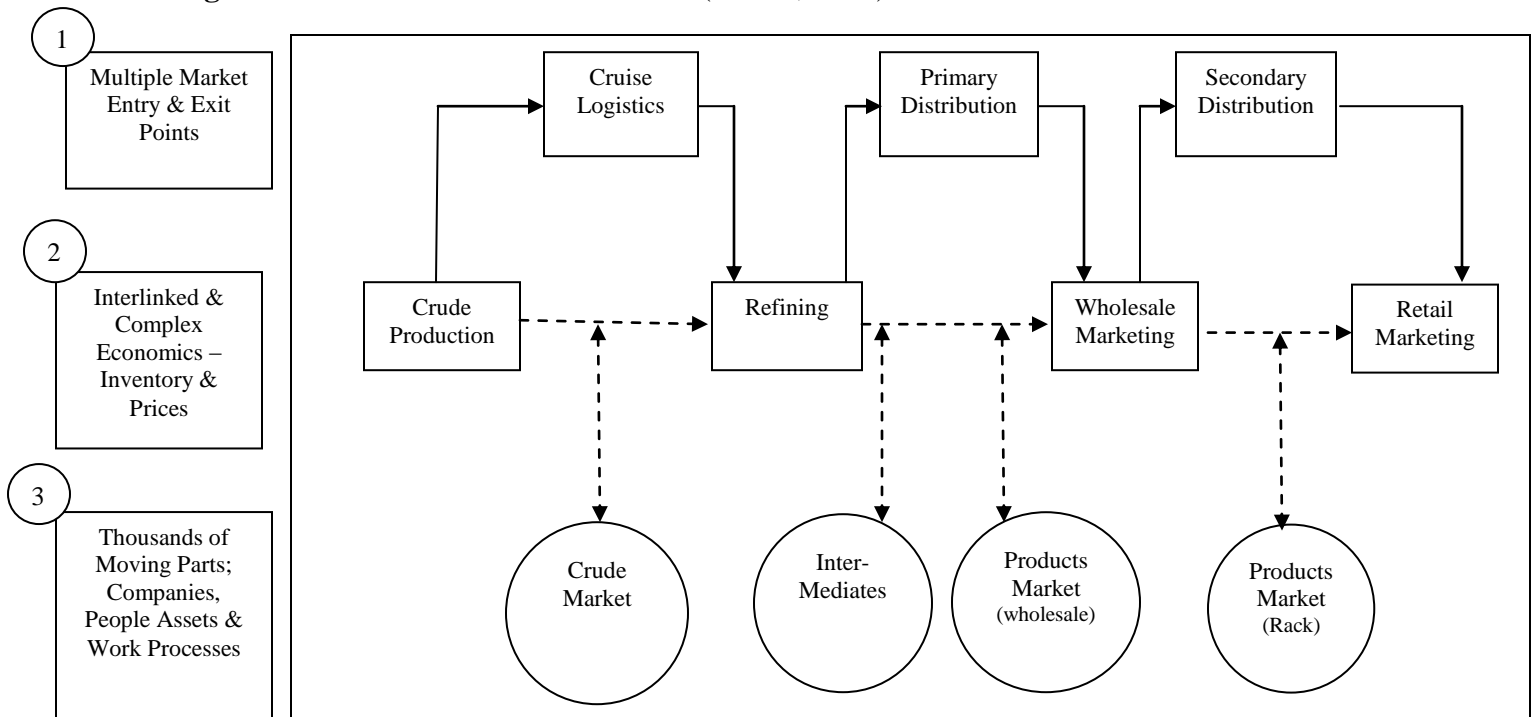
The case study method is best suited in applying theory to an already operational organization, with the researcher having the privilege of being part of the daily processes of the organization. The method also allows the investigator to understand and retain the holistic and meaningful characteristics of real-life events, such as the organisational and managerial processes and maturation of industries (Yin, 2003).

The research question in this study which begins with “how” denotes an explanatory type of research strategy which would need to deal with the operational links of the subject of the case study over a period of time, rather than mere frequencies or incidence which would be more suited to an experimental type of strategy. Hence, the researcher sought to investigate the application of value chain analysis along the petroleum supply chain by understanding the operations of one organization which is the subject of this study.

### **Research setting**

The research focused on a study of a single company operating within the South African petroleum supply chain, thus the research will focus on this particular company’s petroleum value chain. However, for confidentiality reasons the name of the company is not disclosed in this dissertation. For the purposes of this dissertation, the company is hereafter referred to as ABC Oil Company. Figure 2 shows an example of a typical petroleum value chain.

**Figure 2: The Petroleum Value Chain (Moore, 2005)**



The petrochemical value chain is like no other manufacturing business sectors' value chains in that it is the only industry which has one input and a range of products totalling about 40 different products, which makes the pricing process extremely difficult. Another consideration is the transportation and storage costs of the products, bearing in mind that the petroleum products are highly flammable and very hazardous to the environment and to people. Options for trading, swapping and exchanging crude, intermediates and products throughout the chain only add more complexity to the determination of the profitability of the different products. The situation is exacerbated by a proliferation of regional product specifications, volatile markets, increasingly stringent environmental regulations, and constantly changing supply and demand patterns. This is particularly true to the South African market where the fuel price is regulated by the government. Operating in such a market creates huge challenges because of the volatility of the crude prices which is filtered down to the price of final product. In many cases due to the length of the value chain and the manufacturing processes, a company may begin the production of a product which it is not sure how much it will be sold for to the end customer. It is in light of these many challenges in the downstream petroleum value chain that this research

will not include the upstream activities and will only focus on the downstream activities of the petroleum value chain.

ABC Oil Company is one of the major multinational oil companies in South Africa, participating throughout the petroleum value chain as shown in the above diagram and has invested assets that span across the entire chain. It manufactures petroleum products from crude oil and so the study will focus only on fossil fuel products. The research will focus on the value activities across ABC's petroleum value chain in South Africa and offers insights into the opportunities as well challenges faced by this company as it manufactures and markets petroleum products for the South African market.

### **Application of the research method**

In order to achieve the research objectives, the initial phase in the data collection was to identify the respondents. As the research was focused on the petroleum supply chain, managers or leaders in the relevant core activities in the supply chain were identified to help assist with relevant information regarding their areas of expertise. However, these individuals will not be named due to a confidentiality agreement signed by researcher as mentioned earlier. The core value chain activities identified for investigation were the refining and manufacturing, logistics (which includes, storage distribution and transport), and retail and marketing.

Thus an interview guide<sup>4</sup> was prepared with the dual aim of avoiding bias, and ensuring adequate reporting within the frame of reference of the study (Brenner, 1985). An interview guide ensures complete and consistent coverage in each interview of themes under study and thus reduces the tendency to resort to unplanned and non-neutral probes (McCracken, 1988). In order to elicit full and undirected accounts from participants on the themes under study, the interview guide was designed to be used flexibly (Brenner, 1985). The major themes that were investigated using the interview guide included; core activities of the respondents in their respective roles and their positioning within the companies value chain. The interview guide also sought to assist researcher to identify

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<sup>4</sup> Interview guide see Appendix 1

strategic assets deployed along the supply chain and understand their respective value for the business. Questions also probed the rationale behind the asset positioning along the petroleum supply chain.

Another theme investigated was the issue of process improvement within the respective departments of the company and if any, limitations to such improvement. And lastly, due to the nature of the petroleum industry, the researcher also included the questions to probe the environmental aspect of the petroleum business and the effect of environmental legislation to the refining, distribution, storage and marketing of petroleum products.

The Manufacturing Manager and the Refinery Commercial Manager were interviewed to provide insights into the value activities at the refining stage of the value chain as well to provide insights on to the key performance indicators used to measure refinery profitability. The Refinery Asset economist was also interviewed to provide information regarding the sourcing of crude and the refinery diet and all aspects that affect the crude purchase decisions as well as timing of such decisions.

For insights into the distribution and storage of petroleum products from refining to market, the Regional Stocks Manager, Transport Manager and the Logistics Manager were interviewed. These key individuals were pertinent in providing information about the petroleum supply management. Given the nature of petroleum product, the transportation of these products forms an intricate part of the logistics team role within the value chain.

Lastly, the Marketing Manager and Retail Managers were interviewed to provide insights into the last stages of the value chain- providing petroleum products to the consumers. Due to the geographical locations of the major cities in South Africa where demand is greatest, location of the retail market proves to be a very strategic decision in order to reach a wider market.

For each of the respondents, the researcher first conducted a 20 – 30 minute meeting informing them of the nature of the research and the research objectives. This was done to both inform the respondents and to notify them of the forthcoming request for an interview. An interview guide was not sent in advance due to the need to introduce the research project to respondents during the initial meeting. Interviews took a total time of 30 minutes to an hour; the ideal time would have been an hour but this proved a challenge as the interviews were conducted during working hours, and respondents had other engagements and sometimes were not available for the full hour.

Follow up interviews were conducted in cases where the researcher required further clarity and confirmation on key issues. This was the case with the Manufacturing Manager and the Refinery Commercial Manager. Similarly, follow up interviews were also conducted with the Transport Manager and Logistics Manager to seek confirmation of issues of petroleum product exchanges and the limitations around inland petroleum products supply.

The nature of the questions asked to the respondents was mainly open-ended and semi-structured. The use of the semi-structured interviews enables the interviewer to discover and learn for themselves the subject matter and provides a scenario where the rules are loosely defined but guided so as to obtain the best information from the interviewee.

The responses from the interviews were tape recorded and sometimes the researcher jotted down notes. Permission to tape record the interviews was sought before the beginning of the interview and was done with the respondents' consent. Permission was granted by the organization to carry out the interviews during working hours and collect any company documents which would be useful in this research. Permission to collect or view these documents was sought before hand and consent received. The documents collected included; refinery configuration diagrams and crude yield diagrams to help the researcher understand refinery processes. Petroleum supply chain internal studies done by previous employees and external parties. These documents were helpful in providing a general understanding of the petroleum supply chain and also identifying core value

activities. Other documents included terminal distribution network maps which showed the strategic positioning of the company's terminals across South Africa. This was particularly useful to inform the researcher's understanding of the role that the state infrastructure played in influencing the company's location and how demand of petroleum products also dictates management decisions on this issue.

Lastly, financial documents in the form of income statements were also collected to provide insights into the profitability of the business and how this profitability is measured. However, these statements provided total costs and profits of the business as a refining and marketing business. Data for each specific stage of the value chain was not available.

The interview data was transcribed using specific words of the respondents where possible, but also on the basis of the researcher's understanding of what the respondents had said. However, to ensure accuracy of the results, the respondents were given opportunity to peruse the final document and sign to confirm the authenticity of the report.

The results obtained from interviews were presented as both qualitative and quantitative. According to Yin (1981), the terms, qualitative and case study are often used interchangeably but case study research can involve qualitative data only, quantitative only or both (Yin, 1984). In this research, both qualitative and quantitative data was used as this approach has been seen to be highly synergistic (Eisenhardt, 1999). Financial statements, transport costs and product prices were the quantitative data that were collected. This quantitative evidence can indicate relationships which may be salient to the researcher. Furthermore, it can bolster findings when it corroborates those findings from qualitative evidence. The interviews with the respondents indicated above, and discussions with colleagues within the company, also provided qualitative data which was useful for understanding the rationale or theory underlying relationships revealed in the quantitative data (Jick, 1979).



## **Limitations**

The researcher found that very little literature in the industry was available for reference hence had to rely on writings from other industries. There was a major limitation on time as most of the respondents were in their working environment and in most cases were in meetings and the researcher could not schedule sufficient time for the interviews. The researcher at times managed to meet with respondents for 30 minutes instead of the requested one hour because of respondents' other commitments. This major reliance on respondents for information proved to be a major limitation in undertaking this study. This limitation at times resulted in failure by the researcher to conduct a follow up interview because some of the respondents' had travelled, and sometimes resigned from the company and therefore while they served their notice period the researcher could not engage them on company matters because of company policy. As a result the researcher had to look for another respondent who was familiar with the departmental activities and could provide insights thereof.

Similarly, the researcher was also in a work environment and other job requirements which conflicted with the scheduling of the interview. This extended the data collection process as interviews had to be rescheduled weeks from the original date at times. Furthermore, the data sourced needed further interpretation which was also time consuming. In addition, the respondents were in most cases not too enthusiastic in taking time to do so as this only further took time out of their busy schedule.

To mitigate these constraints; the researcher also relied on sourcing information from other channels, for instance research done on similar industries as well as drawing on own experience from working within the company. Information discussions with colleagues who had useful knowledge of the problematic issues also provided additional insights for the researcher. Furthermore, comments and useful feedback was received from respondents when the researcher finally got a chance to certify that everything relevant had been captured accurately as per previous discussions.

## **Chapter 4**

### **Results**

#### **Introduction**

This chapter details the specific value chain activities of interest, from the refining of crude oil to the delivery of the products to the final user. The downstream petroleum industry refers to all aspects of refining, distribution, marketing and retailing of petroleum. This chapter aims to investigate the application of the value chain analysis methodology within these key activities in order to ascertain how it confers competitive advantage through customer value creation. The results from the interviews conducted in the research setting are then presented.

The petroleum downstream sector is complex and highly competitive. From the major input of crude oil, numerous products are produced of which each product in each market region reacts to a different set of supply and demand as well as transportation pressures. To remain viable, refiners must balance a number of competing factors in crude selection, capital investment and what range of products to manufacture. These critical decisions are further complicated by the need to operate in a sustainable and environmentally responsible manner.<sup>5</sup>

Petroleum is the second largest consumable on the planet- second only to water. As a society, we depend more on petroleum than any other resource for the comforts and conveniences of our modern world. The industry provides products that are critical to the functioning of the economy. Virtually all transportation, land, sea, and air, is fuelled by products that are refined from crude oil (Piorg, 2007). The increasing reliance on petroleum is motivating industry business leaders to find better ways to secure, process, and deliver petroleum products, while maximizing margins, minimizing waste, and

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<sup>5</sup> Overview of the Canadian Downstream Petroleum Industry, Oil Division , July 2005.

improving overall corporate profitability with the constraints set by prevailing societal and environmental pressures.<sup>6</sup>

South Africa produced 23571 million litres<sup>7</sup> of liquid fuels products in 2005, according to the South African Petrochemicals Industry Association (SAPIA). About 36 percent of the domestic supply is met by synthetic fuels (synfuels), which are produced locally, largely from coal and from natural gas. The rest (64 percent) is supplied by products refined locally from imported crude oil. This dissertation focused on products produced from crude oil as stated in the research methodology. Although the refined products markets differ from crude markets, the crude prices strongly influence the prices of refined products. Refined product prices have historically reacted to changes in the acquisition cost of crude in both directions, with falling crude prices leading to declines in refined product prices and vice-versa.

Having given an overview of the South African petroleum industry, it is necessary to present the specific value chain activities within the supply chain that formed this study. The sections below discuss the key downstream value chain activities that were investigated. In order to give context to the specific value chain activities of this supply chain, the details of the empirical study are inter-woven with relevant literature.

## **The Study**

The downstream petroleum supply chain studied spans from refining to the delivery of the final product to the customer. Figure 3 shows the petroleum value chain in which ABC Oil Company operates; from crude sourcing to delivering product to the end customers. ABC manufactures petroleum products to serve a variety of customers which range from aviation, mining, agriculture, marine as well as individuals. This broad focus inherent in the petroleum supply chain distinguishes it from any other manufacturing supply chain where costs, schedules and distribution processes are fixed and do not change. The petroleum supply chain is therefore more complex and challenging (Hussain

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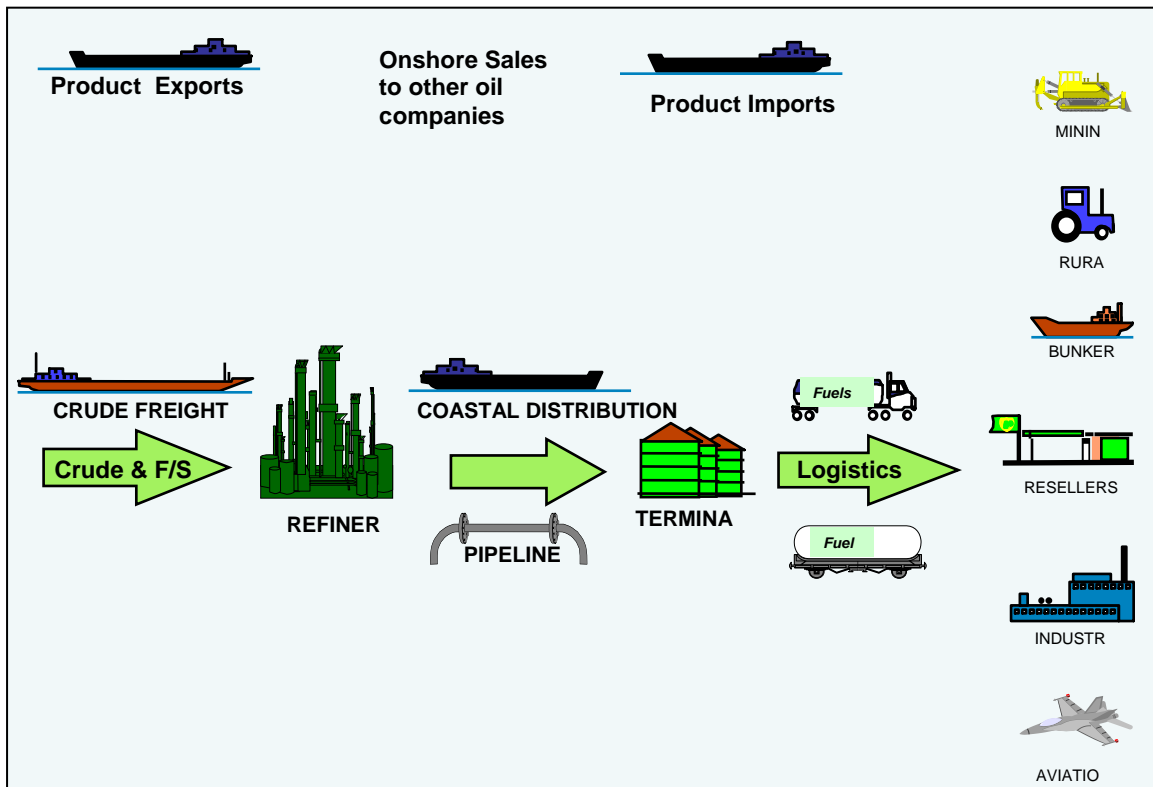
<sup>6</sup> [http://www.petrovantage.com/publication\\_files/Enterprise\\_Opt\\_Petro\\_WP.pdf](http://www.petrovantage.com/publication_files/Enterprise_Opt_Petro_WP.pdf) Aspen Technology, Inc (April, 2002)

<sup>7</sup> [www.dme.gov.za/energy/liquid.stm](http://www.dme.gov.za/energy/liquid.stm)

et al, 2006). At any point in the petroleum downstream supply chain, components can be bought and sold to any of thousands of market participants. This inherent optionality leads to inevitable value leakage ranging from sub-optimal crude slate purchases, to inefficient transportation schedules among other factors.<sup>8</sup>In light of these challenges it is of paramount importance that the oil industry looks for opportunities to improve efficiency and maximize value in order to increase margins and still provide products at a competitive price as well as an acceptable quality.

The value activities identified along this particular supply chain include; refining, including crude sourcing, distribution and marketing. The sections that follow will focus on these value activities that were investigated.

**Figure 3: Petroleum Supply Chain<sup>9</sup>**



<sup>8</sup> Oil and Gas Journal, June 2006, Russian Edition

<sup>9</sup> Adapted from ABC Oil Company

## **Refining**

Petroleum in its unrefined state is of limited value and of limited use, thus refining is required to obtain products that are attractive to the market (Gary, et al, 2007). Thus petroleum refining is a series of steps by which the crude oil is converted into saleable products with the desired qualities and in the amounts dictated by the market (Speight and Ozum, 2002). A refinery can be defined as an integrated group of manufacturing plants that vary in number with the variety of products (Gary, et al, 2007).

South Africa has the second largest oil refinery system in Africa. Egypt has the largest with 726,250 barrels per day. Since South Africa is not a major oil producer it relies on crude imports for its refining needs. According to SAPIA, the majority of the crude oil imports destined for South African refineries come from the Middle East, Iran and Saudi Arabia. Nigeria and Angola (among others) also supply crude oil to South Africa.

Most of South Africa's refined products are sold to the local market and exported within the Southern Africa Region and the Indian and Atlantic Basins. Major refineries include South African Petroleum Refineries (SAPREF) (172,000bbl/day) and Engen Refinery (118,750 bbl/d) in Durban, Chevron Refinery (110,000bbl/d) in Cape Town, and National Refinery (87,547 bbl/d) at Sasolburg.<sup>10</sup> Appendix 2 shows the location of these refineries around South Africa.

International Oil Companies (IOCs), including British Petroleum, Chevron, Engen, Shell, and Total are major participants in South Africa's downstream petroleum industry. There are other several domestic firms that also participate in the industry, including Naledi Petroleum and Afric Oil.

Refineries are the major assets of the downstream petroleum business and effective management of the refinery activities underpin the organizations' success. Management decisions regarding refinery activities are critical in ensuring the company creates value for the customer. These decisions range from input sourcing as well as the range of

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<sup>10</sup> Oil and Gas Journal, South African Petroleum Industries Association (2007)

products to produce and refinery utilization. Crude oil is the primary input in the petroleum refining industry, therefore a brief discussion on the properties and the sources of crude will provide valuable context to the downstream business.

### **Crude oil**

Crude oil as it comes from the ground is of little use and must undergo a series of refining processes which converts it into a variety of more valuable products for instance, fuel for cars, fuel for heating, diesel fuels for heavy transport to name a few.<sup>11</sup>

The term crude oil covers a wide assortment of materials that may vary widely in volatility, specific gravity, and viscosity. Crude can be considered sour or sweet based on its properties. Sour crude contains substances such as sulphur compounds, carbon dioxide that is often mixed with hydrocarbons in various proportions and cause problems in production and processing. Crude oil is considered sweet if it contains few sulphur components. Sour crude contains an appreciable amount of hydrogen sulphide and carbon dioxide. The existence of any measurable sulphur content (more than one part per million) and sulphur components, particularly hydrogen sulphide can cause considerable damage to the production facilities and can significantly lower the commercial value of the oil or gas (Dawe, 2001). Therefore, the sulphur components will have to be extracted from crude oil (however, they can be converted to sulphur and sold on as a useful product). Other materials which can be found in crude include metal containing constituents. Notably, those compounds that contain vanadium and nickel usually occur in the more viscous crude oils in amounts of up to several thousands parts per million and can have serious consequences during processing of these feed stocks (Gruse and Stevens, 1960; Speight, 1984).

Furthermore, the manufacturing process used to refine petroleum generates a variety of air emissions and other residuals, some of which are hazardous to the environment. The environment impacts of refining and the use of refined products have resulted in a number of environmental laws and regulation. Some of the significant statutes focus on

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<sup>11</sup> Heather Wansbrough , *Refining Crude Oil*

altering the product formulation in order to reduce air emissions generated by their use (Gary et al, 2007).

In a bid to reduce the sulphur emissions from petroleum, South African passed energy legislation advocating the reduction of the sulphur content in diesel. Diesel fuel used in South Africa as of January 1, 2006 now has ultra-low sulphur content of 0.005 – 0.05 percent.

However, it is not only choice of crude oil that determines the viability of a refinery; supply and demand factors are pertinent in ensuring an efficient and economic operation. The overall economics or viability of a refinery depends on the interaction of three key elements:

- the choice of crude oil used (crude slate),
- the complexity of the refining equipment (refinery configuration)
- and the desired type and quality of products produced ( product slate)

These factors, which are critical in improving the effectiveness of value chain activities, are discussed in the following sections below.

### **Crude slate**

Evaluating the economic performance of the petroleum refining industry is complicated by the fact that many refineries can use crude oil of different quality as an input, while others cannot (Piorg, 2005). This is mainly because of the configuration of the refinery as well as the strategy of the refinery and the desired products to be produced. Crude oil can be of lighter or heavier density, as well as having higher or lower sulphur content. The density of the crude is of importance because lighter crude oil input yields a lighter product mix which is more valuable and therefore results in higher prices for the refiner.

However, this does not mean that refiners always seek to use the lightest crude available. The crude oil market pricing mechanism compensates for differences in the quality of crude oil by a price differential, the light-heavy price spread. At any given time, the actual spread value is also influenced by the relative availability of crude oil on the world

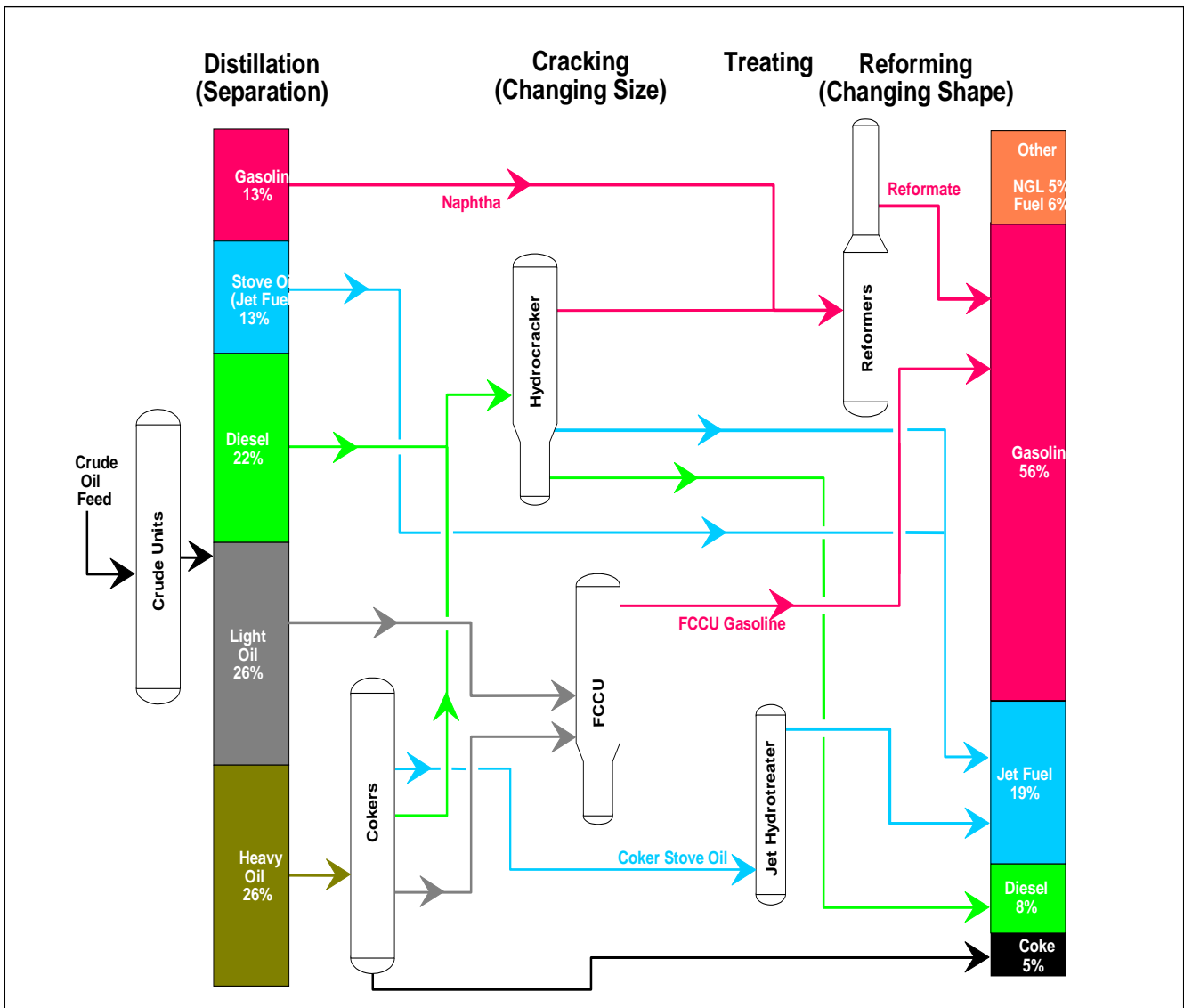
market as well as the location of the crude oil. As a result, the value of the spread changes, and at given time, the purchase of either light or heavy crude might be warranted by economic conditions (Piorg, 2005). Another element that ensures the economic and efficient operation of a refinery is the refinery configuration which is discussed in the following section.

### **Refinery Configuration**

Figure 4 below of a typical refinery shows the various processes involved in refinery to produce the desired products as per demand specifications. The type of crude that a refinery is able to process is determined by the type of processing units at the refinery .At different stages of refining the product slate can be upgraded to create value for the refinery by producing even more value products.



Figure 4: Typical Refinery<sup>12</sup>



A “simple” refinery, frequently referred to as a topping or hydro-skimming refinery, consists of atmospheric distillation and typically one or more pre-treatment facilities, catalytic reforming, and hydrodesulphurization. Simple refineries have limited capacity to change the composition of the crude oil input. A “complex” (cracking) refinery or

<sup>12</sup> Adapted from ABC Oil Company

“very complex” (coking) refinery is characterized by significant upgrading capacity and a high level of integration. Simple refineries have the lowest margins and are often operated by small, niche players. As shown in Figure 4 above, complex refineries are able to change the composition of the crude oil input, taking low-value heavy oils and converting them into high-value, light products. The heavy oils are reduced through a process of distillation and cracking from 26 per cent to 5 per cent and thus increasing the gasoline and jet fuels from 13 per cent to 56 per cent and 19 per cent respectively.

Coking refineries use the coking process to eliminate the vacuum residue, converting virtually the entire barrel of crude to valuable light products. Coking refineries enjoy the highest upgrading margins and are highly flexible. Unlike cracking refineries, the economics of coking refineries are driven largely by the light-heavy differential, the difference in price between light, sweet crude oils and heavy, sour crude oils. Complex refineries tend to make large margins when processing heavy, sour crudes and smaller margins when processing light crudes (Gary et al, 2007).

The most advantageous position for a complex refinery that has invested in the capability to produce a light product mix from a heavy crude input is a large price spread between light and heavy crude, and a similarly large spread between light and heavy products. The potential for economic gain represented by these two price spreads form the incentive for investing in more complex processing units in the refining process. The ability to better handle the heavy crudes enhances the economic potential of most refineries (Gary et al, 2007).

With reference to this study, ABC’s refinery can be described as a ‘complex’ cracking refinery. The refinery has two distillation units; Crude Distiller 2 (CD2) and Crude Distiller 3 (CD3), a cracking unit, a visbreaker unit and a lubes complex. Each of these units performs a specific function to ensure desired products slate is produced.

According to ABC’s manufacturing manager, the ideal crude mixture to maximize the refinery’s profitability is 15% condensate, 30% light crude, 45% medium/heavy crude

and 10% heavy crude. Condensate, light crudes and heavy crude are sourced from the Asian Gulf and Nigeria whereas medium and heavy crudes are bought from Angola. But before discussing the purchasing of these crudes, the next sections offer a brief explanation of the processing operations at ABC refinery.

This mix mentioned above is only used for processing in CD2 which manufactures the main fuels; gasoline and mogas (diesel and petrol respectively) as well as liquid petroleum gas (LPG) and jet fuel. The residue from the distillation is used as feed for the cracking unit for further processing to produce more products as above. Similarly, the residue from this unit will again be processed in the visbreaker unit which produces fuel oil which is used to fuel ships.

CD3 operates differently from CD2 because it is used to manufacture lubricants therefore, it is linked to the lubes complex and it is not linked to the visbreaker. The type of crude for this unit is sour heavy crude. The other by-products from this unit are referred to as extracts; these extracts are similar to the short residue feed into the cracking unit from CD2 so these also will be processed similarly. The residue from CD3 after lubes production is bitumen which is used in road construction. Furthermore, because crude for CD3 is sour crude, sulphur is extracted during the distillation process.

Crude sourcing for ABC refinery to feed into the units mentioned above is a process that requires careful planning. Three departments at ABC Oil Company work together in this planning process, namely; refining, marketing and supply. The marketers forecast products demand for the company and communicate this to refining. In turn, refinery will come up with a manufacturing plan to cater for this demand. Refining will then advise supply of the production plan which they will use to plan their distribution plan which ensures the products get to the customer as per demand.

The purchase decision will depend on the profitability analysis done by the Asset Economists as well as the Crude Trader who will complete the purchase. The Asset Economists use mathematical models to arrive at the most profitable mix of crudes which

will yield the best financial gain for the refinery. These mathematical models take into account the required products slate (discussed in more detail in the following sections) and refinery availability. The result of this analysis produces what is referred to as the “crude pecking order”; this is the ranking of the crudes to be considered for purchase. All the information is then passed onto the Crude Trader who will source these crudes on the market. ABC has no crude trading capability so this function is located at their parent company in Europe. Sometimes the desired crudes might not be available at the required price and timing, in which case, the “crude pecking order” is revised and the above process repeated. This process is always carried out 90 days in advance; this allows time for amendments to the purchasing decisions if required as well to accommodate any changes in the crude oil market.

Once crude has been purchased it is transported by ship to the refinery. To minimize freight costs, ABC has agreed a co-freight agreement with other oil companies in South Africa. This was agreed to because all but one oil company discharges their crude in Durban. As shown in appendix 2, most refineries are located along the South African coast. The inland refineries also receive their crude at the coast and then transport it by pipeline inland. Most of the crude into South Africa as discussed earlier comes from the Asian Gulf and Angola; hence this agreement is relatively simple to coordinate.

### **Product slate**

The main products of refining are commodities, that is, they are undifferentiated from those of a competitor and are sold on the basis of price, defined in competitive markets through the intersection of supply and demand curves. The main products of refining are gasoline (aviation and motor gasoline and light distillates), middle distillates (diesel fuel, jet fuel, and home heating oil), fuel oil and other products (fuel gas, lubricants, wax, solvents, and refinery fuels). The product slate is determined by the demand, inputs and process units available, and the result of intermediaries entering into the production of other products. The price differential between gasoline and fuel oil and other products represent the supply – demand requirements for the fuel and the premium for production.

## **Refinery Cost drivers**

The economics of a refinery is a function of many variables, namely the plant configuration, acquisition price of crude oil, product prices and strategic decisions with regards to location and scale of operations as well as operating cost, and environment requirements. The two inter-linked structural cost drivers; plant configuration and technology utilized on the plant significantly affect refinery economics. Drivers often interact to determine the cost of an activity. In this case, the plant configuration determines the refiner's complexity and ability to produce different product slates from a variety of different crude slates. The plant configuration affects the ability to process a lower valued crude slate into a higher valued product slate. Furthermore, the flexibility of the plant also enables the production of more differentiated product slate to deal with regulation and demand fluctuations. Coupled with the plant configuration, technology utilized is also important because it provides more cost efficient processes.

Optimizing a refinery is a matter of balance because every benefit has a cost, every incremental gain has an offsetting loss, and every attempt to remove one unwanted product creates a new waste stream. Utilization fluctuates as refinery operation adjust to changes in demand, however, refiners can increase their refinery utilization by reducing refinery downtime and the number of unplanned outages, executing maintenance and revamps more efficiently and extending run times through improved catalyst performance ( Gary et al, 2007).

The refiner has some control over the cost of production but price structures exhibit a more complex relationship. Refiners attempt to maximize earnings from fluctuations in the market price of the crude oil and the product slate. The potential for economic gain arises when there is a large spread between light and heavy crude and light and heavy products. A refiner will buy heavy crude to minimize input costs and sell a light product mix to maximum product revenues.

The location of the refinery is of utmost importance as it will affect the accessibility of the refinery to markets as well as to the inputs. ABC's refinery as discussed earlier is

located at the coast to reduce transportation costs. Other refineries can also be strategically located inland, for instance in Johannesburg, as it is right where the greatest demand for product is. Thus even though it is located further away from the crude receiving point, it has an advantage in locating near the market, (See Figure 9).

Lastly, the scale of the refinery operations also affects the economics of the refinery. Scale driven efficiency improvements reduce the cost per barrel. This is achieved by taking advantage of economies of scale which is the ability to spread fixed costs over a greater number of barrels. However, complex refineries find it difficult to really achieve economies of scale due to the multiplicity of products and production processes.

### **Refinery Profitability**

The refining industry has historically been a high volume, low margins industry, characterized by low return on investments (ROI) and volatile profits. This trend can be attributed to the high capital requirements that are needed for the set up of a refinery and the volatile market in which refining inputs and products are sourced and traded. Refinery profitability is measured by a number of key indicators which provide a holistic view of the financial performance. These include the gross margin, Return on Capital Employed (ROCE), crude margin gain and losses (CMGL), the business environment, feedstock product selection (FPS) and availability (refinery availability).

The gross margin is equal to the difference between sales and cost of sales. However, the difference of this calculation to any other accounting calculation is that the cost of sales are adjusted and valued at the replacement cost of crude. The sales are also valued at crude import/export parity. The reason for this adjustment is due to the fact that refining of petroleum products is linked to the international economic situation. In addition, the inputs and products are bought and sold on the world market. Thus it makes business sense to value sales and cost of sales with what it would cost to import and export the products to gain a clear and more accurate gross margin value. Similarly, the ROCE is also adjusted to reflect the replacement cost value, for instance, ABC values their crude oil and products at the end of a financial period at what it would cost the refinery to

replace these assets. This means if they were to purchase crude and products at current market prices- *what would it cost?* This adjustment helps the refinery to reflect their true performance and to reflect a more current representation of the return of investment.

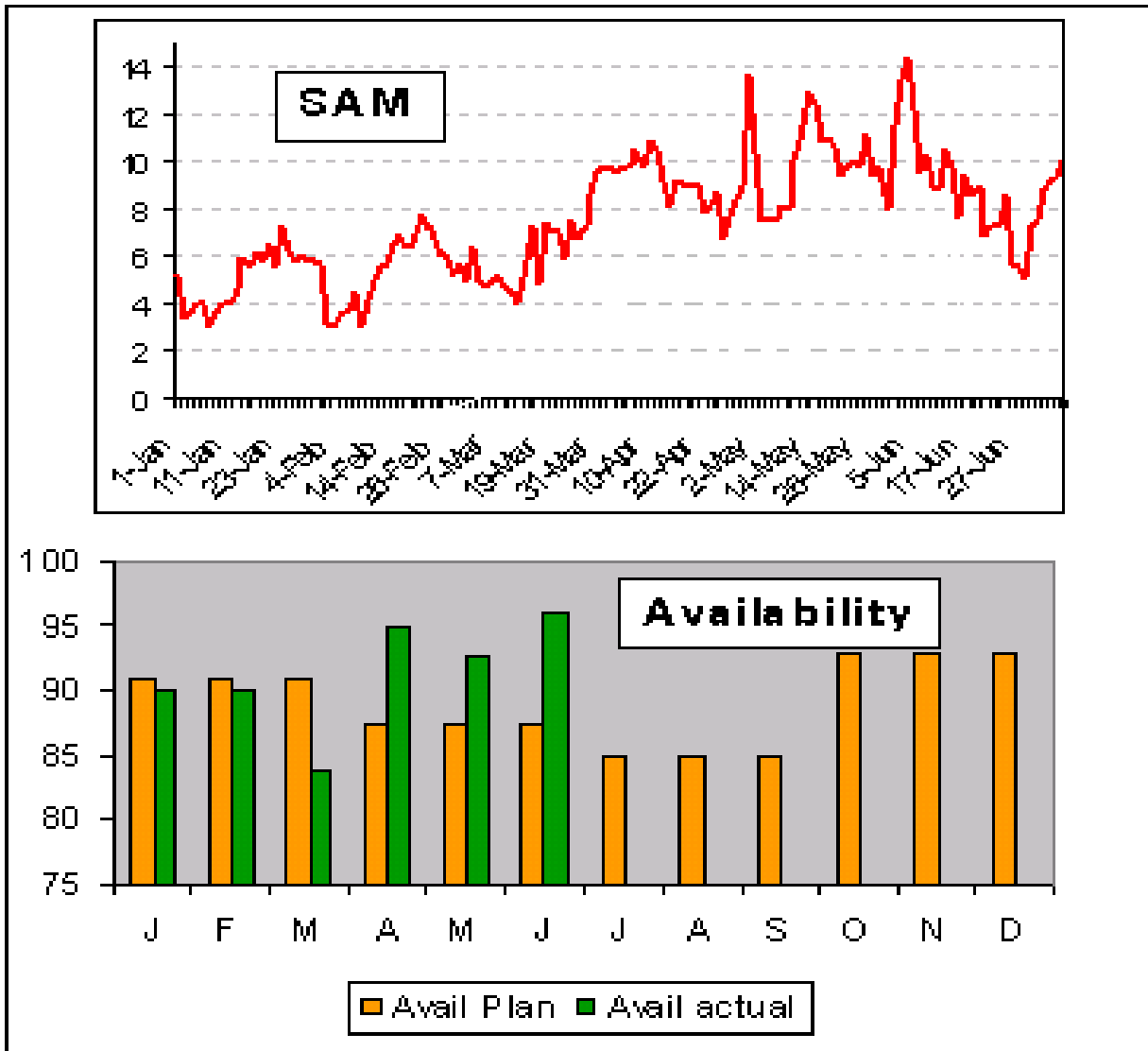
Another key indicator is the CMGL which looks at the quoted price including the differences and the replacement cost of crude which is the basic price before the differences. The refinery will analyse the differences in the month in which the crude is processed in order to ascertain the effect of their crude buying decisions on profit margins. Coupled with this indicator is the FPS which analyses the crude selection effect on profitability. As a result of varied refinery configurations, a refinery will have a set of crude that it is designed to process (basket crudes). However, a refinery can choose to include one or two types of crude outside the basket which improve the product slate and thereby produce high value products. Thus this indicator measures the profitability of such crude sourcing decisions.

Lastly, the global market indicator known as the Site Available Margin (SAM) in dollars and refinery availability, shown as a percentage, are measured to give the refiner an indication of how well the refinery has performed in light of the global economic environment. SAM provides the margins that are available for the refining business for a particular region at a given period. The refiner should therefore aim to ensure that the refinery is fully operational at those times and is available to produce products to supply the markets when the expected margins are increasing to maximize on profits.

Figure 5 below shows a comparison of SAM and refinery availability for ABC at a given time period. The SAM from January to Mar shows the margins fluctuating from \$3 to \$8, at this same time period, the refinery availability was around 90 percent for the January and February but dropping to about 83 percent in March. This shows that during the time margins were low the refinery did not operate at an optimum level and thus was below plan. However, as margins start to pick, from April to May, the refinery operated above plan at around 95 percent and thus fully taking advantage of the high margins. This information is used to inform the business regarding the commercial performance of the

refinery. In turn this would inform management decisions such as equipment upgrade at the refinery to avoid breakdowns which would cost the company.

**Figure 5: Comparative Site Available Margin and Refinery Availability**



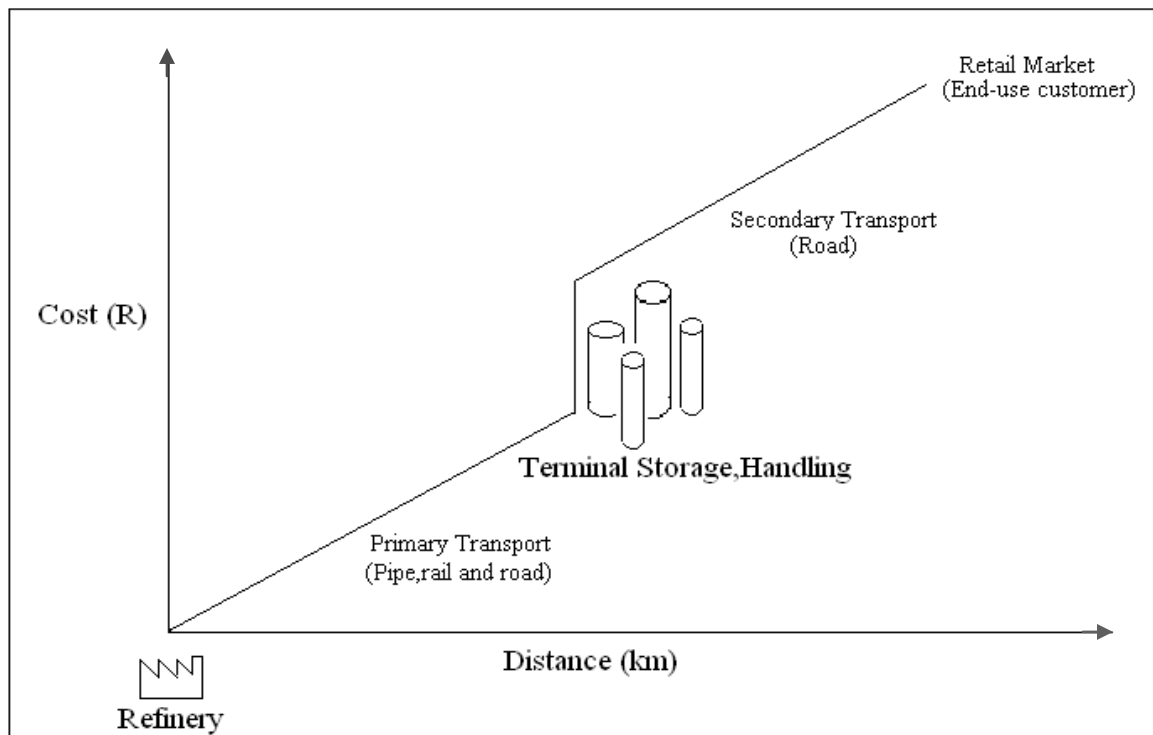
After the refining process has been completed, petroleum products are then transported to various parts of South Africa to be marketed. The next sections discuss the supply logistical network of the petroleum supply chain. This supply logistical network involves the use of primary transport from the refinery to terminals. Secondary forms of transport will then transport products from these terminals to the retailers.



## Petroleum Supply Logistical Network

The logistics network required to supply petroleum products from the refineries to the end-users is a complex system of pipelines, ships, railways, a countrywide terminal network and trucks. In most instances, two or more modes of transport are utilized to move product from the refinery to terminals across South Africa and finally to the retail stations. The long distance and variety of modes of transport represent further challenges to oil companies that range from product degradation, loss and theft as well as risk of accidents. Understanding the value activities around the petroleum logistical chain is critical to the profitability of the entire value chain. This is because even though the logistical activities do not generate revenue for the business, they incur costs. It is therefore paramount for the business to put in place cost management strategies that ensure the effective transportation of petroleum products from the refinery to the end user in a cost effective way within the constraints of the supply chain. Figure 6 below shows this distribution network.

**Figure 6: Refined products supply logistics network**



*Source: Authors own diagram.*

In a competitive market, the oil industry is faced with the challenge of ensuring a constant supply of product in line with market demand. The challenge therefore is to ensure efficiency in the supply chain as well as flexibility as and when required. The constraints that exist on the pipelines and the rail network add to the supply challenges, these challenges coupled with the ever increasing inland demand for fuel, transporting products from coastal refineries is thus very demanding. The oil companies therefore need to strategically position their terminals near the markets and thus will require ample storage facilities to curb loss of business due to product unavailability.

ABC has strategically positioned terminals around South Africa to cater for their customers around the country. The size of the terminal, in terms of tank capacity is determined by the demand in and around the terminal. This terminal distribution will be discussed in full in the later sections.

Further to strategically locating one's business near the market, companies have to contend with additional risks associated with the nature of petroleum products. Petroleum products present challenges to transport and handle because of their high flammable nature. These products present huge environmental impact in cases of spills, regardless of what mode of transport. A spill on the road or in water will have far reaching effects on the environment and huge costs for the cleanup process. Petroleum products can also be easily sold on the open market and this further presents risk of truck hijackings and theft.

In South Africa, the pipelines and rail network is state-owned and operated. The oil companies therefore, have to share pipeline capacity as well as rail tank cars as prescribed by Transnet Pipelines and Spoornet respectively. Any outstanding volumes that can not be accommodated by pipe and rail will therefore be transported by ship along the coast and by truck inland as well as along the coast. Given this limitation, oil companies have resorted to product exchanges and co-loading (similar to the co-freight arrangement) on ships to reduce costs.

## **Product exchanges**

To reduce transport costs. Oil companies have resorted to product exchanges in different parts of South Africa. Product exchanges occur when one refiner provides another refiner with specific products in a certain location in exchange for a similar quality and volume of products in another location. These product exchanges significantly reduce the volumes and distances over which products are moved, thereby considerably reducing transportation costs and environmental exposure. Similarly, the same arrangements have been applied to the coastal shipping network, where product is transported from the Durban refineries to the coastal cities of East London and Cape Town. The oil companies have gone as far as opening “Borrow/loan” product accounts of which any outstanding volumes can be settled over an agreed period of time. This system is extensively used by ABC such that a team of analyst is employed specifically to manage these exchanges.

These arrangements have enabled the industry to consolidate their refinery operations and have also been extended to the terminals as well. Many terminals are now co- owned or one company can host one or more oil company at their terminals. These relationships will be discussed later on in this chapter.

In cases where products exchanges are not available, ABC companies will need to make their own arrangements to transport product to their terminals as well as retail outlets. To do so ABC owns a fleet of trucks that can transport 40,000 litres to 80,000 litres of fuels. Where these trucks do not meet customer requirements, contract operators are employed. These company owned trucks are used for secondary transport only, all the trucking requirements for primary transport are outsourced.

## **Primary Transport**

All the primary transport is outsourced and the rail and road rates are all negotiated separately except for the pipeline rates which are published and adjusted every year. The main purpose of primary transport is to move refined products from the refinery to the terminals located strategically around the country. The product is then stored at these

terminals before being transported to the retail sites who then sell to the final customer at the pump.

### **Secondary Transport**

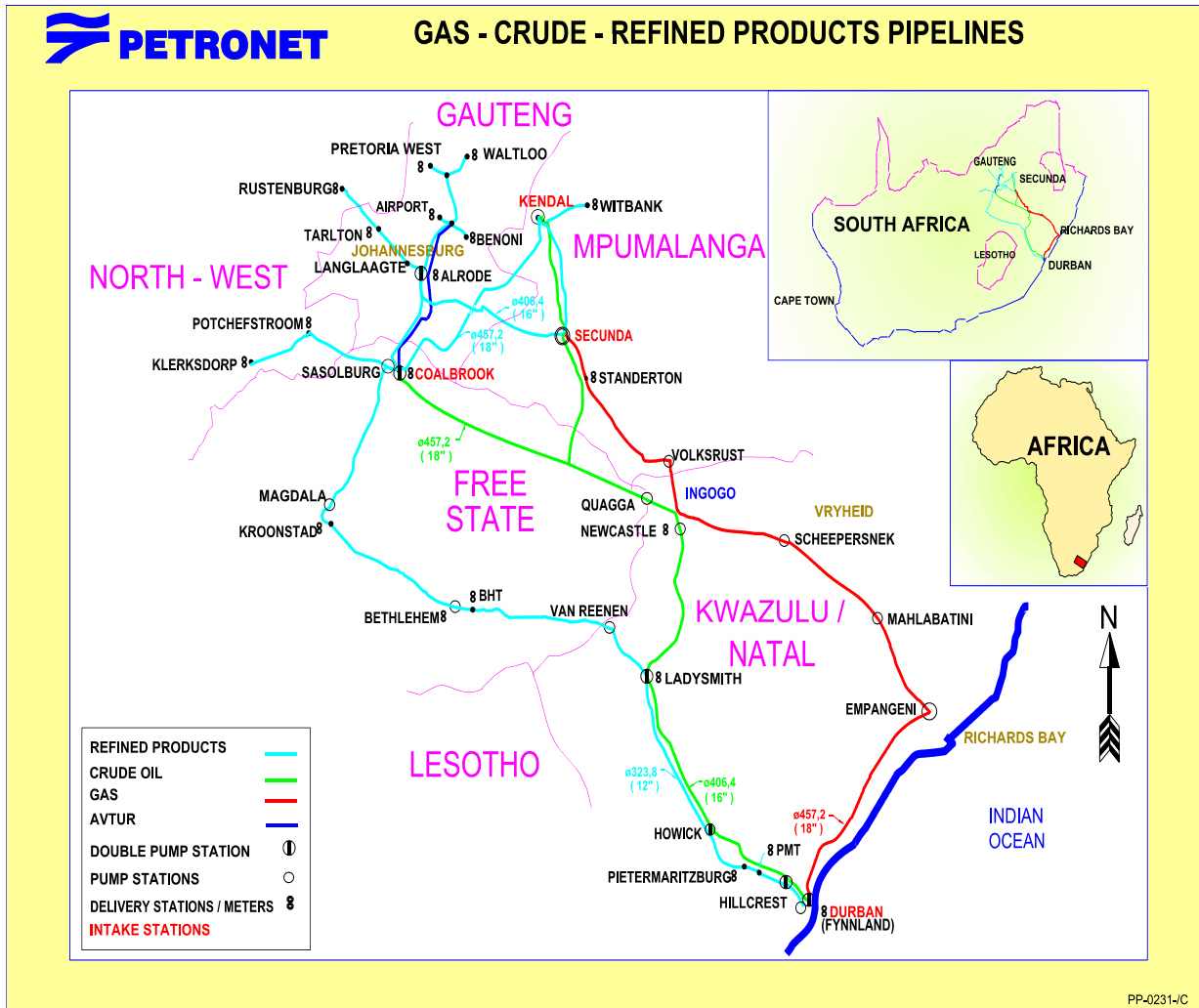
Similarly to primary transport, pipe, ship, rail and road are the modes of transport used in this part of the petroleum products distribution. This leg of distribution delivers product from terminals to end users, industry as well as individuals. The method of transportation that is used to transport product is strongly influenced by demand, geographical barriers, the risks associated with different transport modes as well as the relative costs of transportation. In each case, the choice of transportation has its own strengths and weaknesses.

The following sections briefly discuss the different modes of transport that are used by ABC in distributing their products to their terminals and to their customers.

### **Pipeline**

Transnet Pipelines owns, maintains and operates a network of 3000km of high-pressure petroleum and gas pipelines. Figure 7 shows the Durban-Johannesburg Pipeline (DJP). The products transported by Transnet Pipelines include, leaded and unleaded petroleum, diesel, aviation turbine fuel crude oil and gas. Transnet pipelines convey 77% of all petroleum products from the coastal refineries and inland refineries, to the depots owned and operated by oil companies.

Figure 7: Gas – Crude – Refined Products Pipelines



(Pipeline map Courtesy of Transnet pipelines)

Secondary transport is then used to transport the products from the pipeline end point at the terminals to the final destination. The pipelines operate on an open access principle and tariffs are equal to all the different zone prices for regulated petroleum products<sup>13</sup>

Pipelines form the cornerstone of bulk transport of petroleum products and gas. However, the one pipeline South Africa is not sufficient to service the inland demand as it continues to rise (Figure 10). There demand is forecasted to continue to grow with the staging of the 2010 Football World Cup in South Africa. To address this deficit Transnet has

<sup>13</sup> [http://www.kzvttransport.gov.za/public\\_trans/freight\\_databank/kzn/pipeline/1\\_xml.html](http://www.kzvttransport.gov.za/public_trans/freight_databank/kzn/pipeline/1_xml.html) 8/07/2008

awarded a R2.5 billion contract to a joint venture including the international company, Spiecapag and Group Five Civil Engineering Company to build the R11.2 billion New Multi-Product Pipeline between Durban and Gauteng<sup>14</sup>. The new pipeline will encompass the replacement and expansion in capacity of the (DJP).

Currently, ABC has a weekly allocation to transport 20million litres from their coastal refinery to their inland terminals on the DJP. This volume is used to supply the inland market, which include the major cities as well as the surrounding areas, Johannesburg, Pretoria, and Polokwane as well Rustenburg. The products ABC injects into the pipeline include petrol, diesel as well as Jet fuel to supply the Oliver Tambo International Airport.

ABC also supplies the coastal cities of East London, Port Elizabeth as well as Cape Town with main fuels. This is done mainly by ship.

### **Ship Transport**

The coastal areas mentioned above are supplied with petroleum products by two time charter vessels. ABC has chartered these vessels to operate along the Durban- Cape Town coast line as well as to supply product to neighbouring countries including, Namibia and Mozambique. Similarly, a co-freight arrangement is in place if any of the other oil companies operating along the same route need the vessels' services.

### **Rail Transport**

The rail network is also owned and operated by Transnet division, Spoornet. As discussed earlier, all volumes that can not be transported by pipe are then distributed to the relevant terminals by rail. Rail provides bulk, safe and a cost effective service to oil companies. Transnet runs dedicated freight trains on a regular schedule, with the service determined by the cost-efficiency of the specific freight logistics solution. Customers are able to customize wagons which enable the company to meet varying customer needs.

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<sup>14</sup> Transnet press release, 21 May 2008 , Transnet Ltd spokesman John Dlodlu.

### **Type of services**

- Mega Rail** Dedicated jet fuel trains that runs from Durban to Johannesburg International airport daily.
- Flexi rail** Block train traffic is moved from Krugersdorp to Botswana, Pretoria to Zambia and Sasolburg to Beitbridge.
- Access rail** Small consignment loads which are transported on mixed or general trains. They are distributed throughout the country from all six refineries.
- Rail tank car** the fuel rail tank car (RTC) fleet comprises of about 4000 RTC's in total<sup>15</sup>. The XP series are used interchangeably for jet fuel, petrol and paraffin. The XJ series for diesel, XV series for liquid petroleum gas and the XO series for heavy furnace oil, the average carrying capacity of the XP's is 36000 litres and for XP's 30000litres.

To supplement the DJP volume into the inland market, ABC also runs two RTCs to Pretoria.

### **Road Transport**

All road transport trucks utilized for primary transport are owned and operated by contractors which include, Unitrans Group, Wardens, Tanker Services and Nokwe petroleum to name a few. The rates for this transport can be influenced by a number of factors, such as, the distance, the risk associated with the route, the volume of the journeys and the duration of the contract. However, the oil companies are able to negotiate individually with the service providers for favourable rates. In this regard, relationship building with the truck operators is very critical. ABC also performs its own route assessments, the truck companies are required to strictly travel on these routes. These routes would have been analysed for dangers and therefore reduced accident risks and allows the security and safe transportation of ABC's product.

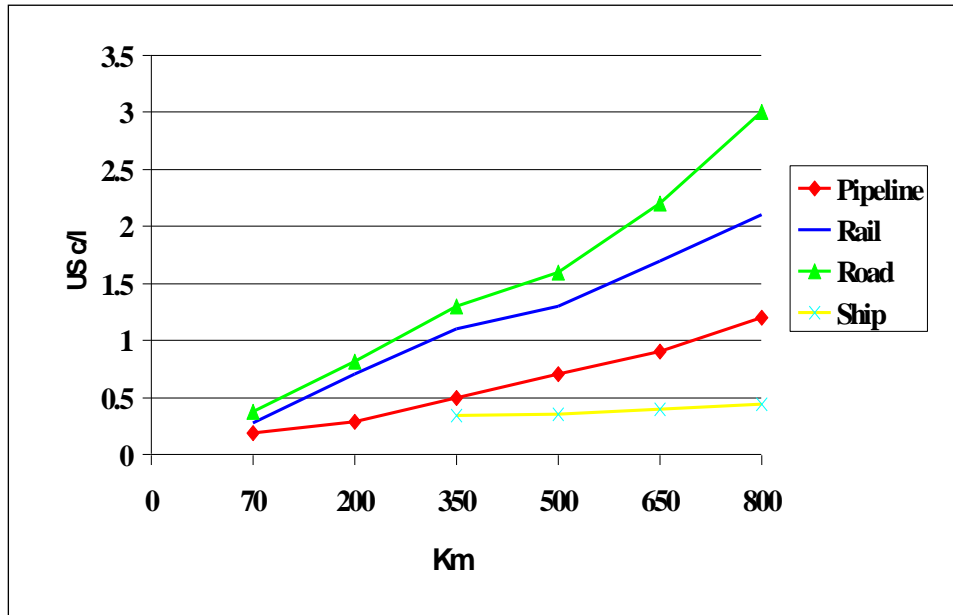
Figure 8 below shows transport comparative costs, the cheapest costs for primary transportation of products is by Ship; this mode of transport is only used along the east

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<sup>15</sup> [www.spoornet.co.za/Website/fuel.html](http://www.spoornet.co.za/Website/fuel.html)

coast of South Africa from Durban to the ports cities of East London and Cape Town. Thus the mode of transport that applies to the rest of the country and most cost effective is pipe. However, due to the restrictions on the pipeline, ABC has to resort to road transport which is costly and holds the highest risk.

**Figure 8: Comparative Modes of Transport Rates (2008)<sup>16</sup>**



The major problem with road transport is the risk of road accidents and possible hijackings. The results of such incidents are mainly loss of product due to theft or spillage and even death to the driver and even other road users. The fact that refined products have a ready market also makes managing of road transport complex. To mitigate ABC has put in place measures to reduce such incidents by enforcing conditions in their contracts with truck operators. These conditions include the use of drivers who hold valid defensive driving certificates and ensuring that they work reasonable hours on the road to avoid fatigue. The vehicles should also be road worthy and be serviced regularly. Adherence to the route as prescribed by the company as mentioned above is also another mitigation factor. This is to say that the selection of Truck Company to service the

<sup>16</sup> BP Statistical Review 2008



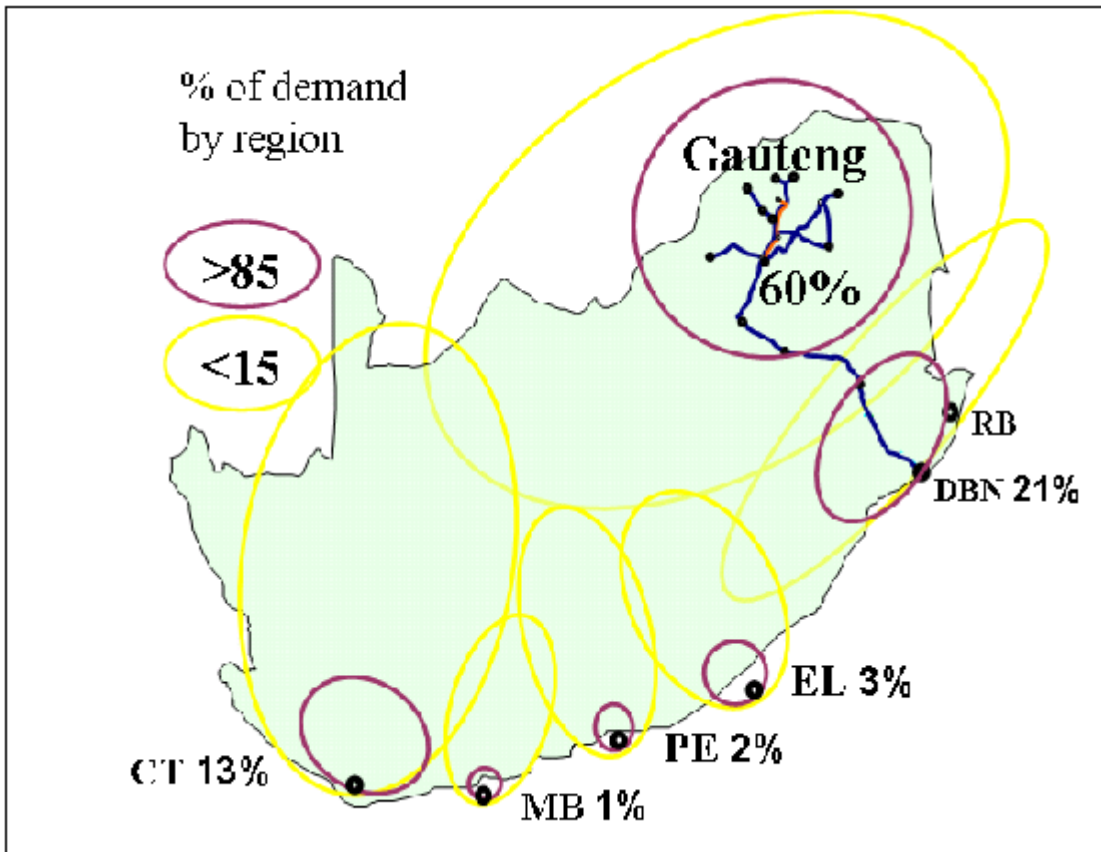
logistical needs of the oil company should be one that has the capacity to provide the level of safety which is in line with the oil companies' standards.

Once petroleum products have left the refinery using the various modes of transport mentioned above, the products are periodically stored at various terminals. The following sections briefly discuss these terminals and their strategic role along the supply chain.

### **Terminals**

As discussed earlier the refined products are delivered to the terminals before further being distributed to the retailer. The terminal plays the role of storing the huge volumes transported which will then be transported in smaller quantities by road to different retailers. The terminals therefore play a significant role in the petroleum supply chain, and their location and storage capacity is of paramount importance in the petroleum value chain. The demand profile map (*Figure 9*) clearly shows the areas where the demand is concentrated, that is around major cities with the majority of the demand (60 per cent) in Johannesburg. The oil companies have therefore organized their terminal networks to be able to meet the demand and thus the terminal network is more widely spread compared to the refineries and location of the terminals is also in line with the demand for the particular region. Figure 10 shows the distribution of terminals in South Africa.

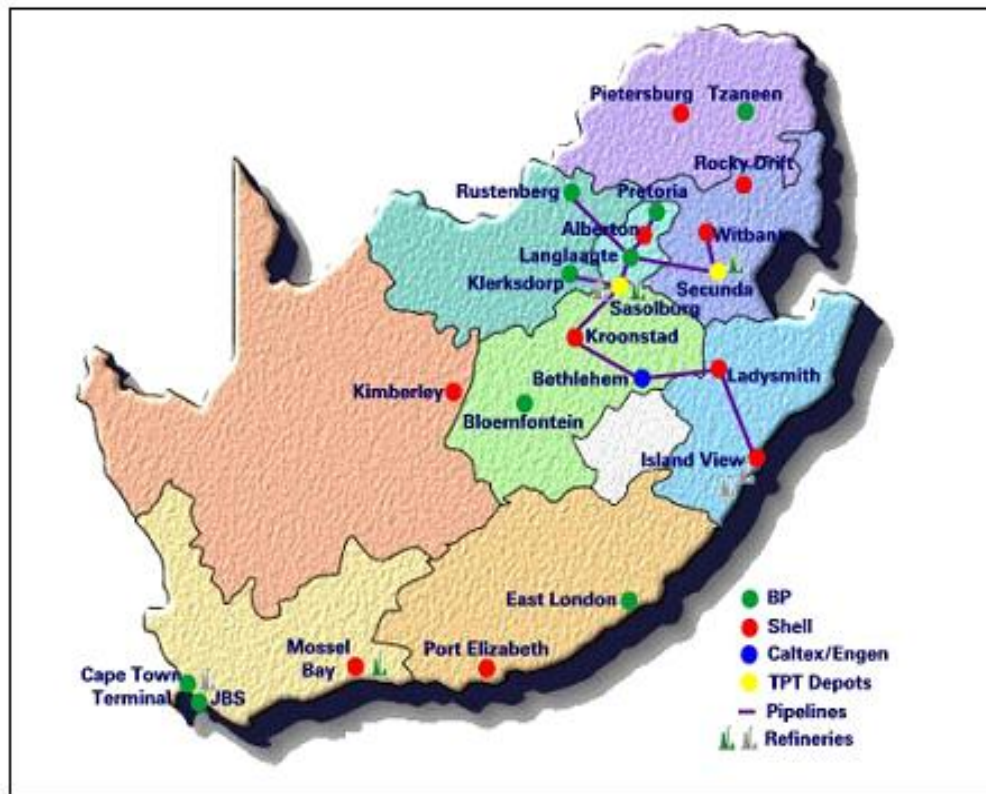
Figure 9: South Africa refined Products Demand Profile<sup>17</sup>



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<sup>17</sup> <sup>17</sup> Adapted from ABC Oil Company

Figure 10: South African Terminal Network<sup>19</sup>



Setting up a terminal involves huge amounts of capital investment in terms of the building the tanks and having delivery links into the terminal that is whether the storage tanks are pipeline feed or rail feed, there should be existing supply points or the oil company should invest in such a setup. This situation is further compounded by the fact that the scarcity of land which local municipalities would allow to have such facilities built. This is so because of the potential danger of having highly flammable products close to the residential or the central business district and also the environmental impact of any spill or fire might have on the nearby human and animal inhabitants.

It is in light of these constraints that oil companies have resorted to accommodating one another in the already established terminals around the country. This is particularly evident in the Gauteng province because of the nearness to market, thus the region is of

<sup>19</sup> Source: [http://safrica.bpweb.bp.com/distribution/depots/South\\_Africa.htm](http://safrica.bpweb.bp.com/distribution/depots/South_Africa.htm)

strategic importance to all oil companies. For instance, as shown in the map 2 above, BP Southern Africa owns the Pretoria terminal and Shell owns the Alberton terminal. The two oil companies have reached an agreement to work together in the region and thus, BP accommodates Shell at Pretoria and Shell accommodates BP at Alberton. The similarly trend is followed by other oil companies around the country.

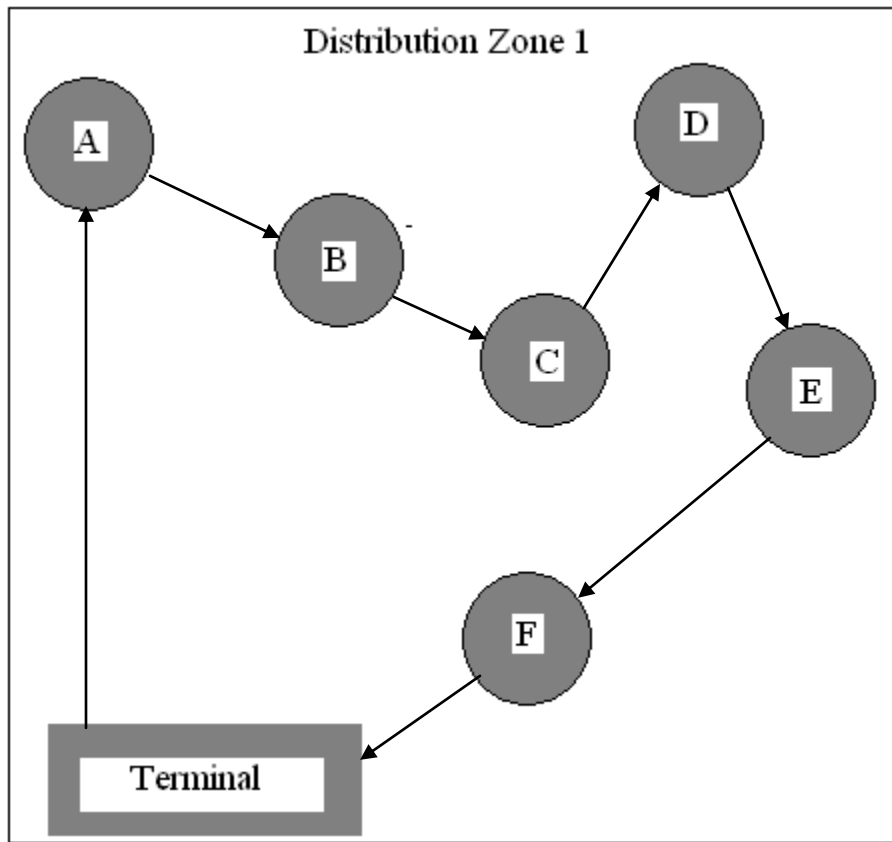
Although, the two companies will receive the same product from the refinery but before the product leaves the terminal the different companies add additives to the fuel which differentiate the product from competitors. This branding of the product differentiates the product and depending on the marketing efforts, branding can give the company competitive advantage. When the refined products are ready to leave the terminal they are then transported in smaller volumes to retail sites by truck.

### **Secondary Transport Optimization**

Transportation of product from the terminal is carefully coordinate to ensure optimization of the fleet and ensuring retailers' needs meet timely. ABC employs a transport manager responsible for this function. Truck delivering routes are carefully mapped out into zones. Customers' locations are zoned and trucks are then allocated a particular zone in which they operate. Figure 11 shows an example of such a zone and the route which the truck will follow.

The fleet is optimized to ensure that the most cost effective route used for the delivery is selected and the trucks are used effectively. The truck deliveries are organized into zones determined by the logistic team in line with the geographical locations of the retail customers and the amount of the volumes to be delivered. This analysis is aided by the use of a mathematical model which inputs the volume and distance in kilometres that is required to service the customers and also factors in the costs of maintaining the fleet which include tyres, fuel and lubricants. As mentioned earlier the logistical function provides a service to the refining and marketing functions and thus the costs associated with the distribution of petroleum products is allocated to the refining and marketing functions.

**Figure 11: Secondary Transport Optimisation**



*Source: Authors own diagram*

So far, the study has traced the petroleum product value chain from manufacturing through to distribution. The following section focuses on the final activity of the downstream petroleum value chain; retail and marketing. This final activity in the chain is the customer facing activity and all the preceding activities aim to provide a desired product for this final customer. The following sections discuss this activity and all the government regulations which govern the marketing and pricing of the main fuels.

### **Retail and Marketing**

As discussed earlier ABC manufactures a variety of petroleum products, however in this section the study focuses on the retail and marketing of main fuels: petrol and diesel ABC Oil Company owns and operates fuel retail sites across South Africa. The other retail sites are operated by dealers on the company's behalf. The rest are franchises that are

owned and operated by individuals. All these sites all carry the companies branding and the general appearance and operation are all the same as this is specified by the oil company.

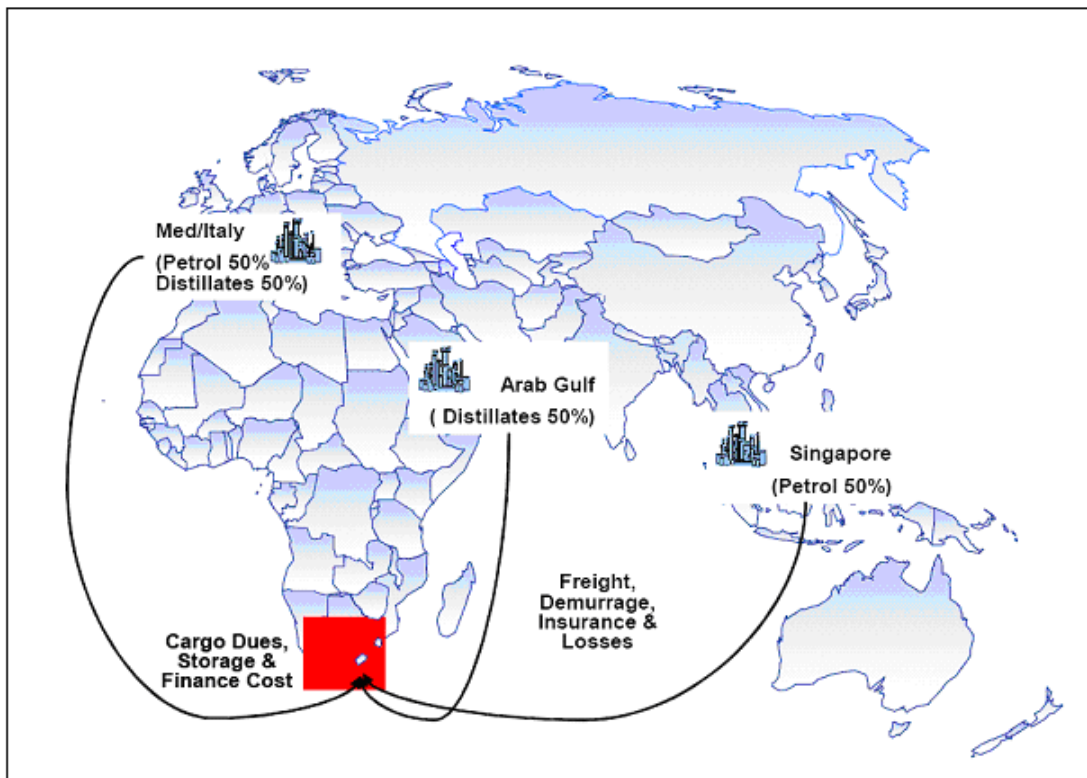
The above mentioned sites all receive their products from the terminals described above. At ABC the marketing and retail function is all combined into one business unit-marketing. Sales representatives are employed to cater for the varied needs of the retail sites, these needs include ensuring the sites receive their product timely and all the site operation conform to the oil company specifications.

As discussed earlier in this chapter the retail price of petrol is regulated by the South African government, a brief discussion of the pricing structure is essential to provide context to the retail business.

### **Product pricing in South Africa**

Figure 12 illustrates how the Basic Fuel Price (BFP) is determined from international prices.

**Figure 12: How Fuel Price is calculated in South Africa (BFP determination)** <sup>20</sup>



For simplicity purposes, the pricing structure of only two products will be discussed, petrol and diesel. The prices for these products are driven by supply and demand in a particular market. As mentioned earlier crude oil prices have a major effect on the product prices. For a refiner to be profitable, the price of the products produced should be higher than the price of crude. The retail petrol price is regulated by government and adjusted every month on the first Wednesday of the month (see *Appendix 2* of the January 2008 price adjustment press release). The calculation of the new price is done by the Central Energy Fund on behalf of the Department of Minerals and Energy (DME)<sup>21</sup>.

The petrol pump price is composed of a number of elements and these can be divided into international and domestic elements. Basic fuel price (BFP) is the international element

<sup>20</sup> Source: The [http://www.sasol.com/sasol\\_internet/downloads/FuelPrice\\_calculation\\_SA\\_07\\_1170868230705.pdf](http://www.sasol.com/sasol_internet/downloads/FuelPrice_calculation_SA_07_1170868230705.pdf)

<sup>21</sup> [http://www.sasol.com/sasol\\_internet/downloads/FuelPrice\\_calculation\\_SA\\_07\\_1170868230705.pdf](http://www.sasol.com/sasol_internet/downloads/FuelPrice_calculation_SA_07_1170868230705.pdf)

which is based on what it could cost a South African importer to buy from an international refinery and to transport the product onto South African shores. BFP formula was first used in April of 2003 replacing the In Bond Landed Cost (IBLC)<sup>22</sup>; the formula was agreed by the African Minerals and Energy Forum (AMEF) and SAPIA and maintains an import parity structure. Therefore, BFP reflects the realistic cost of importing a litre of product from international refineries with products of a similar quality compared to local South African specifications on a sustainable basis.

The following sections will briefly discuss the nature of the cost elements which make up the petrol pump price.

### **Free on Board**

The largest component of BFP is the price that one would be paying on international markets when physically importing product to South Africa. The FOB (Free on ship's board) product prices from different locations in the world, based on product availability and product quality, are used.

Petrol FOB price is calculated as:

50% of Mediterranean spot price for premium unleaded petrol and 50% of the Singapore spot price for 95 Octane unleaded petrol (*See Map 3*).

Diesel FOB price is calculated as:

50% of the Mediterranean price for Gas oil and 50% of the Arab Gulf price for gas oil, plus the quoted spot price market premiums applicable.

### **Freight costs**

Freight cost represent the voyage costs from the Mediterranean, Arab Gulf and in 50:50 contributions as appropriate in the international markets used in the FOB calculations for the respective products. Freight tariffs used are published by the World Scale Association

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<sup>22</sup> IBLC was first introduced in the 1950's with the establishment of the first refinery in South Africa, and was previously revised in 1995, when market spot price component was introduced.



for the transportation of refined products via medium range vessels to a weighted average for South African coastal ports, plus demurrage for an average 35000 ton vessel for 3 days, adjusted with the average Freight Rate Assessment (AFRA) of the London Tanker Brokers Panel, plus a market premium for transporting fuels to South Africa.

### **Insurance costs**

Insurance costs are calculated as 0.15 percent of the product FOB and freight costs, to cover insurance cost, as well as other costs such as letters of credit, surveyors' and agents' fees, and laboratory costs.

### **Ocean loss allowance**

It has been agreed in international petroleum products trading, shipping and insurance, a loss of 0.3% for products has been accepted as a normal leakage and evaporation loss. Therefore, the normal loss is not insurable and has to be accepted by the buyer.

### **Cargo Dues**

The BFP calculates Cargo Due charges in terms of the ruling National Ports Authority of South Africa contract tariffs for Petroleum products.

### **Coastal Storage**

This element allows recovering for the costs realistically incurred in a substantial import scenario, related to costs of the handling facilities at coastal terminals providing storage.

### **Stock Financial Cost**

A charge for the financing of 25 day's stock of an importer, at an interest rate of 2 percentage points below the ruling prime rate of the Standard Bank of South Africa is also included in BFP.

The BFP as determined above is converted to SA cents per litre by applying the applicable SA RAND/US Dollar exchange rate (four banks selling rates at eleven o'clock

averaged over the pricing period before the price change, and a constant litre per gallon factor of 3.8038 for petrol.

### **Domestic elements**

To arrive at the final pump price in the different pricing zones ( magisterial district zones) certain domestic transport costs, government imposts, taxes and levies and retail and wholesale margins needs to be added to the international price.

### **Transport costs**

In keeping with the import parity principle, this element recovers the cost of transporting petroleum products from the nearest coastal harbour (Durban, Port Elizabeth, East London, Mossel Bay or Cape Town) to the inland depot serving the area or zone. Transport to the different pricing zones is determined using the most economic mode of transport, that is, pipelines (C zones), road (B zones), or rail (A zones). This is the only element which values differ per pricing zone, and is the reason why the petrol price is not the same for the whole country.

### **Delivery costs (Service differential)**

This element compensates marketers for actual depot related costs (storage and handling) and distribution costs from the depot to the end user at service stations. The value is calculated on actual historical costs of the previous year, averaged over the country and industry.

### **Wholesale (marketing margin)**

Money paid to the oil company through whose branded pump the product is sold, to compensate for marketing activities. This margin is controlled by the government, allowing for changes based on the oil companies' return on their marketing assets. The formula used to determine the wholesale margin is based on the results of a cost/financial investigation by a chartered accountant firm into the profitability of the wholesale marketers. The level of the margin is calculated on an industry basis and is aimed at

ranting marketers a return of 15% on depreciated book values of assets, with allowance for additional depreciation, but before tax and payment of interest.

### **Retail margin**

The retail margin is fixed by the department of Minerals and Energy (DME). It is determined on the basis of actual costs incurred by the service station operator in distributing petrol. All proportionate driveway related costs such as rental, interest, labour, overheads and profit are also considered. The way in which the margin is determined creates an incentive to dealers to strive towards greater efficiency, to beat the average and to realize a net profit proportionate to their efficiency.

### **Equalization Fund Levy**

This is a statutory fixed monetary levy, and the fund is regulated by ministerial directives issued by the Minister of Mineral and Energy Affairs in concurrence with the Minister of Finance, as laid down by the Central Energy Fund act, No 38 of 1977. In terms of the Ministerial directives the fund is principally utilized to smooth out fluctuations in the price of liquid fuels through slate payments; to afford synfuel producers tariff protection and to finance the crude oil 'premium ( price differential applicable to SA oil purchases during the late 1970s)

### **Fuel Tax**

Tax is levied by government annually adjusted by the Minister of Finance effective from the price change in April of each year, announced in the Minister of Finance in his annual budget speech.

### **Customs and Excise levy**

A duty collected in terms of the Customs Union agreement.

### **Road Accident Fund (RAF)**

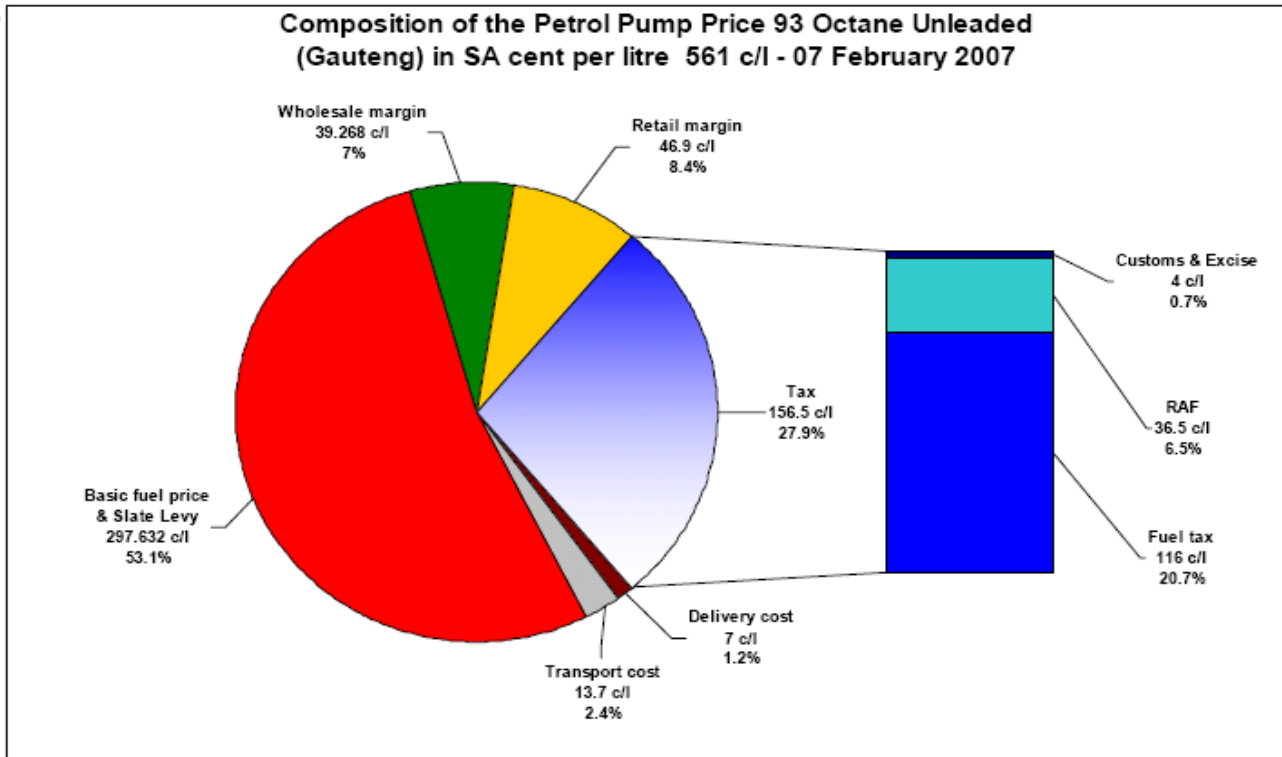
The RAF receives a fixed value which is used to compensate third party victims in motor accidents.

### Slate levy

A levy paid by the motorists recovering money “owed” to the oil companies due to the time delay in the adjustment of the petrol pump price.

Figure 13 provides a summary of these components of the basic fuel price:

**Figure 13: Summary of the Pricing structure<sup>23</sup>**



From the above diagram for the February 2007, the wholesale margin is 39.268 cents/litre and this margin is thus available to the refiners when they supply independent dealers or franchisees. Similarly, 46.9 cents per litre is the set margin for the retailers. Since these margins are fixed it is up to the retailer or wholesaler to formulate their own competitive strategy around activities that they can influence. This therefore intales that the retailers

<sup>23</sup> Source: The [http://www.sasol.com/sasol\\_internet/downloads/FuelPrice\\_calculation\\_SA\\_07\\_1170868230705.pdf](http://www.sasol.com/sasol_internet/downloads/FuelPrice_calculation_SA_07_1170868230705.pdf)

have to be creative in the way they market their products to increase volumes in the case of the petrol. Diesel provides a more options for the retailer because the retail price of diesel is not regulated by the government thus retailers can either choose to accept a lower margin in the anticipation of selling more volumes or rather maximize on full margin and thus are covered in cases of decreased demand.

ABC activities' in the retail market ensures that they have the option of both the wholesalers margin (dealer owned and operated sites), and the retailers' margin (company owned and operated sites). As the wholesaler and retailer margin is determined by the government as mentioned above, petrol retails at the same price at any petrol station. Therefore, for ABC to gain any advantage over its competitors, location of retail sites becomes a key strategic decision. An increased volume of traffic at ones sites ensures high sales volume resulting in increased income. ABC has therefore strategically located its retail sites to maximise on traffic volume. However, it might not be always possible to obtain premium location hence the need to offer customers something more than just petrol at the site. ABC has therefore incorporated convenience shops, fast food restaurants and car wash services. These changes to the traditional petroleum retail market have provided ABC with other sources of revenue and also strategically position their businesses to be able to reach a wider market.

The decision to include restaurants, fast food outlets and convenience shops to petrol station is a strategic one that in the long run is expected to contribute to the increased sales volume of petrol and diesel. The logic is that it is better to stop at a retail site that will provide with all amenities from car wash food as well as filling up your car.

Marketing efforts have also been increased to improve brand awareness. Marketing of retail sites through the media as well as customer promotions such as competitions, have also assisted in building customer loyalty and in some cases attract new customers. An example would be promoting products such as bread and milk in retail convenience shops. As these are perishable products motorists will tend to frequent the retail station.

This is a strategic decision which is hoped would lead to the increased demand for petroleum products.

Although the petroleum supply chain is complex and oil companies are being confronted by many challenges, it is clear that there are many opportunities for creating value for the customer as well as areas which will require striving for process improvement.

## **Chapter 5**

### **Analysis**

This research has been carried out with an objective of analysing the application of value chain analysis along the downstream petroleum supply chain. This process required the identification of the petroleum value chain, which includes; refining, distribution as well as retail and marketing. Within these value activities, the research sought to understand the extent to which value chain analysis is applied to infer competitive advantage and also inform organisation's strategy in attaining this advantage.

In Chapter 4, the case study reveals the activities of the oil company studied and how these activities support the company's strategy. The company has clearly identified the value activities as the manufacturing of the product (refining), supply to market (distribution) and availing the product to the consumer (retail and marketing). In performing these activities the company has identified the cost drivers of each activity as explained in the previous chapter, for instance the location of the refinery, choice of crude grades. Similarly, on the distribution the company has sought to locate its terminals near to market and in cases where this is not possible, linkages with other supply chain participants has been sought by entering into exchange agreements or seeking to share distribution centres across the country. These activities clearly show that the structure of the petroleum industry does lend itself to the value chain analysis and a company can formulate strategies as a result of such analysis.

In addition, the study has shown the identification of non-value activities and how this process informs management decisions. For instance, the outsourcing of all primary road transport from external parties shows that at this level the company does not need to get to avail resources which would otherwise be utilised elsewhere. Also the fact that all other modes of primary transport are owned and state run supports the decision to outsource this service.

On the retail activities, price differentiation is not possible for petrol and diesel (wholesale only) however, a number of strategic activities have been incorporated in the retail sector of the business to differentiate the products. The inclusion of additives at the terminals to differentiate the product has also assisted the ABC Oil Company to build customer loyalty and therefore create competitive advantage. The addition of convenience shops, although not essential to the retail of petroleum products, is a strategic decision which supports the petrol retail business by attracting customers to the retail sites.

The research has also highlighted how customer product demand informs manufacturing decisions. This reveals how management should view all supply chain activities as interlinked activities. For instance in this study, the demand forecast informs the refinery production plan and in turn, refinery production plan will inform supply distribution plan. In addition, the supply challenges faced by the company studied also highlight the need for greater co-operation among the petroleum companies in South Africa to build supply chain stability. The petroleum industry's infrastructure constraints highlighted in Chapter 4 along the petroleum supply chain suggest that companies should strive to look for synergies to optimise the supply of petroleum products to the inland market. In addition, because of the state owned and operated distribution infrastructure such as pipelines and rail network, which forms part of the industry's primary transport network, the study also highlights the need for the petroleum industry to engage with the government in infrastructure developments decision along the supply chain.

Furthermore, the study also highlights the need to understand cost structure of all petroleum products, not just the main fuels discussed in this study but all petroleum products. Understanding each products cost structure would enable management to make calculated improvement decisions in line with overall strategy. The research also highlighted the impacts of the global environment on the South African petroleum industry. From crude sources, refinery performance as well as marketing, the global economic, political and social developments have a huge impact on the South African petroleum industry. The volatility of crude oil prices alone has a huge impact on the



business and requires flexibility and swift response by management in terms of strategy and manufacturing decisions. To this end the study has highlighted the need for accurate and reliable demand forecast data that inform supply decisions.

### **Conclusion**

The study confirms the key findings in the value chain analysis literature, especially the issues around strategic value chain activities and their importance in conferring competitive advantage in the context of the oil industry. In addition the study demonstrates the importance of understanding cost structure of all petroleum products, not just the main fuels, so as to facilitate management improvement decisions in line with overall strategy.

However, this research was based on the analysis of one company which does provide limited insights. Further studies on more similar organisation or a comparative study between two similar companies can provide more comprehensive data and greater insights of the petroleum industry. In addition, further study focusing on a wider range of other petroleum products in different settings and even including the upstream activities, provides a broader focus of the value chain from the oil wells to the consumer.

## **Appendix 1**

### **Interview guide<sup>24</sup>**

#### **Introduction**

##### **General introduction to researcher and institution**

##### **Introduction to research question and objectives**

The research was conducted in an informal setting as all the interviewees were colleagues of the researcher and it was important for the researcher to understand the nature of the business and the daily operations before embarking on the research.

##### **Area of research and objectives of research**

The study is focusing on value creation along the petrochemicals supply chain using the value chain concept, a brief explanation of the objectives of the research would be given to give the interviewee a general idea of the research.

The interview was very relaxed as it was conducted in familiar setting to both researcher and respondent.

The interview was tape-recorded to allow the researcher the ability to fully concentrate on the discussion and the interviewee was asked if they objected to the conversation being recorded. The respondents' permission to record the interview was sought prior to commencing the interview.

The recording of the interview allowed for the researcher to ensure accuracy and for preservation of the data and to allow the researcher to refer to the interview at a latter date.

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<sup>24</sup> Interview guide adapted from Anne M. Lillies , A framework for the analysis of interview data from multiple field research site, Accounting and Finance,1999.

Confidentiality was assured to all participants and confirmation of management permission in conducting these interviews was communicated to all respondents and that all information received would be used for academic purposes only.

### **Organisational Background**

This information had been made available to the researcher; hence there was no need to ask related questions to the interviewee.

### **Choosing interview candidates**

Since the research is based on the petrochemicals value chain, the researcher identified the individuals best suited to respond and provide information to a particular section of the value chain and prior consultation was done with management.

### **Interview questions**

The study was conducted with semi-structured questions. The reasons for this included the need not to limit the responses and to encourage the interviewee to feel free to add on any material they thought was useful to the research. The questions that were put to the respondent were only for the purpose of guiding the discussion. For this reason no questionnaires were used in this research. The semi- structured questions were meant to help the research to understand the interviewee's knowledge of the value chain and how their activities impacted there of the business.

### **Questions**

#### **Understanding of the petroleum value chain**

1. Where is your department positioned on the value chain?
2. What are your core activities?

### **Assets**

3. a) What are the assets employed to carry out activities?
- b) Are there any restrictions on these assets?
- c) Any there any strategic reasons for the positioning/location of these assets along the supply chain?

### **Value creation**

4. a) Where are you creating value for the business?
- b) Are there any constraints in you achieving this objective?
- c) Do you focus on the next activity in the value chain?
- d) Are you looking at your department as part of the overall value chain?

### **Suggestions for improvement**

5. a) Are there ay areas in your business that you think can be done better?
- b) If yes, in what areas?
- c) And how do you propose this could be done?
- d) What are the implications to the rest of the business as a result?
- e) If respondent feels nothing can be done to improve their situation then the next question would be:
- f) What is the limitation? Are there any operational constraints that are beyond their control?

### **Environmental matters**

#### **Rationale**

The petroleum business deals with highly flammable products that are also very harmful to the environment in cases of spillage or fires. There are also concerns with regards to pollution in the production of petroleum products as well as the amount of hazardous chemicals that are allowed in finished products for instance, the sulphur content in diesel.

6. a) what are the regulations in terms of your operation with regards to the environment you operate?

b) What is the cost implication of having all these controls?

c) Do you have to make changes to your manufacturing process because of government regulation, in cases of minimizing pollution? If yes, how is this implemented?

**Demographic information**

Job Title.....  
Length of service within the organization.....  
Length of time in Current position.....  
Age.....

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