

**SUPPLY CHAIN RISK FACTORS AND PERFORMANCE IN
PETROLEUM INDUSTRY IN KENYA**

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DECLARATION

This research project is my original work and has not been submitted for award of any degree in any institution of higher learning.

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TABLE OF CONTENTS

DECLARATION.....	ii
ACKNOWLEDGEMENTS	iii
DEDICATION.....	iv
LIST OF TABLES	viii
LIST OF FIGURES	ix
ACRONYMS AND ABBREVIATIONS.....	x
ABSTRACT.....	xi
CHAPTER ONE: INTRODUCTION	1
1.1 Background of the Study	1
1.1.1 Risk	2
1.1.2 Supply Chain Risks.....	4
1.1.3 Petroleum Supply Chain Performance.....	7
1.1.4 Petroleum Industry in Kenya	8
1.2 Research Problem	10
1.3 Research Objectives.....	11
1.4 Value of the Study	11
CHAPTER TWO: LITERATURE REVIEW.....	13
2.1 Introduction.....	13
2.2 The Components of Petroleum Products Supply Chain	13
2.2.1 Exploration and Production of Crude Oil	15
2.2.2 Transportation	16
2.2.3 Crude Oil Storage	17
2.2.4 Refinery.....	17
2.2.5 Product Pipeline and Retail Storage Terminals	18

2.2.6 Product Distribution.....	19
2.3 Petroleum Product Supply Chain in Kenya	20
2.4 Supply Chain Risks.....	23
2.4.1 Procurement Risk Factors	24
2.4.2 Transportation Risk Factors	26
2.4.3 Delivery Risk Factors	28
2.4.4 Political risks.....	29
2.4.5 Risk Mitigation Measures	31
2.5 Theoretical Foundations.....	32
2.5.1 The Agency Theory	32
2.5.2 Transaction Cost Theory.....	34
2.5.3 Property Rights Theory.....	35
2.6 Impacts of Risks on Supply Chain Performance	36
2.7 Conceptual Framework.....	36
2.8 Chapter Summary	37
CHAPTER THREE: RESEARCH METHODOLOGY	39
3.1 Introduction.....	39
3.2 Research Design.....	39
3.3 Target Population.....	39
3.5 Data Collection and Presentation.....	40
3.6 Data Analysis	41
3.6.1 Impact of Risk Factors and Performance in Petroleum Industry in Kenya	42
CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION	43
4.1 Introduction.....	43
4.2 Response Rate.....	43

4.3 Demographic Review.....	44
4.4 Descriptive Statistics.....	47
4.4.1 Procurement Risk Factors	47
4.4.2 Transportation Risk Factors.....	50
4.4.3 Delivery Risk Factors	51
4.4.4 Risk Mitigation Factors.....	53
4.4.5 Supply Chain Performance	55
4.5 Impact of Procurement Risk, Transportation Risk, Delivery Risk and Risk Mitigation on the Performance of Petroleum Sector Supply Chain.....	57
4.6 Discussion of Study Findings	60
CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS	65
5.1 Introduction.....	65
5.2 Summary of Findings.....	65
5.3 Conclusion	67
5.4 Recommendations.....	69
5.5 Limitations of the Study.....	69
5.6 Suggestions for Further Research	70
REFERENCES.....	72
APPENDICES.....	76
Appendix I: Letter of Introduction.....	76
Appendix II: Study Questionnaire	77
Appendix III: Registered OMCs Petroleum Importers.....	83

LIST OF TABLES

Table 4.1: Extent of the impact of procurement risk factors	48
Table 4.2: Extent of transportation risk factors	50
Table 4.3: Delivery risk factors consideration level	51
Table 4.4: Consideration of Risk Mitigation Factors.....	53
Table 4.5: Supply chain performance indicators	55
Table 4.6: Model Summary	57
Table 4.7: Study ANOVA Model	58
Table 4.8: Regression Coefficients	59

LIST OF FIGURES

Figure 2.1: Petroleum Industry Supply Chain	14
Figure 2.2: Risk factors and Performance of Petroleum Product Supply Chains in Kenya	37
Figure 4.1: Study Response Rate	43
Figure 4.2: Gender Disparity among Study Participants	44
Figure 4.3: Ownership Type of Firms involved in the Study	45
Figure 4.4: Number of Outlets Operated by Firms involved in the Study.....	45
Figure 4.5: Mode of Transport preferred	46
Figure 4.6: Availability of Supply Chain Managers in the Firms	47

LIST OF ACRONYMS AND ABBREVIATIONS

AGO	:	Automotive Gas Oil
CIPS	:	Chartered Institute of Purchasing and Supply
DRC	:	Democratic Republic of Congo
ERC	:	Energy Regulatory Commission
FDI	:	Foreign Direct Investment
IK	:	Industrial Kerosene
JET A1	:	Aviation Fuel
KAM	:	Kenya Association of Manufacturers
KPC	:	Kenya Pipeline Company
KPRL	:	Kenya Petroleum Refineries Limited
KRA	:	Kenya Revenue Authority
LAPSSET	:	Lamu Port and South Sudan Ethiopia Transport Corridor
MOEP	:	Ministry of Energy and Petroleum
MSP	:	Motor Spirit Premium
OMCs	:	Oil Marketing Companies
PSC	:	Petroleum Supply Chain
SCOR	:	Supply Chain Operations Reference
SMEs	:	Small and Medium Enterprises
SPSS	:	Statistical Packages for Social Sciences
UNCTD	:	United Nations Conference on Trade and Development
US	:	United States
VOCs	:	Volatile Organic Compounds

ABSTRACT

Competitiveness and continuous innovation to maintain it have been the driving force of the dynamism observed in the modern world of business. The petroleum industry is one of the most dynamic sectors with the sector being highly dependent on its supply chain, especially in Kenya where the sector is fully dependent on imports to serve the market, though recent developments indicate that local production is imminent. This study therefore was done with an intention to investigate the supply chain risk factors and their relationship with performance in the petroleum industry. A descriptive survey research design was adopted to meet this objective targeting a population of all the petroleum firms licensed by the Ministry of Energy and Petroleum to import petroleum product to Kenya, which are 53, from whom the study adopted a stratified sampling technique to acquire a sample of 47 respondents. Primary data was collected from the target respondents composed of supply chain Managers using questionnaires. Descriptive and inferential statistics were used to analyze the study variables. Various risk factors were found that are considered in the operations of the petroleum industry supply chain that were put into three strata of procurement risk factors, transport risk factors and distribution risk factors. These factors were observed to affect the performance of the supply chain significantly in the sector with consideration of procurement and transportation risks being observed to garner positive impact on supply chain performance while a negative impact was realized for the consideration of distribution risk factors. The study found that mitigation measures are effective in that their consideration by the firms affect the supply chain performance. It was therefore recommended that increased consideration of both transport and procurement risk factors in the supply chain should be encouraged while distribution risk factors should be substituted with positively impacting factors. Application of various risk mitigation measures is also recommended, as they are effective in enhancing supply chain performance.

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Petroleum products form a very important part of any country's economy around the world. Different petroleum products are used to accomplish various activities in the economy. For instance, petrol and diesel are used for road transport in many countries across the globe whereas oil is very important in the generation of electricity. This is a clear indication that petroleum products play a central role in the economic development of most countries in the world. It is also important to note that most households in developing countries rely heavily on petroleum products as sources of energy such as lighting and running of small and medium enterprises (SMEs), this is according to the Kenya Association of Manufacturers (KAM website 2014). In essence, petroleum products have a huge macro and microeconomic effect on the economies of most countries (Kojima, Mathews and Sexmith, 2010).

With the critical role that petroleum products play in enhancing economic development, there is need to ensure that there is efficient and effective flow of the products through the entire supply chain. The activities that take place between the procurement, processing, transportation and delivery of the products need to be carefully managed to ensure harmony and ability to meet market demand. Supply chain of petroleum products involves both upstream and downstream activities. On the upstream side, the main activities include exploration, production, trading and transportation of crude oil to the refineries. The downstream activities on the other hand involve marketing and distribution of the refined petroleum products to the end users. (Nnadili, 2006).

Most countries in Sub-Saharan Africa do not produce their own crude oil hence rely on imported oil from other countries. However, there are a few countries that produce their own crude oil but

most of the countries have to engage in global logistics to obtain the crude oil for refining locally or have to import finished products. Kenya is among the countries in the region that have a local refinery that processes crude oil into different products for sale in the region. Kenya is also among the few African countries that have underground pipeline transport for the finished petroleum products. Occasionally due to power outages, pump stations affecting operational efficiency. Several activities take place in the supply chain of petroleum products but this study will focus on procurement, transportation and delivery of petroleum products in Kenya (Kojima, *et al.*, 2010).

1.1.1 Risk

Many managerial decisions are subject to significant uncertainty and risk becomes an overriding factor. A prime example is the allocation of resources in defence organizations. Threats to national security change, sometimes in unimaginable ways. Technological obsolescence occurs rapidly. Weapon systems costs and development times cannot be predicted with certainty. Future costs for the various components of operations and maintenance are uncertain. These circumstances, among many more, lead decision makers to view resource allocation decisions as risk management decisions. Risk management decisions, as with all decision problems, require definition of three elements: A Set of Alternatives, an Information Structure and Decision Maker Preferences (Savage, 2009)

The set of alternatives in risk management initially contains only two elements: (1) NO, the risk is “insufficient” to warrant further action and can be ignored; or (2) YES, there is “sufficiently high” risk and it cannot be ignored. Only after accepting the affirmative alternative, will we proceed to the management decision problem: What course of action most reduces risk subject to resource constraints? Here there can be many alternatives, generally classified in three broad

groups: (1) prevention/avoidance actions; (2) mitigation actions; and (3) “changing the rules” or negotiation with the environment. The information structure is established by the problem definition. This includes definition of the decision maker’s objective and its quantification using a variable called the *outcome of concern*. This is a measure of gain (when the statement of the objective implies “more is better”) or a measure of loss (when the statement of the objective implies “less is better”). Also included is the definition of all variables that affect, or explain, the outcome of concern. These variables include those known to be under the control of the decision maker, as well as those beyond the control of the decision maker. Finally, there is specification of the function relating the outcome of concern to the explanatory variables. Probabilistic models for variables and relations complete the problem definition to account for uncertainty (Savage, 2009)

Decision maker preferences are complicated when uncertainty is present. Uncertainty creates an environment called “decision making under risk”. In this environment decision maker preferences literally exhibit “more twists and turns” than decisions made under certainty (Starmer, 2000). The simple linear “more is better” or “less is better” payoff function is inadequate to explain decisions and led to the use of a nonlinear *utility function* (Bernoulli, 1954). Recent research exposing the defects of the utility function has led to its replacement with a *prospect function* (Kahneman and Tversky, 1979). This describes the preferences of the decision maker using a *payoff function* with: (i) a *reference point* separating losses from gains; (ii) *loss aversion* where losses loom larger than gains; (iii) and *decreasing marginal returns* with respect to both losses and gains. The characteristics of a prospect function become critically important in risk assessment. This is especially so for the reference point. For example, suppose the decision maker has a preference for “less rather than more” of the outcome (e.g., fatalities,

economic loss, etc.). An outcome probability distribution depicting the very high likelihood of very large values for the outcome may cause this decision maker to conclude the situation is “too risky” and demand that “something be done to lower the risk”. On the other hand, another decision maker may observe the same distribution but conclude the situation has “low” risk. Why? The first decision maker may have a much lower reference point than the second decision maker. Without knowledge of preferences (i.e., the payoff function), the information generated in risk assessment is meaningless. This last point is of major importance for, as Sam Savage says (Savage, 2009): “Risk is in the eye of the beholder.” What is risky to one person may not be so to another. The need to explicitly recognize the role played by preferences in risk assessment and management is of paramount importance.

1.1.2 Supply Chain Risks

According to Rodrigue, (2012), supply chain refers to a process that focuses upon a product and extends over to the different actors, activities and resources required for making it available at the place of consumption. The process includes a set of logistics and transport chains linking activities from basic extraction of raw materials to final consumption of the end product. Rodrigue (2012) further asserts that, it may not be possible for the entire supply chain to be managed by a single actor and therefore it remains a functionally integrated entity. The flow of products at the supply chain level are organizational in nature, implying that they reflect a sequence of tasks required to make a product available, including where and how they are undertaken.

According to Chopra, Sunil and Meindl, (2001) any supply chain is characterized with a set of unique market demands and operating challenges. However, the issues that are addressed by each supply chain basically remain the same across all supply chains. As a result, all supply

chains regardless of the variations in market demands and operating challenges have to make decisions concerning five main areas. The first area concerns the production where firms have to make decisions regarding what to produce and by when. This involves development of production schedules and ensuring that the production capacity is met. The second area is inventory management. The firm has to decide how much inventory should be held as raw materials, work in progress and finished products. The other area is location of facilities within the supply chain to ensure efficient and effective delivery. The firms must also make decisions on the transportation of products as well as the information that needs to be shared along the supply chain (Chopra, *et al.* 2001).

Risk management involves the process for identifying, measuring and controlling risk. Risk assessment is the process for identifying the threats and vulnerability as they are related to the existing controls as well as the impact if the threats become real. Some key concepts of risk management are vulnerability that relate to a weakness in the information system that can be potentially exploited by a threat. Threat is a potential danger, which is harmful to an information system, whether intentional or accidental. The risk concerns the likelihood that a threat will take advantage of vulnerability while exposure is the instance when losses are exposed due to a threat. Assets risk concept involves the business resources attributed to the system, including hardware, software, personnel, documentation and data. Control risk concept involves mechanisms in place to reduce, mitigate, or transfer risk. The other risk concepts are countermeasures that relate to controls developed through risk analysis to reduce vulnerabilities. Safeguards risk concept relate to controls that provide some protection to assets .The mitigation risk concept is an effort to select and implement controls with the purpose to reduce risk to acceptable levels (Fernades *et al.*, 2009).

The Petroleum Supply Chain (PSC) is a complex assortment of infrastructures and processes whose mainstream begins with exploration of crude oil and finalizes with the delivery of petroleum products to the consumers. The petroleum sector is highly automated and optimized, so disruptions can rapidly escalate to industry wide or nationwide crisis. Oil companies aware of these risks; have put significant effort in risk management. There are however no direct method to identify possible uncertainties, risks and mitigation strategies for a particular situation (Fernandes *et al.* 2009).

The petroleum chain divides into two major areas; upstream and downstream. The upstream comprises of crude oil production and transportation. The downstream industry involves product refining, transport, storage, distribution and retail. Two major activities aggregate several hundreds of processes and thousands of equipment items where availability is paramount. The procurement supply chain activities are sequential in nature and as such any failure is critical to the next stage and more so as this implies huge working capital that is blocked in petroleum inventories. The prevalent risks in business, operations, finance, environment, safety and security provide a huge potential for risk optimization (Fernandes, *et al.* 2009).

Blanchard (2009) argues that there are a number of risk factors that may affect various supply chains. One of the risk factors relates to the country of origin of the product in question. It is important for firms to understand the susceptibility of their produces in terms of delays. Shipment and delivery accuracy is also a major supply chain risk. Firms need to establish with certainty the ability of the supplier to consistently and timely deliver products. The physical security of the products in question is also important since it can cause losses to the firm. The other risks relates to social and environmental responsibilities. The supply chain has to be sustainable in nature.

1.1.3 Petroleum Supply Chain Performance

Supply chain performance measures have a significant impact on supply chain performance on business performance and this can be demonstrated by using bench marking data and equally it can be shown how the two link together. The two most widely used set of performance measures that have been most widely accepted in the industry are bench marking and the Supply Chain Operations Reference (SCOR) model (Janat 2009).

The Supply Chain-Council is an independent, non-profit, global corporation interested in getting the industry to standardize supply chain terms so that meaningful supply chain bench marking can be carried out. It has developed the Supply Chain Operations Model (SCOR) model as the main industry standard for supply chain management. Supply chain vendors such as SAP have adopted the SCOR performance measures in their performance management module. Under the SCOR model, supply chain performance measures fall under four broad categories namely cost, assets, reliability and flexibility.

The supply chain council refers to measures related to costs and assets as internal-facing measures, while reliability and flexibility are termed as customer-facing measures. Typically, a firm offers a bundle consisting of price, delivery and flexibility to its customers. Price in competitive markets is dictated by the market place. Therefore, only delivery and response related measures are termed as customer facing measure. The performance measures related to assets and costs affect the profitability of the firm and are, thus, termed as internal facing measures. The use of standard measures allows firms to carry out meaningful bench marking studies (Shah 2009.) The petroleum supply chain is lengthy and is proving to be a source of concern in the face of disruptions in sourcing, production and distribution of the petroleum products and services. Such disruptions may be caused by natural disasters such as cyclones,

tsunamis, industrial accidents or acts of terrorism. These disasters have created greater demands on firms to keep supply chains flexible and integrate disruption risk management into every facet of supply chain (Dhongde 2006).

The consequences of petroleum supply chain disruptions affect firms when trying to identify the effect of these disruptions on the firms operations and generally focus on the risks that the firms can see. The supply chain function within that firm will tend to concentrate on the risks that it will be held accountable for. Fleck and Cianto (2003) classified disruptions on the basis of their effect into six major kinds. These are disruption in supply, disruption in transportation, disruption of facilities, disruption in demand and disruption in communication. This study will therefore focus on three main disruptions and related namely procurement, transportation and delivery of the petroleum products supply chain in Kenya. The effectiveness of the mitigation measures and effects on performance will also be established.

1.1.4 Petroleum Industry in Kenya

The Ministry of Energy and Petroleum (MOE&P) is the mainstream government organ that oversees all the activities that take place in the petroleum industry in Kenya. The petroleum industry in the country therefore falls under the direct control of the Ministry of energy and Petroleum. There are other institutions that form the institutional framework of the petroleum industry in the country. These institutions include the Energy Regulatory Commission (ERC) which provides regulatory guidelines in the energy sector; The Kenya Pipeline Company (KPC) which is a state corporation charged with the responsibility of transporting petroleum products to various destinations; the Kenya Petroleum Refineries Limited (KPRL) a Limited Company that operates a single skimming refinery in Mombasa and has been declared uneconomical facility to operate. The company is owned both by the government of Kenya and Essar Energy Overseas

Limited on a 50 percent basis. The industry is also dominated by independent multinational oil marketing companies and a state owned Petroleum Company (Kieyah 2011).

After the deregulation of the oil industry in Kenya in 1992 the market structures of the oil industry remains oligopolistic both in whole and retail level (Government of Kenya, 2005). About 85.3% of market share control is by major oil companies that is Shell/BP now VIVO, Total, Kenol Kobil, Caltex sold all their assets to Total K, and Mobil currently Oil Libya. The major oil companies are vertically integrated with a stake of 51.4% of the 1,153 retail outlets, the remaining are controlled by new entrants and independent owners (Government of Kenya 2005).

According to UNCTD (2005) petroleum products have no close substitutes in Kenya and their prices have a major impact on the country's economy. The use of petroleum products in the country seep into several production and distribution aspects of the economy hence the reason why they have significant implications on the level of inflation; employment, poverty reduction and the overall long term economic growth of the country. It has been found that there is no explicit coordination of pricing of petroleum products in Kenya but evidence from a ministerial taskforce conducted in 2003 and 2004 indicated that there is clear indication that major oil companies exhibit cartel-like behavior in dealing with pricing of petroleum products.

The supply chain of petroleum products in Kenya involves procurement of crude oil by licensed importers depending on their historical market share through open tendering system. The country imports both crude oil and refined petroleum products into the country. The petroleum industry in Kenya has experienced gradual increase in the prices of petroleum products over the years (Kieyah 2011). Shortages in the supply of petroleum products are frequently experienced in the country and this affects the retail prices of the products. Pipeline transportation of the products is

also affected by power outages and this derails timely delivery of the petroleum products within the country (Kojima, *et al.* 2010).

1.2 Research Problem

Petroleum products are typically in high demand in most economies around the globe. The supply chain of the commodities is characterized by transportation of crude oil from where it is extracted to refineries by ship or pipeline. At the refineries, processing takes place and this is a form of value addition that brings out various products. Transportation of the final products is also done to facilities that are closer to the final markets. Transportation requires a high degree of coordination of procurement and transport logistics to ensure that right volumes, prices and supply reliability are achieved. So many risks are involved throughout the entire supply chain of the petroleum product including marine transit losses (Kojima *et al.* 2010).

Kenya has frequently experienced interruptions in the supply of petroleum products over the years. The prices of the petroleum products have also been consistently rising over the years. Among the main reasons for these variations are the dependence on international crude oil and inefficient supply chains. Studies on petroleum industry show diverse findings. Several studies have been conducted on the petroleum industry both globally and locally. (Siddharth, *et al.* 2008) study on evaluating petroleum supply chain performance in India established that the following factors are important in evaluating the performance purity of product, market share, and steady supply of raw material and use of information technology. Kojima *et al.* (2010) study on petroleum markets in Sub-Saharan Africa revealed that petroleum products are widely used in most countries and have far-reaching micro and macroeconomic effects. Kieyah (2011) also studied the petroleum industry in Kenya and established that leading petroleum companies have some level of power to influence activities in the industry.

It is evident from the studies conducted that extensive research has been conducted as far as the petroleum industry is concerned. However, there was very little research done on the risk factors that affect the performance of supply chain of petroleum products especially in Kenya where wide variations in supply and prices are experienced. This study therefore addressed this research issue by answering the following questions: What risk factors affect the supply chain of petroleum products in Kenya? What are the effects of risks on supply chain performance? How effective are risk mitigation measures in relation to procurement, transport and delivery of the petroleum supply chain?

1.3 Research Objectives

The general objective of this study was to establish the risk factors and performance of petroleum products supply chains in Kenya.

Specific objectives included:

- i. To establish supply chain risks in the petroleum industry in Kenya;
- ii. To establish the impact of petroleum supply chain risks on supply chain performance;
- iii. To establish the effectiveness of mitigation measures on the risk factors.

1.4 Value of the Study

The findings from this study assisted in providing more knowledge on the supply chain risk factors. It enabled players in the petroleum industry to get a better understanding of the supply chain risks and how to deal with them. It enabled researchers who are interested in this area to get access to more information.

The policy makers in the petroleum industry in Kenya benefited from the findings of the study. Based on the findings of the study, can be able to come up with risk management policies that are appropriate in alleviating the prevalent supply chain risks in the industry.

Other firms in other industries may also benefit from the findings. They can be able to establish the supply chain risk factors that may cut across industries. This assisted them find ways of addressing them. The establishment of supply chain risks was important to the petroleum firms performance as they helped in optimizing the level of customer service. Firms may target performance levels of the four dimensions of customer service namely the order delivery lead-time, responsiveness, delivery reliability and product variety.

The mitigation management of the petroleum supply chain risks may help firms identify, quantify and prioritize the risk inherent in its supply chain. The advantage of engaging deeply in risk mitigation of the identified risk is critical as it assists in shaping the new technologies and regulatory requirements of the petroleum firms in the management of the identified risks in the upstream, midstream and downstream supply chains.

CHAPTER TWO: LITERATURE REVIEW

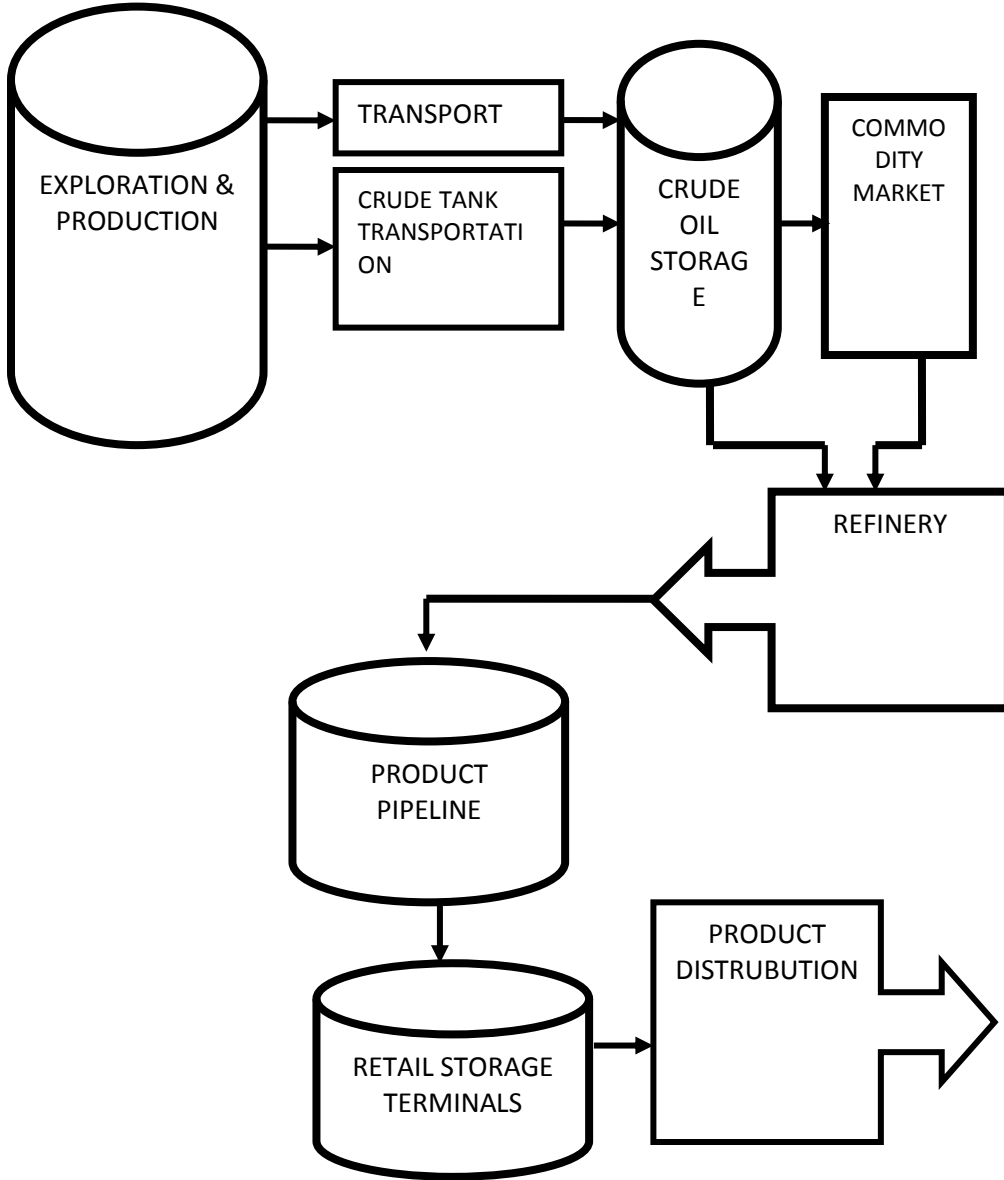
2.1 Introduction

This chapter presents a review of studies that are relevant to the risk factors and performance of petroleum products supply chains in Kenya. The main areas of focus include risk factors affecting procurement, transportation, delivery, performance and effects of risk mitigation measures.

2.2 The Components of Petroleum Products Supply Chain

The oil and natural gas supply chains can be complicated and sometimes obscure systems to many who rely on their products and services. Various scholars have created supply chain models for both oil and natural gas supply chains to communicate, in the simplest terms, how the industry works from the identification of resources to the end user. These models provide simple visual descriptions of these critical systems, their major components, and the critical customers and services, which are dependent on this energy. Recognizing the critical components and their placement in the system provides the context to understand the diversity of the systems, the issues that can affect the various stages of development, production and distribution, and the resilience that is inherent throughout our Nation's energy infrastructure as shown in Figure 2.1.

Figure 2.1: Petroleum Industry Supply Chain



Source: Adapted from Wright (2013).

From figure 2.1, it is evident that the petroleum industry supply chain consists of nine sections, which all interacts to make the supply chain successful. These are as explained in the following section.

2.2.1 Exploration and Production of Crude Oil

This is the initial stage of the supply chain, which concerns the commercial production of petroleum products through mining. The only way to prove what lies in buried rocks is to drill a well. Even with modern geology and geophysical techniques, drilling remains risky. An exploratory or 'wildcat' well in an area that has not been drilled before faces high odds against success: approximately one of seven to 10 exploratory wells finds commercial accumulations of oil or gas. To be commercially viable, a well must be able to produce enough oil or gas to justify the costs of drilling and placing it on production. In wildcat areas, the first exploratory wells are often drilled as tests, and they are not expected to yield oil or gas. Such wells, however, produce valuable information about the nature of the rocks, and their oil and gas potential through the analysis of core samples, rock cuttings and data gathered from down-hole surveys (Wright, 2013).

If exploratory wells establish the presence of producible quantities of oil or gas, "development" wells are drilled to define the size and extent of the field. In development drilling, the odds for success are higher: about six or seven successful wells for every 10 drilled. Nevertheless, the element of risk is still present. There may not be enough oil or gas to make the site commercially feasible or the technology required to produce oil or gas may be too expensive (Wright, 2013).

Because crude oil and natural gas are non-renewable resources, optimizing recovery is critical. Only about 25 per cent of the oil can be recovered from a typical reservoir by natural means or primary recovery techniques. Enhanced-recovery techniques permit production of more oil from many reservoirs. The most common enhanced-recovery method, water injection, involves injecting water into the oil-bearing formation, and the water then forces the oil toward the

producing well bore. Such techniques can result in recovery rates that can exceed 80 per cent of the oil in place (Siddharth, *et al.* 2008).

Natural gas generally flows to the surface through its own pressure; thus, a natural gas wellhead is usually composed of only a series of chokes and valves to control flow. This wellhead structure is called a "Christmas tree." Crude oil, which typically contains some natural gas or solution gases, is sometimes produced through its natural pressure, but most crude oil wells require some method of lifting or pumping the oil to the surface. Pumping equipment is known by various names, including 'pump jack,' 'horse head pump' and "walking beam" pump (Sidhart *et al.* 2013).

2.2.2 Transportation

The crude oil is transported to the refinery wharf by tankers managed by the Shipping Company. Berths for crude oil tankers are situated along the refinery's marine terminal. At the terminal, the cargo of crude oil is discharged through pipelines to storage tanks in the refinery. The terminal also has berths to load refined products. About 65 percent of all refinery products leave the refinery via ship or barge (Wright 2013).

A lot of care is taken to protect air quality at terminal by installing a Vapour Recovery (VR) system at the terminal to control vapours of volatile organic compounds (VOCs) that are generated during cargo loading. The VR system complies with the Clean Air Act's regulations for control of VOC emissions from tank vessels that carry oil and chemicals in bulk, (Sidhart *et al.* 2013).

2.2.3 Crude Oil Storage

Tanks, some with capacities of more than 390,000 barrels (16 million gallons), store the crude oil, as well as intermediate stocks (partially refined), finished products and chemicals (Wright 2013). The refinery's 200 tanks have containment areas designed to hold their capacities in the event of a tank rupture. The system also diverts rainwater runoff from this area to the refinery's effluent treating facilities to protect local waters (Sidhart *et al.* 2013).

2.2.4 Refinery

A barrel of crude oil has a mixture of all sorts of hydrocarbons in it. Oil refining separates everything into useful substances. Chemists use the following steps: The oldest and most common way to separate things into various components (called fractions), is to do it using the differences in boiling temperature. This process is called fractional distillation. You basically heat crude oil up, let it vaporize and then condense the vapour. Secondly, newer techniques use chemical processing on some of the fractions to make others, in a process called conversion. Chemical processing, for example, can break longer chains into shorter ones. This allows a refinery to turn diesel fuel into gasoline depending on the demand for gasoline. Thirdly, the refineries must treat the fractions to remove impurities. Refineries combine the various fractions (processed, unprocessed) into mixtures to make desired products. For example, different mixtures of chains can create gasoline with different octane ratings (Sidhart *et al.* 2013).

The products are stored on-site until they can be delivered to various markets such as gas stations, airports and chemical plants. In addition to making the oil-based products, refineries must also treat the wastes involved in the processes to minimize air and water pollution (Nnadili 2006).

2.2.5 Product Pipeline and Retail Storage Terminals

The nation's crude oil pipelines transport crude oil from oilfields to refineries where the oil is turned into dozens of useful products, such as gasoline, home heating oil, jet fuel, diesel, lubricants and the raw materials for fertilizer, chemicals, and pharmaceuticals. Products pipelines then transport refined products to terminals or local distribution centres. Refined products are distributed to the companies and consumers who rely on a steady and economically transported supply of these products (Nnadili 2006).

Most gasoline and diesel fuel supplies are delivered to the marketplace by pipelines from refineries to local distribution centres. Tanker trucks carry gasoline only the last few miles of the trip to individual service stations. Major airports rely almost entirely on pipelines, and have dedicated pipelines to deliver jet fuel directly to the airport. Almost all plastics are made from resins and other raw materials derived from oil. From our office desks to children's toys, we touch some sort of petroleum-based product almost every moment of our day. Pipelines make this possible (Wright 2013).

Product terminals are more widely distributed than refineries and are generally located near major markets. Pipelines are the safest, most reliable and cost-effective way of transporting the large volume of petroleum products that must be moved throughout. However, the enormous capital cost associated with constructing pipelines limits their use to locations where very large volumes of product are to be moved for an extended period of time. The payback period for these projects is often 15-20 years or greater (Sidhart *et al.* 2013).

Where the volume of petroleum products cannot justify the construction of a pipeline, petroleum products are transported to terminals across land by truck and rail and over water by

marine tank. Although transportation by truck is the most expensive transportation method, it is also the most flexible. Highway truck tankers transport all gasoline from the terminals or refinery truck loading facilities (commonly referred to as "racks") to underground storage tanks at each retail outlet (Wright 2013).

2.2.6 Product Distribution

Like other sectors of the oil and gas business, the marketing and distribution of petroleum products takes place on a vast, global scale. Every day, hundreds of millions of companies and individuals buy these products at wholesale or directly from retail outlets that number in the hundreds of thousands worldwide. If we include indirect users of petroleum products, the number of consumers runs into the billions (Wright 2013).

Refined product markets are different from crude oil markets (see Petroleum Online module titled, "*Marketing & Trading of Crude Oil*") in a number of ways. The scale is much smaller: a typical crude oil transaction involves 500,000 or even one million barrels of oil, while a typical refined product sale may involve only 5,000 to 10,000 bbls. Product quality is more stringent as well – crude oil, by nature, has a wide variation in quality, while refined products must meet stringent specifications or else be considered off spec and a breach of contract or a regulator violation (Nnadili 2006). Finally, there are many opportunities for arbitrage in the products market, because price differentials between grades of refined products are constantly changing at a given location or between locations many miles apart. This offers traders the opportunity to blend grades at one location or move cargoes around the world to achieve better prices or margins (Sidhart *et al.* 2013).

No refinery or marketer has a fully balanced product system so a major aspect of the product markets is to redistribute surpluses and deficits that arise at each location. Although patterns change over time, there are regular flows of products from one region to another and price levels are set according to this trade. For example, European traders regularly export gasoline to the United States (US) and gasoil to the Far East (Wright 2013).

Clearly, the marketing and distribution of petroleum products is a complex and wide-ranging sector of the international petroleum industry. The purpose of this module is to provide you with an overview of the characteristics of the products sold and their applications; to gain an understanding of the products distribution system and the structure of the marketplace; and to identify the main players in this segment of the business and how they create value. You will also learn the nature of the markets for products in different parts of the world, how they differ from region to region, and how products are priced along the value chain including margins, taxes and final commercial or retail pricing. Our discussion culminates with a look at one of the most visible and, on a day-to-day basis, most relevant symbols of the industry—the retail gasoline outlet (Sidhart *et al.* 2013).

2.3 Petroleum Product Supply Chain in Kenya

The Kenyan Economic Survey (2007) indicated that there has been an observable increase in demand for petroleum products within the Kenyan Economy and that of the neighbouring countries. This has been fueled by the growth of the industrial and agricultural sectors, road transport, rail transport, aviation, power generation and manufacturing. The demand for petroleum products in Kenya has therefore seen a constant increase. The 2011 Economic Survey shows that the Total demand of petroleum products grew by 4.3% from 3610.8 thousand tonnes

in 2009 to 3760.7 thousand tonnes in 2010. The demand for power generation increased by 7.2% in 2010; the transport and communication sector experienced a growth of 5.9% in 2010, driven by the expansion of transport and storage sub-sectors.

The Oil Marketing Companies fall in the larger Petroleum industry in Kenya. They are involved in the import, export to the neighbouring countries and distribution of petroleum products to the end-consumers within Kenyan territory. Most of the neighbouring countries to Kenya like Uganda, Rwanda, Burundi, DRC, and The Republic of South Sudan continue to rely on Kenyan petroleum distribution networks and infrastructure. Most of the supply chain decisions to these countries are made by locally incorporated oil companies. There has also been an increased number of Oil Marketing Companies, implying increased competition both for the available distribution infrastructure and for the consumers. There are currently 53 registered OMCs, which actively participate in the importation of petroleum products (KPRL 2012).

Petroleum products come to Kenya through the port of Mombasa, imported in the form of refined products and as crude oil. The refined products are received by the OMC's, as well as by Kenya Pipeline Company. or the Kenya Petroleum Refineries Ltd. on behalf of the OMC's. KPC stores and transports the finished products to upcountry destinations. The crude oil is received at the KPRL for processing to various petroleum products based on a processing agreement, which sets out the precise terms on which KPRL takes custody of specific quantities and types of crude oil on behalf of the OMCs. The Mombasa local depots are served directly by KPRL. Bitumen and Fuel oil are however transported by road. The supply chain of the petroleum products include three main activities namely the upstream activities which include oil and gas exploration and production of crude oil, the procurement of the crude by different users and the shipment to the different users. The internal organizational supply chain activities would consist

of the processing of the crude oil to produce refined petroleum products. The downstream activities would include the transportation, marketing, packaging, warehousing and distribution of finished petroleum products. In the context of Kenyan petroleum industry, the downstream activities would start at the activities after the receipt of the petroleum products at the port of Mombasa. These activities include receipt of refined petroleum products at KPC, KPRL or at the OMC's depot, the receipt of crude oil by KPRL for refining, the transportation of the petroleum products received from KPRL and product stored at KPC by the pipeline or by oil tankers, and lastly, the distribution of the petroleum products to the end users (KPRL 2012).

The OMCs on receipt of the refined products at the port of Mombasa will liaise with KPC on the quantities required of given products at different parts of the country, and KPC will schedule to deliver the products to the OMC at the required destination, by the required dates. The OMC will also coordinate with KPRL Refinery Scheduler on the entitled quantities of product that they would require from KPRL and schedule this to be delivered to the Mombasa local depots or transferred to the pipeline for onward transportation. Requirement for all oil companies are consolidated to form a single product batch to be transported by KPC. OMCs have to share the available pipeline as well as storage tankage at KPC and KPRL. Sharing of the batch volume is based on each oil company's proportionate share of the stock at the KPC storage facility at the time of pumping. The Kenya Revenue Authority through its Customs Services Department stipulates the requirement for warehousing of petroleum products. The Department determines how much duty and when to pay the duties and levies as well as the import and export requirements. The individual OMCs have to pay up all the required tax duty before any oil is released from the storage depots (KPRL 2012).

Each OMC has to liaise with KPRL Planner, or the Pipecor (Pipeline Coordinator) who determines whether or not the marketer has material at KPRL or at KPC. KRA has then to clear the required amount for the marketer to have access to their product. The Pipecor and Refinery Scheduler then ‘queue’ the product for transportation by the pipeline, or for certain products to be transferred to the local depots for trucking before the transportation begins. Poor planning on the side of the OMCs will lead to them not having their products where they would require them, at the required time. KPC will move the batch to the next time slot that product will be transported in the pipeline. The supply chain in the Petroleum industry is very dynamic, and thus it is very important to measure its performance to know what to control and keep the company on track of its business objectives. Measuring the performance of a supply chain will create a scope for improvement of its performance, which will go a long way in leading a company to gaining competitive advantage. This study intends to focus on the downstream supply chain in the petroleum industry in Kenya and examine the extent to which OMC’s measure their performance (KPRL 2012).

2.4 Supply Chain Risks

Supply chains have become longer and more complex while the severity and frequency of supply chain disruptions seems to be increasing in recent years. Significant supply chain disruptions reduce the share price of affected companies by as much as seven percent on average, (Wright 2013). The petroleum supply chain in Kenya therefore is affected by these disruptions.

Natural disasters and extreme weather conditions are not the only threats to supply chains. Systematic vulnerabilities, such as oil dependence and information fragmentation, also pose serious risks as do political unrest, cybercrime and the rising cost of insurance and trade finance. Wright (2013) asserts that 80 percent of companies world see better protection of supply chains

as a priority. This study will therefore establish that a risk such as procurement, transportation and delivery of petroleum products contributes substantially in the performance of the petroleum chain in Kenya.

Companies of all sizes are realizing they no longer have complete control over their market success. This is because they rely heavily on the performance of their supply chain trading partners. Kenya imports petroleum products such as automotive gas oil (AGO), Motor spirit premium (MSP), Industrial kerosene (IK) aviation fuel (Jet A1) from OPEC as refined products. The products are transported by sea, stored in tanks in Kipevu Oil Storage Facilities, and then transported by state owned Kenya Pipeline Company (KPC) to the hinterland. This study will therefore consider the risks involved in the procurement, transportation, delivery, mitigation and performance of the petroleum product supply chain in Kenya.

2.4.1 Procurement Risk Factors

Petroleum products are used in most parts of the world for several purposes. For instance they are used as the main source of power to run automobiles and various machines. However there are few countries around the globe that produce crude oil that is very essential in the processing of various petroleum products. The procurement process of petroleum products for most countries around the globe therefore involves international processes that are subject to a number of risk factors. These risk factors may affect the ability to meet market demand for the petroleum products (Nnadili 2006). One of the most prevalent risk factors that affect the procurement of petroleum products is the fluctuation in foreign currency. As indicated earlier, most countries around the globe depend on crude oil from producing countries that is later refined into different petroleum products. Foreign currency is largely involved in the procurement of the crude oil. Most currencies experience fluctuations due to the forces of demand and supply of the

currencies. These frequent fluctuations have an effect on the price of crude oil and finished petroleum products in the global market. The fluctuations end up creating a lot of instability in the prices of petroleum products and this effect is spread across the entire supply chain, Chartered Institute of Purchasing and Supply (CIPS 2012).

According to Kajiwara (2001), the other risk factor that affects the procurement of petroleum products relates to the ever increasing or escalating prices of crude oil prices. The global trend for the prices of crude oil prices has been more inclined to the upward increase. The increase in global prices of crude oil is attributed to the increased uses of petroleum products and the scarcity of the products due to the limited supply that is available across the globe. The upsurge in the crude oil prices keeps on posing a challenge to the firms that are engaged in the procurement of crude oil or the finished petroleum products. The companies involved in this trade have to keep on injecting more finances into the business in order to cater for the increasing prices of the crude oil and finished petroleum products. It is also important to note that procurement of petroleum products requires huge investments in terms of financial resources that can only be managed by few firms that can gain access to such resources.

The Chartered Institute of Purchasing and Supplies CIPS (2012) assert that conflicts are also a prevalent risk factor that affects the procurement of petroleum products and crude oil. Conflicts that occur in oil producing countries such as the Middle East and some few African countries such as parts in North Africa and the rest largely affect the procurement of petroleum products. Conflicts make it impossible for firms willing to procure petroleum products to proceed with transactions since the products must be physically picked from these countries. Conflicts make it impossible also for crude oil producers to continue with the activities of mining the crude oil due to unstable conditions.

2.4.2 Transportation Risk Factors

World trade is dependent on maritime transport and great strides have been made in recent years to render this system as open and frictionless as possible in order to spur even greater economic growth. However, the very things that have allowed maritime transport to contribute to economic prosperity also render it uniquely vulnerable to exploitation by terrorist groups. The risks are numerous and encompass both containerized and bulk shipping. The vulnerabilities are important, and range from the possibility for physical breaches in the integrity of shipments and vessels to documentary fraud and illicit money-raising for terrorist groups. Finally, the stakes are extremely high, as any important breakdown in the maritime transport system would fundamentally cripple the world economy (Crist, 2003).

Transportation and distribution are two sectors of industry, which should also be mentioned regarding safety issues applied there. Many incidents are indicating that there is a need of some improvements in practices applied so far. Therefore, my suggestion is to discuss this topic further. Recorded incidents provide important information regarding hazardous events for example like oil spills, which usually are caused at terminals or by vessels' leakage. These are damaging the environment and may even cause human losses. In addition, these accidents are damaging the reputation of companies, which usually have to deal with extra costs of oil recovery and compensations. Sometimes vessels and crews are faced with piracy, which is not a random failure event. On top of this, terrorists could target pipelines and vessel as the potentially flammable material enables huge explosions. In these occasions, safety problems are caused by criminal activity of some groups of people and not by random failures. Such dangerous conditions are unpredicted and in case of being attacked the destiny of the crew, the vessel and the containing fluids is unknown (Sergios, 2012).

Offshore and onshore pipelines are also sometimes hazardous. According to many incidents demonstrating the fact that humanity has encountered many problems caused either by failure of the equipment or by criminal and in some cases by political activity. In these cases the potential victims are also the people working in these facilities, the surrounding area and definitely the company exploiting the entire facility. However, there is a significant difference between supplying fuels to a specific area and to the entire country, in terms of relying on the pipeline or the vessel as the only energy source. The pipeline has the property of constant flow, which means that consumers are depending on this kind of energy supply, in contrast with tankers, where is some kind of flexibility related to product delivering. Thus these damages, explosions, sabotages or even closed valves after the decision of operators of the pipelines reflect to the energy reliability of dependent consumers (Sergios, 2012). According to Transport Canada (2013), Oil spillage especially in maritime transport is one of the biggest risk factors that affects firms that trade in petroleum products. The tankers that carry petroleum products may experience oil spillage that may lead to huge losses and interference with the marine ecosystem. Oil spillage may end up affecting not only the financial position of the company involved but also the lead times and inability to meet the market demand for petroleum products for the affected areas.

The other major risk factor that has developed in the last two decades relates to terrorism activities in the high seas. In the recent past terrorism has become a thorny issue to the international community since ocean going vessels are frequently being attacked by pirates and commandeered to unknown destinations. Terrorism has made it very difficult to determine with certainty that an ocean tanker transporting oil and petroleum products will be able to arrive to its destination safely without and interference.

The other risk of transporting petroleum products relates to road transportation. In most countries especially in Sub-Saharan Africa where pipeline network and rail transport are not well developed, road transport is very common in transportation of petroleum products to various places in the market. However, road transport is associated with several risks such as frequent accidents of oil tankers and pollution of the environment. Road accidents lead to huge losses in terms of lost products and lost revenue. The supply of the products into the market is seriously affected and the lead time is also prolonged as the customers have to wait for a longer time for the products to be delivered (ESMAP, 2003).

2.4.3 Delivery Risk Factors

Delivery of petroleum products normally takes place through terminals normally known as filling stations. There are a number of risks that are also associated with such kind of terminals. One such a risk is leakage of petroleum products especially the ones in liquid or gas form. Leakage is very dangerous since it may lead to destruction of property through fire. Leakages usually happen due to poor workmanship or careless handling of the terminals by the employees concerned. There is also a risk of experiencing explosions especially if inflammable gases are involved in the leakage (Defra, 2009).

The other risk that is associated with the delivery of petroleum products is normally related to the delay in the purchase of petroleum products. The firms that deal in petroleum products normally rely on international markets in order to serve the local markets. Any delays that happen as a result of risks in the international business environment will definitely affect delivery of the petroleum products to the market. Delivery of oil products to the market also depends on some other factors such as the weather conditions that may not be favorable at times. In most countries in Sub Saharan Africa where road transport is very prominent, weather conditions and poor

infrastructure may affect efficient and timely delivery of the petroleum products into the various markets (ESMAP, 2003).

2.4.4 Political risks

The economic development of emerging markets and developing countries depends to a large extent on the possibility to make profitable investments and accumulate capital. Having access to foreign capital and investments allows a country to exploit opportunities that otherwise could not be used. Recent experiences with opening capital accounts in emerging and developing economies, however, have proved to be a mixed blessing, as it is becoming increasingly clear that not all types of capital imports are equally desirable. Short-term credits and portfolio investments run the risk of sudden reversal if the economic environment or just the perception of investors change, giving rise to financial and economic crises. It is therefore frequently advised that those countries should primarily try to attract foreign direct investment and be very careful about accepting other sources of finance (Prasad, *et al.*, 2003).

While the economic determinants of FDI flows to developing countries have been analyzed to a considerable degree, it is rather astonishing that the importance of changes in political institutions and of other relevant policies in host countries have received relatively little attention. In the 1990s, most existing studies on the influence of policy-related variables on FDI flows consisted of international cross-country studies. Within this framework, it has been found, for example, that there is a negative link between institutional uncertainty and private investment (Brunetti and Weder 1998), a positive relationship between FDI and intellectual property protection (Lee and Mansfield, 1996), and a negative impact of corruption on FDI flows (Wei, 2000).

In principle, the bias in the estimates of such effects could be in either direction, and it is therefore important to supplement the cross-section studies with time-series estimates. The first attempt was made by Jun and Singh (1996), who regressed an aggregated indicator for political risk, based on a number of sub-components, and several control variables on the value of foreign direct investment inflows. For their data sample of 31 developing countries, the political risk index is statistically significant and the coefficient implies that countries with higher political risk attract less FDI. Likewise, Gastanaga, *et al.*, (1998) examined the link between various political variables and foreign investment inflows. They found that lower corruption and nationalization risk levels, and better contract enforcement are associated with higher FDI inflows. Yet they state that their findings do not always hold up, which may be due to the relatively small country sample of 22 developing countries.

More recently, several studies have analyzed the relationship between fundamental democratic rights and FDI: Using different econometric techniques and periods, Harms and Ursprung (2002), Jensen (2003), and Busse (2004) found that multinational corporations are more likely to be attracted by countries in which democracy is respected. Li and Resnick (2003), on the other hand, argue that competing causal linkages are at work. They found that democratic rights lead, above all, to improved property rights protection, which in turn boosts foreign investment. Apart from this indirect impact on FDI, increases in democracy may reduce FDI. These studies use pooled time-series analysis, but not all of them account for possible endogeneity of the independent variables. Moreover, they often concentrate their analysis on very specific indicators, such as democratic rights, leaving out a broader range of other elements of policy-related variables.

A number of these political risk components are also linked to the quality of political institutions. Above all, the quality of the bureaucracy is closely associated with the institutional strength of a particular country. Likewise, ensuring law and order and reducing corruption levels are important determinants (and effects) of high-quality institutions. They constitute relevant sub-components of an overall assessment of “good governance” (Kaufmann, *et al.*, 1999).

2.4.5 Risk Mitigation Measures

The past 20 years, have seen tremendous increase in the awareness of risk and use of risk management in organizations. Managers in organizations have always been mandated with the task to take decisions and act bearing future uncertainty in mind. At its core is the knowledge that we cannot predict the future with certainty, but we can take steps, which will tend to preferable outcomes over less attractive ones. Risk management therefore is the discipline of making decisions and acting whilst demonstrably taking account of this potential for different future outcomes (Garlick, 2007). The standard risk management processes can be seen as four stage process centered on identification, quantification, management and reporting. Each element is vital link in the chain and must be implemented correctly in order to be effective (Bank, 2008).

Shah (2009) on risk mitigation insists strategies involve buy back contracts postponements or innovations in a supply chain designs that enhance flexibility. Most supply chain the world over is slow, costly and do not deliver good value to the end customer. However, technological and managerial innovations, along with development of logistics specialists, have helped progressive firms to improve supply chain performance. The petroleum industry faces various challenges such as taxation structure, poor state of logistics infrastructure, power supply disruption, break down on communication systems; the fast changing technology and the challenges; the petroleum liberalized market; dealing with adulterated petroleum products and the market price

speculation. This study will explore the effects of different risks encountered during procurement, transportation and delivery of petroleum products in the Kenyan context and the overall effect on the cost, infrastructure, reliability and flexibility in the supply chain.

2.5 Theoretical Foundations

This study is founded on the agency, the transaction cost, and the property rights theories. These theories provide a look at the firm in relation to the environment, hence presenting issues that are related to the supply chain.

2.5.1 The Agency Theory

The agency theory is concerned with the principal-agent contractual relationship. Unlike transaction costs theory, which considers the dimensions of the transaction itself, agency theory places greater conceptual emphasis on the economic incentives of the contracting parties (individuals) within the context of this principal-agent relationship. Agency theory would interpret this business case from the economic perspective of the individual oil firm. The key productive resources are the oil leases (oil-producing tracts of land) and not the drilling capabilities of oil firms (leaseholders), which are assumed to be homogeneous across different oil firms. Alchian and Demsetz (1972) suggest that given the free rider problems inherent in team production where each team member's actions are non-observable and/or are difficult to measure, a party central to all contracts is needed as the monitor to ensure each party's compliance with the contractual stipulations. But because the nature of oil field contracting makes it difficult to detect defection, rather than attempting to monitor compliance by each individual contracting party, oil field unitization centralizes the extraction activity to a single unit operator. Therefore, the principals would be the oil firms (including the unit operator) while the unit operator is the (lone) agent. Another important point to note is that an agency theory

analysis of this particular case of oil field unitization would look at how the principal–agent relationship is managed once this relationship is established. If there are economic benefits to team production (e.g. with unitization) then, under agency theory, there is no reason for the unitization to not be put into place.

Agency theory concentrates on the economic incentives of individuals (in this case, individual oil firms), particularly on how to align the economic incentives of the agent with those of the principal in order to maximize aggregate economic payoffs (for the principal). Absent unitization (i.e. if there is competitive drilling), the incentives of each oil firm are to maximize the economic value of their own oil lease. But with unitization, all the oil firms stand to gain significantly in terms of productivity increase when the output of the unit as a whole is maximized. That is, there is great potential for aggregate economic gains from team production (i.e. unitization), but as is often the case in team production settings, agency problems exist. In agency theory, the focal point is to have the high powered market incentives of individuals channelled to productive uses, by aligning those economic incentives with the overall goals (i.e. maximization of unit production), and monitoring the behaviour of the agents, and thereby minimizing residual economic loss via ex ante contractual design. The agency relationship in unitization is between the oil firms (principals) and the lone unit operator (agent). Monitoring exists in the form of various governance mechanisms such as voting rules, notification requirements, grievance and arbitration procedures, unit operator reporting and accounting practices, and supervisory committee, among others (Libecap and Smith, 2001). Even with all of these monitoring mechanisms in place, there is still residual economic loss due to misalignment of economic incentives (because monitoring is costly).

2.5.2 Transaction Cost Theory

The unit of analysis under transaction costs theory is the transaction, i.e. the unitization contract posited by Ronald Coase in 1937. Transaction costs theory explains the choice of organizational form as matching transactions that have certain transactional characteristics with the appropriate governance mechanisms (Williamson 1996). The strong interdependence between the different tracts of land, whereby one oil firm (leaseholder) can extract oil from his lease and impact the extraction output of another oil firm within the reservoir would be, in transaction cost terms, asset specificity. High asset specificity necessitates, under transaction costs logic, integration of these idiosyncratic assets and coordination by the hierarchy mechanism as the more efficient organizational form to mitigate transaction costs of maladaptation.

Transaction costs theory is more explicit about the possibility of inefficient economic outcomes. Unlike agency theory, an important premise of transaction costs theory is that incentives in hierarchies are qualitatively different from market incentives, and can encourage economic cooperation in situations where purely high-powered market incentives would result in inefficient economic results (i.e. there is a relative economic efficiency of hierarchy over market). Potential contracting problems are acute where there is asset specificity involved, as there are potential holdup problems (opportunism). In the oil field unitization case, forming a unit and assigning all production to a single unit operator with economic sharing rules specified in advance effectively eliminates the holdup problem. By forming a unit, the asset specificity problem is mitigated because interdependent assets are consolidated into one asset (i.e. the oil field is ‘unitized’). However, interdependence between assets does play an important economic role in agreeing on (or, failing to agree on) the economic sharing rules. In effect, although holdup is precluded in the case of oil field unitization, the oil firms that transaction costs theory would

predict to have an economic incentive to engage in holdup would likely engage in other activities to extract the appropriable quasi-rents that it could have gained had holdup been a viable option: hence, the potential ‘holdout’ problem.

2.5.3 Property Rights Theory

The main concern of property rights theory, beginning with Coase (1960), has been social welfare, and with regard to unitization, the main concern is with inefficiency (dead-weight social loss) at an overall economy level and its implications for public policy and the legal framework. The unit of analysis is the unitization contract, and not only is the individual unitization contract considered, but the viability of the institution of unitization is considered as well. Because property rights theory focuses on the institution of unitization, the political environment and analysis of public policy regarding unitization are considered in addition to the unitization contract at a micro-analytic level (i.e. various dimensions of the transaction and within the context of principal–agent relationships).

Indeed, one of the empirical findings of property rights analysis in oil field unitization in the United States is that the various elements that lead to widespread contractual failure have far-reaching implications for some of the reasons why the government is also ineffective in resolving economic inefficiencies (Kim and Mahoney, 2002). Not only will people pursue their self-interest within the rules, they will also allocate resources toward changing (or maintaining) property rights rules to their own benefit (Miller, 1992). In fact, it should be noted that agency theory, property rights theory, and transaction costs theory can all be usefully applied to explain economic cooperation among oil firms within an oil reservoir. Relative to transaction costs and agency theory (especially mathematical principal–agent models), property rights theory takes a more dynamic (evolutionary) view of the contract (Kim and Mahoney, 2002).

2.6 Impacts of Risks on Supply Chain Performance

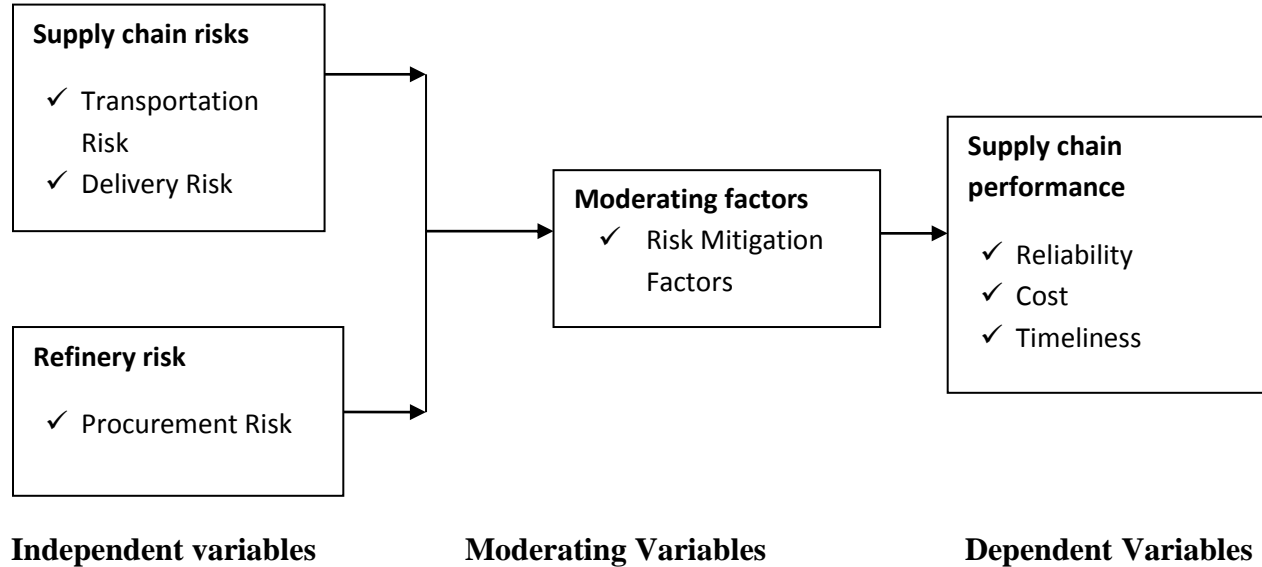
Inadequate storage facilities, poor risk management especially volatility in transportation costs, capacity constraints leading to delays in the petroleum products at the depots resulting to long lead times, supplier relationship matters, weak exchange rates, rise in prices of oil per barrel, slump in the value of the shilling against the dollar, and increased role of traders and speculators are all signs of an inefficient distribution (Economic Survey 2011). Nyikal (2005) asserts that unreliable supply chain such as the petroleum chain in Kenya is expensive and its impact affects the way its customers are served. This impacts negatively and directly on the company's cash flows and its competitiveness in the long run.

Kenya uses the continuous replenishment supply chain model. The idea is to constantly replenish the inventory by working closely with the Ministry of Energy and Petroleum, Importers and oil marketing companies both multinational and independent transporters. The replenishment process should involve as few shipments as possible to reduce the cost and to protect the supply chain from collapsing thereby increasing efficiency and timely delivery of petroleum products to the customers thereby adopting a very stable and reliable performance chain.

2.7 Conceptual Framework

Conceptual framework is a diagrammatical representation that shows the relationship between the dependent variables and independent variables Young (2009). In this study, the conceptual framework examines the risk factors and performance of petroleum products supply chains in Kenya as shown in Figure 2.2.

Figure 2.2: Risk factors and Performance of Petroleum Product Supply Chains in Kenya



Source: Author 2014

2.8 Chapter Summary

A review of literature demonstrates the importance of identifying, measuring, controlling and effective mitigation of supply chain risks of petroleum products. In the review, three key risk factors affecting petroleum products supply chain are realized. They included procurement risks, transportation risks and delivery risks. Consideration of mitigating the three risks and the effectiveness of mitigating the risks in petroleum products supply chain will be identified.

Nnadili (2006) on market demand perceive procurement of petroleum product. CIPS (2012) noted foreign currency fluctuations and conflicts in oil producing countries adversely affect procurement of petroleum products in the supply chain. Kajiwara (2001) notes that the ever-increasing prices of crude oil by oil producing countries similarly pose risks in the supply chain. Crist, (2003) echoes similar sentiments that disruptions on maritime transport poses risk in the petroleum products supply chain. Sergios (2012) observes that damage to vessels causes oil spills and damage to the environment and damages the reputation of the firms involved. Further

literature express views that damage to pipelines and mal operation of valves causes explosions and operations interference. Transport Canada (2013) concludes that oil spillage especially on maritime transport is one of the biggest risk factors that trade in petroleum products.

Defra (2009) asserts that risks of explosions and fires occur from flammable gases and petroleum products and this causes delays in delivery of the petroleum products. ESMAP (2003) asserts that weather conditions, poor infrastructure risks affect efficient and timely delivery of petroleum products. Research done in the petroleum products supply chain indicate that little research has been done on risk factors that affect the petroleum products supply chain. This study will seek to establish the risk factors affecting the petroleum products supply chain in the context of procurement, transportation, delivery and mitigation measures in Kenya.

The four most common models in the supply chain are integrated make-to-stock, build- to-order, continuous replenishment, and channel assembly. This study will concentrate on the idea of continuous replenishment supply chain model where the key concept is to constantly replenish the inventory by working closely with suppliers and or intermediaries. The petroleum products are continuously imported and transported by pipeline to various destinations. Manuj and Mentzer (2008) document a summary of common risks in global supply chain. The risks are; currency as changes in exchange rates; transit time as variability of time spent in transit and port clearance. Forecast this reads to errors in prediction of demand leading to shortage or excess stocks. Quality of products differing from site to site; safety, business disruption caused by supplier sudden inability to produce goods. Survival when a supplier suddenly goes out of business and ownership of inventory as this may lead to confusion of disputes over ownership of inventory and intellectual property. Fluctuating oil prices, opportunism and cultural barriers.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter is a blue print of the methodology that was used by the researcher to answer the research questions. This included the research design, population and sampling design, data collection and analysis, which are discussed in the section.

3.2 Research Design

The study adopted a descriptive cross sectional research design. A descriptive study is concerned with determining the frequency with which something occurs or the relationship between variables (Bryman & Bell 2003). Descriptive research design is a valid method for researching specific subjects and as a precursor to quantitative studies. In this case the research problems were the risk factors affecting the supply chain of petroleum performance in Kenya. The survey was chosen since the study focused on several firms that are engaged in the supply chain of petroleum products in Kenya.

3.3 Target Population

Kitchenham and Shari (2002) define a target population of a study as the group or all the individuals to whom the study applies. Kothari (2004) likewise describe a target population as a specific population about which information is desired. The two researchers conclude that a target population is obtained by establishing all the individuals who are likely to provide relevant information for the study. In addition, the target population is a finite list of all the individuals who are considered suitable in providing relevant information for the study at hand. Based on the above definition the research shall adopt a census of all the fifty-three companies listed by the ministry of Energy and Petroleum (MOEP) in appendix 3. A census approach is also provided for according to Glen (1992).

3.4 Sampling

A census for small populations strategy was used for the sample size where the entire population of 53 petroleum companies was used since the population is less than 200 (Glen 1992). Yamane, (1967) provided a simplified formula to calculate sample sizes. A census eliminates sampling error and provides data on all the individuals in the population. In addition, some costs such as questionnaire design and developing the sampling frame are “fixed”, that is they are the same for samples of 50 or 200 (Glen 1992) in the formula below.

A 95% confidence level and $P=5$ are assumed and precision of $\pm 10\%$.

$$n = \frac{N}{1 + N(e)^2}$$

$$n = \frac{53}{1 + 53(0.05)^2} = 47$$

Where n is the sample size, N is the population size, and e is the level of precision. When this formula is applied to the study population, a sample of 47 is achieved. Therefore, a sample of 47 companies was targeted for data collection.

3.5 Data Collection and Presentation

The study used both primary and secondary data with structured and unstructured questions. Respondents included the supply chain managers only. The study used a questionnaire to collect primary data. A letter of introduction requesting for information accompanied by the questionnaire explaining the purpose of the study to the respondent was presented to supply chain managers of all the fifty-three companies targeted for the study. The questionnaire was administered through drop and pick method. Structured questions were used in an effort to

conserve time and money as well as to facilitate an easier analysis as they are in immediate usable form; while the unstructured questions were used to encourage the respondent to give an in-depth and felt response without feeling to hold back revealing of any information.

A five point Likert Scale was used to gather respondent's opinions. The questionnaire had four sections: section A assessed bio data information of the respondents; section B assessed data on the risk factors affecting procurement; section C seek data on the risk factors affecting transportation and section D carried questions on the risk factors affecting delivery. Section E carried questions on the mitigation factors and section F established the impact of petroleum supply-chain risks on performance. Before embarking on the data collection exercise, the researcher obtained a letter of introduction from the University Of Nairobi School Of Business. This letter assisted in introducing the researcher to the respondents. The questionnaires were distributed through drop and pick method by the researcher and research assistants allowing time for the respondents to fill the questionnaires.

3.6 Data Analysis

The primary data collected was sorted to ensure completeness. It was then coded and entered into statistical packages for social sciences (SPSS) for analysis. The study objectives were analyzed using descriptive statistics and multiple regression. The findings of the study were presented in tables and bar charts. In order to make the study findings more clear and easy to understand, the researcher provided explanations of the findings as illustrated in each table and chart. This in turn assisted in drawing conclusions and making recommendations based on the study findings. A discussion that related the findings of the study to other past studies was also provided. Using the information captured in questionnaires.

3.6.1 Impact of Risk Factors and Performance in Petroleum Industry in Kenya

Section F dealing with performance measures were analyzed through measures of central tendency. These are frequencies, bar charts, pie charts. On the Likert scale measures of less than 2 were regarded as poor performance, mean of 2 to 4 as average and above 5 as good performance. Standard deviation was used to determine the deviation of the results from the expected values.

Multiple regression analysis was used to determine the performance of the supply chain in relation to the risks and mitigation measures. The regression model adopted the following expression:

$$SCP = \alpha + \beta_1 PR + \beta_2 TR + \beta_3 DR + \beta_4 RM + \varepsilon$$

Where:

SCP= Supply Chain Performance

α = Constant

β = Coefficient of the independent variables

PR = Procurement risk

TR = Transportation risk

DR = Delivery risk

RM = Risk Mitigation

CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION

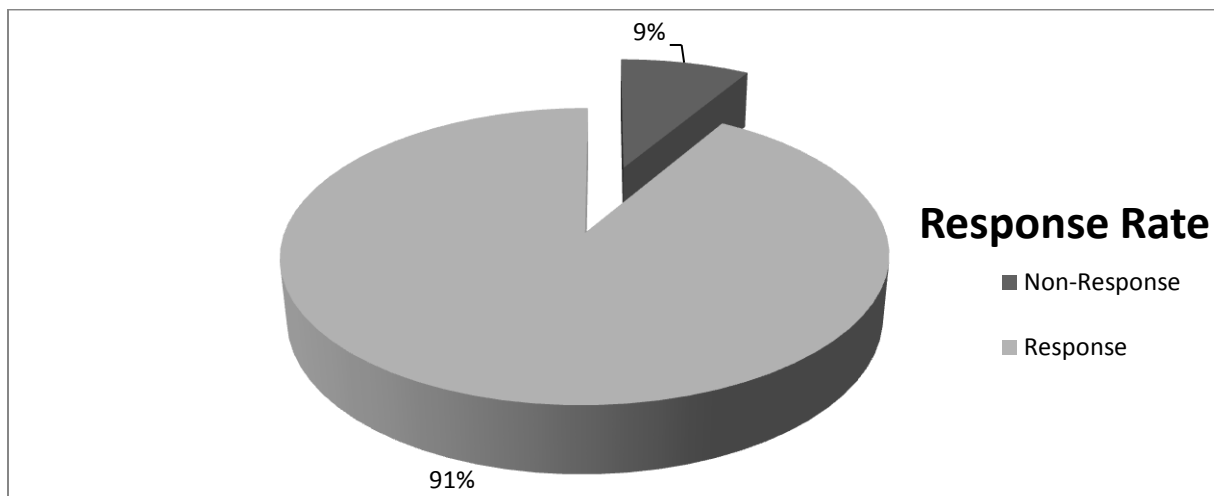
4.1 Introduction

This chapter describes the analysis of data followed by a discussion of the research findings. The findings relate to the research questions that guided the study. Data was analyzed to find out supply chain risk factors and performance in petroleum industry in Kenya. The outcomes are discussed in the following sections of this chapter.

4.2 Response Rate

The study targeted 47 respondents in its analysis whose views would have been considered in the formulating the study outcomes. The response rate turned out as given in Figure 4.1.

Figure 4.1: Study Response Rate



Source: Author 2014

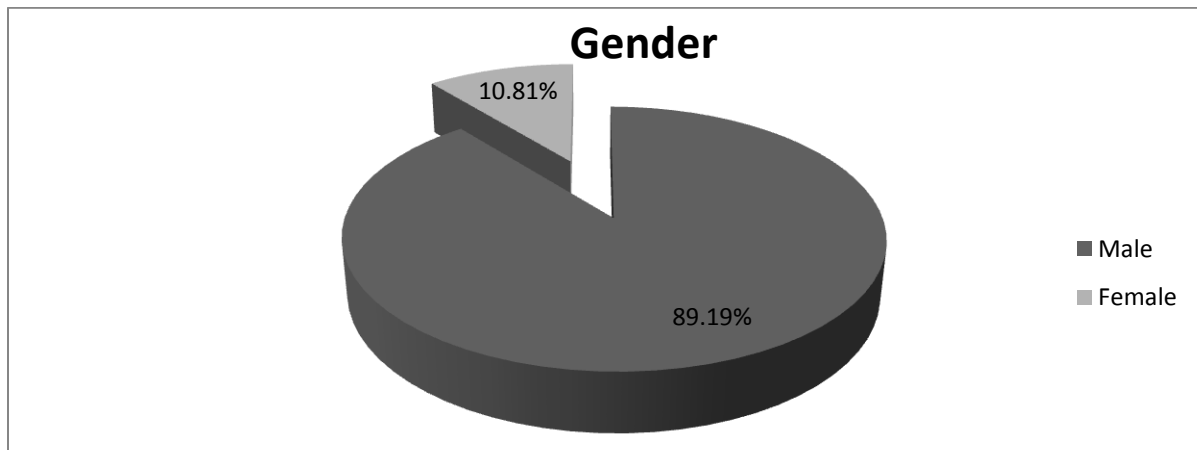
Data was acquired from self-administered questionnaires where a total of 47 respondents from the oil marketing corporations were targeted while only 43 of these Oil marketing Companies (N=43) completed and submitted the questionnaires, a response rate of 91% and only 9% of the

respondents failed to respond to the questionnaires. This response rate was excellent and applicable in the study to come up with conclusive findings on the study objectives.

4.3 Demographic Review

Various demographics of the respondents involved in the study were considered who mainly included key supply chain representatives of firms in the oil sector in Kenya. The respondents' gender, type of ownership of the companies, number of outlets the firm owns, the firms' preferred mode of transport and presence of supply chain managers in the firms were considered. The outcomes of these demographic characteristics reviewed are presented in this section of the study. Figure 4.2 shows the gender disparity among the involved respondents.

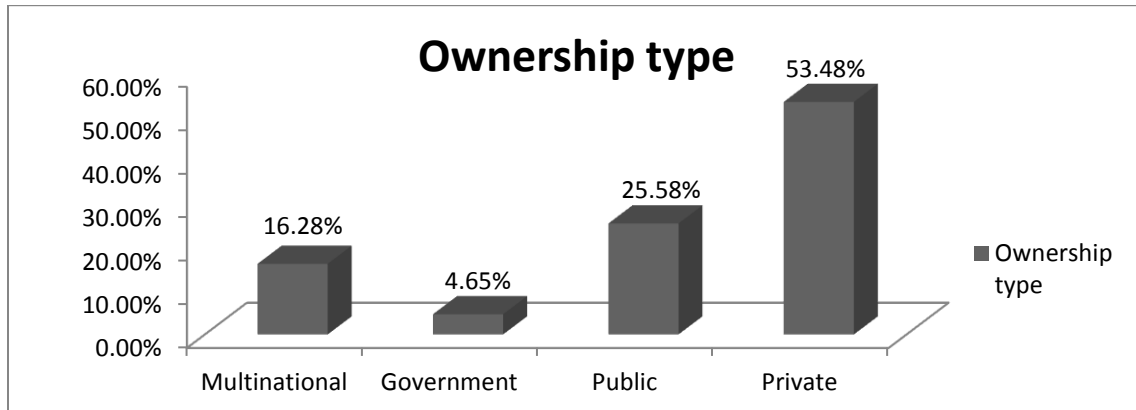
Figure 4.2: Gender Disparity among Study Participants



Source: Author 2014

It was observed that most of the respondents were male (89.19%) while only a very small percentage (10.81%) is female. This confirms the situation in the oil sector in Kenya that the sector is male dominated with very few females getting involved in the sector. Therefore, the study findings are not gender biased but rather confirmed that there is a large disparity in gender in this sector with females getting very few chances. The ownership type of firms was also considered and the following were the findings as presented in figure 4.3.

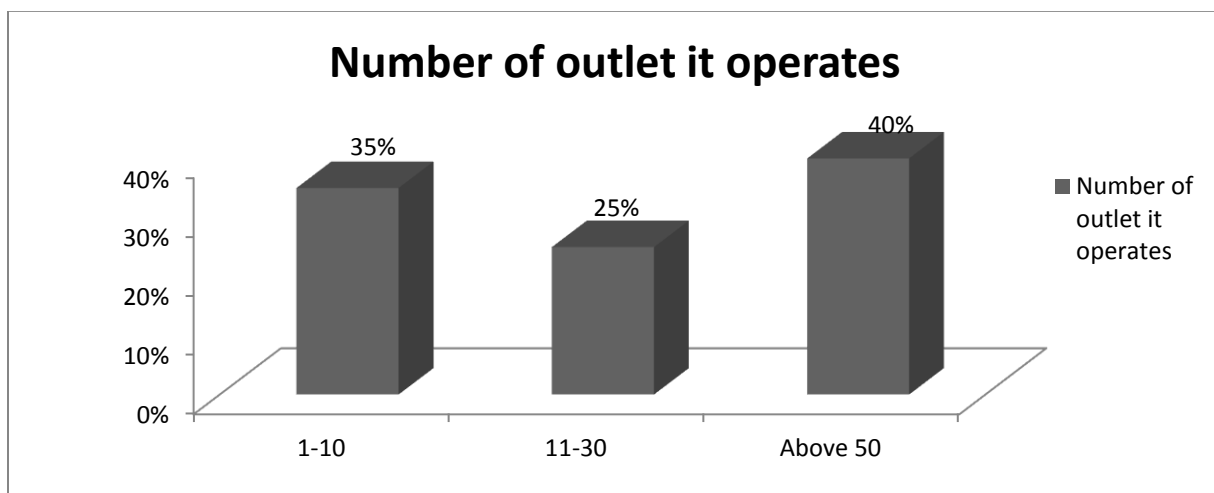
Figure 4.3: Ownership Type of Firms involved in the Study



Source: Author 2014

It was observed that most of the firms involved in the study (53.48%) are privately owned while 25.58% are public owned, 16.28 are multinationals and only 4.65% of the firms represented are government owned. This situation is observed in the sector where most of the firms operating in the country are private companies while a few of the firms are public, multinationals and a few are government owned. The number of outlets operated by the firms involved in the study was also considered and the outcomes are presented in Figure 4.4.

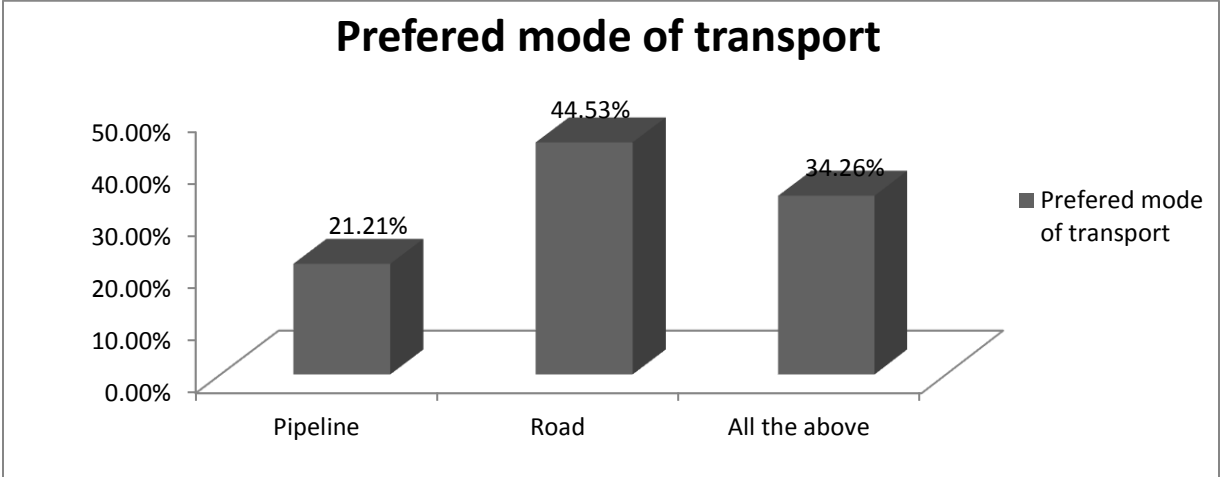
Figure 4.4: Number of Outlets Operated by Firms involved in the Study



Source: Author 2014

It was observed that most of the firms involved in the study (40%) operate above 50 outlets dispersed across the country, while 25% had 11-30% and 35% of the firms operate 11-30 outlets. This scenario is observed since the study mostly targeted the firms, which are registered in Kenya with the Ministry of Energy, which are mainly large companies. However, those firms that are not registered are the most in the country and are smaller with some having one outlet. The firms' preferred mode of transport was considered and the following outcomes were found.

Figure 4.5: Mode of Transport preferred

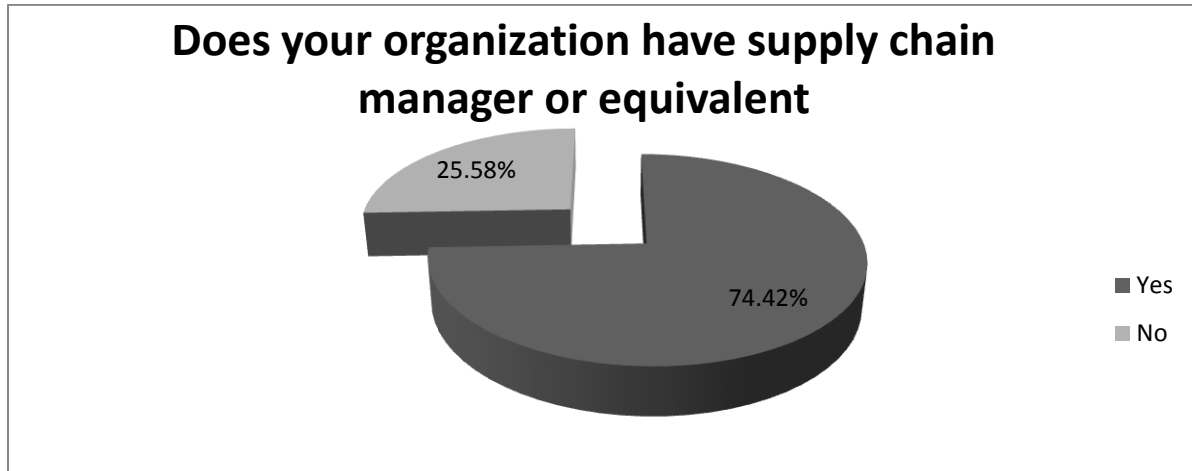


Source: Author 2014

Most of the firms (44.53%) were observed to prefer the use of road transport in carrying their operations in Kenya while only 21.21% prefer pipeline usage. However, 34.26% of the firms prefer both pipeline and road as their mode of transport for the oil commodities. The low preference on pipeline mean of transport might be due to the fact that pipelines are not very extensive and need to be substituted with road transport to be functional.

The presence of supply chain managers in the firms was also considered and the situation shown in Figure 4.6 was observed.

Figure 4.6: Availability of Supply Chain Managers in the Firms



Source: Author 2014

It was found that most of the firms involved in the study have supply chain managers or an equivalent position in their firms. It found that 74.42% of the firms have supply chain managers or a closely related position in their firms while only 25.58% do not have supply chain manager or closely related positions. Some of the firms that claimed there is no such position claim that the position is not available in their firm because the supply chain operation is done within a special

4.4 Descriptive Statistics

The study carried out descriptive analyses on various indicators and the outcomes are presented in this section. The factors were analyzed descriptively using percentage, mean, mode, and linear regression were presented by use of graphs, pie charts and tables in the section.

4.4.1 Procurement Risk Factors

The study enquired from the respondents the risk factors that are encountered by petroleum products procurement supply chain on a five point Likert Scale and the following views were registered in the study as presented in Table 4.1.

Table 4.1: Extent of the impact of procurement risk factors

Factors	N	Very small extent	Small extent	Moderate extent	Large extent	To a very large extent	Mean	Std. Deviation
Failure to plan demand forecast	43	0.0%	14.0%	7.0%	14.0%	65.0%	4.1628	1.4130
Submission of timely procurement requests	40	12.5%	15.0%	7.5%	35.0%	30.0%	3.5500	1.3950
Use of right procurement method	43	0.0%	7.0%	25.6%	20.9%	46.5%	4.0000	1.1751
Incomplete shipment data	43	0.0%	7.0%	14.0%	23.3%	55.8%	4.2791	0.9593
Incomplete technical testing methods and standards	43	0.0%	16.3%	14.0%	27.9%	41.9%	3.9535	1.1117
Protracted contract negotiations	43	0.0%	0.0%	30.2%	27.9%	41.9%	4.1163	0.8510
Foreign exchange fluctuations	43	7.0%	16.3%	14.0%	48.8%	14.0%	3.4651	1.1412
OMC import ullage allocation	43	14.0%	7.0%	20.9%	23.3%	34.9%	3.5814	1.4012
Average		4.2%	10.3%	16.6%	27.6%	41.2%	3.8885	1.1810

Source: Author 2014

Various procurement risk factors were looked at and it was found that they are considered to have impact on petroleum product procurement chain. It was observed that most of the respondents (65%) felt that failure to plan demand forecast impact petroleum product supply chain to a very large extent while a mean of 4.16 realized from the factor confirmed that the factor has a great impact on the supply chain. On the other hand, submission of timely procurement requests was observed to have a great impact by 35% of the respondents while 30% felt that it has a very great impact, which was on average observed to be considered to a great extent by firms given by a mean of 3.55.

It was observed that most of the respondents (46.5%) felt that the use of right procurement methods have a very great impact on the supply chain with procurement indicating a mean of 4.00 to show that there is a great impact expected from the factor. It was observed that incomplete shipment data is considered by most respondents to a very great extent in relation to petroleum supply chain risks as it was considered by 55.8% of the respondents to a very great extent with an overall observation that the factor is considered to a great extent by a mean of 4.28. It was also found that incomplete technical testing methods and standards is considered by most of the study respondents (41.9%) in relation to risks on the supply chain while 27.9% observed the factor to a great extent registering a mean of 3.95, to confirm the factor is important on risks to a great extent.

The study also looked at the consideration of protracted contract negotiations in procurement of petroleum products where the factor was viewed to be considered in procurement risks to a great extent indicated by a mean of 4.12, an indication that protracted contract negotiations have a great impact on the procurement of petroleum products in the Kenyan sector. On the other hand, foreign exchange fluctuations were observed to be considered to a moderate extent in the supply chain realizing a mean value of 3.46 to indicate that the factor affects petroleum supply chain to a moderate extent. It was observed that the consideration of the factor of OMC import ullage allocation is considered to a great extent in the petroleum supply chain indicating a mean of 3.58. On average, procurement risk factors are considered to a great extent at a mean of 3.89, with 41.2% of the respondents claiming they considers them in the petroleum supply chain to a very great extent, 27.6% to a great extent, 16.6% to a moderate extent, 10.3% to a low extent and 4.2% to a very low extent. Therefore, the procurement risk factors are highly regarded in the sector petroleum sector.

4.4.2 Transportation Risk Factors

The study considered the level of consideration of various transportation risk factors and varying views were acquired for each of the factors considered in the study. The observations are as presented in Table 4.2.

Table 4.2: Extent of transportation risk factors

Factors	N	Very small extent	Small extent	Moderate extent	Large extent	To a very large extent	Mean	Std. Deviation
Country of origin	43	6.98%	23.26%	27.91%	6.97%	34.88%	3.3953	1.3652
Terrorism	43	6.98%	13.95%	20.93%	13.95%	44.19%	3.7442	1.3468
KPC system product evacuation	43	11.63%	20.93%	16.28%	30.23%	20.93%	3.2791	1.3332
Market speculation	40	7.50%	15.00%	30.00%	22.50%	25.00%	3.4250	1.2380
Vandalism of pipeline	40	7.50%	15.00%	7.50%	22.50%	47.50%	3.8750	1.3623
Selection of transport strategy	40	0.00%	7.50%	25.00%	67.50%	0.00%	3.6000	0.6325
Choice of transportation mode	43	0.00%	6.98%	30.23%	32.56%	30.23%	3.7907	1.1032
AVERAGE		5.80%	14.66%	22.55%	28.03%	28.96%	3.5870	1.1973

Source: Author 2014

It was observed that the respondents consider the country of origin of commodities, to a large extent indicated by a mean of 3.39. On the other hand, most of the respondents (44.19%) consider the risk associated with terrorism to a very large extent, and the realized mean of 3.74 is an indication that the risk associated with terrorism is considered by firms in the petroleum value chain to a large extent. It was observed that KPC system product evacuation risk is to a moderate extent (M 3.28) considered by petroleum firms in the Kenyan supply chain. Market speculation risk on the other hand is considered by most of the respondents to a moderate extent (30.0%), and a mean of 3.43, confirms that market speculation risk is considered by firms to a moderate

extent. The respondents considers vandalism of pipeline as a risk factor to a large extent (Mean 3.88) with most of the respondents (47.50%) having the view that they considers the factor to a very large extent while 22.50% of the respondents feels that the factor affects their supply chain decisions to a large extent. Selection of transport strategy is considered to a large extent (mean 3.60) in the petroleum sector supply chain with 67.50% of the firms considering the factor to a large extent. The choice of transportation mode is considered in relation to risks at a mean of 3.79, indicating that the choice of transportation mode is a risk factor that is considered to a large extent by the firms operating in the petroleum industry in Kenya.

4.4.3 Delivery Risk Factors

A look at the level of consideration of delivery risk factors in the petroleum products delivery supply chain brought out the outcomes of the study analysis, which are presented in Table 4.3.

Table 4.3: Delivery risk factors consideration level

Factor	N	Very small extent	Small extent	Moderate extent	Large extent	To a very large extent	Mean	Std. Deviation
Political stability	43	6.98%	6.98%	13.97%	20.92%	51.15%	4.0233	1.2628
Infrastructure	43	6.98%	16.28%	9.30%	32.56%	34.88%	3.7209	1.2970
Internet connectivity	43	4.65%	11.63%	48.84%	20.93%	13.95%	3.2791	1.0077
Top management support	43	0.00%	0.00%	20.93%	32.56%	46.51%	4.2558	0.7896
Stabilized power supply	43	6.98%	6.98%	13.95%	13.95%	58.14%	4.0930	1.2876
Upgrade of existing pipeline	43	6.98%	16.28%	30.23%	27.91%	18.60%	3.3488	1.1728
Increased storage capacity	43	0.00%	6.98%	44.19%	30.23%	18.60%	3.6047	0.8767
Market price fluctuations	43	0.00%	27.91%	27.91%	30.23%	13.95%	3.3023	1.0359
AVERAGE		4.07%	11.63%	26.17%	26.16%	31.97%	3.7035	1.0913

Source: Author 2014

It was found that firms consider political stability to a large extent (mean 4.02) in the petroleum sector supply chain with most of the respondents claiming that they consider the factor to a very large extent (51.15%). Infrastructure on the other hand is considered to a great extent (mean 3.72) by the firms in this sector where most of the firms observed that they consider this factor to a very large extent (34.88%). Internet connectivity on the other hand is considered to a moderate extent (mean 3.27) in the supply chain as a risk with most of the respondents (48.84%) having the view that the factor is considered to a moderate extent in their firms. Top management support is considered to a very large extent in 46.51% of the firms and a mean of 4.25 confirms that the factor is considered to a large extent in relation to risk. Similar views are observed for stability of power supply factor that is considered by most of the respondents to a very great extent (58.14%) with the mean of 4.09 indicating that the factor is considered to a large extent in the petroleum sector. Upgrade of existing pipeline on the other hand is considered by most of the respondents (30.23%) to a moderate extent, and this view is confirmed by a mean of 3.35 indicating that the factor is considered as a risk to a moderate extent by firms operating in the sector. Increased storage capacity is considered to a large extent (mean 3.60) by firms in the petroleum sector as a risk. Market price fluctuations is considered by most of the firms (30.23%) as a risk factor in supply chain to a large extent, and a mean of 3.30, confirms that firms in the petroleum industry consider market price fluctuations to a moderate extent as a factor of risk in their firms' supply chain operations. It was observed that delivery risk factors are considered to a large extent in the petroleum sector with a grand mean of 3.70 being observed and most of the respondents (37.90%) considering these factors to a very large extent, 26.16% considering the factors to a large extent, 26.17% to a moderate extent, 11.63% to a low extent, and, 4.07% to a very low extent.

4.4.4 Risk Mitigation Factors

A look at the risk mitigation factors in the petroleum sector supply chain was done in the study and specifically, a look at the level of consideration of the factors in the operations of the sector players was done. The findings are as presented in Table 4.4.

Table 4.4: Consideration of Risk Mitigation Factors

Factors	N	Very small extent	Small extent	Moderate extent	Large extent	To a very large extent	Mean	Std. Deviation
Minimizing disruptions	43	6.98%	6.98%	6.98%	27.91%	51.15%	4.0930	1.2308
Redesign for customer	43	0.00%	13.95%	27.91%	44.19%	13.95%	3.5814	0.9059
Reviewing petroleum chain infrastructure	43	0.00%	6.98%	23.26%	55.81%	13.95%	3.7674	0.7819
Additional investment in the sector	43	0.00%	13.95%	44.17%	27.91%	13.95%	3.4186	0.9059
Construction of more storage facilities	43	0.00%	20.93%	32.56%	27.91%	18.60%	3.4419	1.0305
Wide consultations and interaction among industry players	43	6.98%	23.26%	20.93%	6.97%	41.86%	3.5349	1.4201
Colour coding of export petroleum products to curb adulteration and unreasonable fuel prices	40	12.50%	7.50%	37.50%	20.00%	22.50%	3.3250	1.2687
AVERAGE		3.78%	13.36%	27.62%	30.10%	25.14%	3.5946	1.0777

Source: Author 2014

The study looked at the level of application of various risk mitigation factors in firms operating in petroleum sector in Kenya where the statistics on the consideration of the factors when

considering risks in the supply chain were acquired. It was found that minimizing disruptions is considered to a very large extent by most of the firms (51.15%) in the sector with a mean of 4.09 indicating that the factor is considered to a large extent in the sector. Redesign for customer factor was considered to a large extent by most of the firms (44.19%), realizing a mean of 3.581 indicating that the firms consider this factor to a large extent. On the other hand, reviewing petroleum chain infrastructure was observed to be considered by most of the respondents to a large extent (mean 3.77) with most of the respondents considering the factor to a large extent (55.81%). Additional investment in the sector registered differing views, that firms considers it to a moderate extent (mean 3.42), with most of the firms claiming that they consider the factor to a moderate extent (44.17%). Construction of more storage facilities was observed to be considered to a moderate extent (Mean 3.44) by firms in the petroleum sector. Wide consultations and interaction among industry players was also another risk mitigation factor that the study looked at with most of the firms indicating that they considers the factor to a very large extent (41.86%), but with a mean of 3.53, the study confirmed that the firms consider its application to a large extent in Kenyan firms.

Colour coding of export petroleum products to curb adulteration and unreasonable fuel prices was on the other hand observed to be considered to a moderate extent (mean 3.33) by the firms operating in the petroleum sector with most of the respondent firms considering the factor to a moderate extent (37.50%) On overall, 3.78% of the firms considers risk mitigation factors to a very low extent, 13.36% to a low extent, 27.62% to a moderate extent, 30.10% to a large extent and 25.14% to a very great extent.

A grand mean of 3.5946 realized in the analysis confirms that the firms in the petroleum sector considers various risk mitigation factors to a large extent in their operations in the supply chain.

An enquiry into other risk factors was done and the respondents gave them as: financial constraints; price fluctuations; challenges on planning and procurement; benchmarking with international oil and gas companies; incorporation of leak detection system with loss/gain elements; lack of proper communication and petroleum handling safety; political patronage; product quality, product specification (e.g. are specifically harmonized across consumer countries or not); and, absence of laws and/or reinforcement agents responsible for governing petroleum sector.

4.4.5 Supply Chain Performance

The enquired of factors considered to improve the performance of the supply chain in the petroleum sector and varying views of the performance indicators in the sector were captured as presented in Table 4.5.

Table 4.5: Supply chain performance indicators

	N	Very small extent	Small extent	Moderate extent	Large extent	To a very large extent	Mean	Std. Deviation
Operation cost of the supply chain	43	0.00%	6.98%	6.98%	18.60%	67.44%	4.3256	1.2290
Political risks	43	0.00%	13.95%	30.23%	6.98%	48.84%	3.9070	1.1714
Level of customer service	43	6.98%	4.64%	6.98%	23.26%	58.14%	3.7674	1.1305
Order delivery time	43	6.98%	4.65%	6.98%	13.95%	67.44%	4.3023	1.2254
Perfect order fulfillment	43	6.98%	4.65%	6.98%	23.26%	58.14%	4.2093	1.2063
Supply chain response time	43	0.00%	11.63%	4.65%	34.88%	48.84%	4.2093	0.9894
Supply chain performance	43	0.00%	18.60%	9.30%	44.19%	27.91%	3.8140	1.0523
Average	43	2.99%	9.30%	10.30%	23.59%	53.82%	4.0764	1.1435

Source: Author 2014

It was observed that operation cost of the supply chain is considered to a large extent by firms in the petroleum sector with a mean of 4.33. Political risks on the other hand indicated a consideration to a large extent at a mean of 3.91. Similar findings were observed for level of customer service (mean 3.77), order delivery time (mean 4.30), perfect order fulfillment (mean 4.21), supply chain response time (mean 4.21) and supply chain performance (mean 3.81). On average, it was observed that firm performance factors are considered to a large extent (grand mean 4.08) with most of the firms considering these factors to a very large extent (53.82), while those considering it to a large extent is 23.59%, moderate extent is 10.30% small extent is 9.30% and very small extent is 2.99%. This indicates that these performance improvement factors are considered very important in improving the performance of the petroleum sector supply chain.

An enquiry from the respondents of other factors that would be applied in improving the supply chain performance brought suggestions that competition from the upcoming standard gauge railway line; the newfound oil deposits in Turkana; new pipeline and rehabilitation of Kenya Petroleum Refineries Ltd. by building a modern refinery; supply chain benchmarking; strategic supplier partnerships; innovation; improving IT and other communication tools; capacity building for human resources; emerging consumer demands e.g. ISO certification, high transporting costs in view of eminent competition from standard gauge railway company, lead time for online customer interaction regarding orders; and shortening the supply procedures as well as procurement procedures were some of the suggested considerations that the firms make.

4.5 Impact of Procurement Risk, Transportation Risk, Delivery Risk and Risk Mitigation on the Performance of Petroleum Sector Supply Chain

A regression analysis was done to find out the relationship among the study variables and the following scenario was observed as presented in tables 4.6, 4.7 and 4.8 in this section. This was done while testing and quantifying the relationship between performance of the supply chain in the country and the risks observed in the supply chain such as transportation risks, procurement risks, and delivery risks and considered together with a moderating factor of risk mitigation in the petroleum sector in Kenya, all measured from the primary data collected in the study on the level of their considerations on a five point Likert scale. Table 4.6 represents the model summary realized in the study analysis.

Table 4.6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.884 ^a	.781	.758	.45302
a. Predictors: (Constant), Risk Mitigation, Transportation Risk, Procurement Risks, Delivery Risk				

Source: Author 2014

Table 4.6 discusses the regression model summary. It was observed that the model showed a high correlation coefficient of 0.884, and a high coefficient of determination (R^2) of 0.781 which indicates that the study independent variables can be able to explain 78.1% of the dependent variable, which gives the model a high significance level since it can be able to explain most of the outcomes of the dependent variable. It means that risk mitigation, transportation risk, procurement risks, and delivery risk can be able to explain Supply Chain Performance with

78.1% probability. An ANOVA of the model was carried out and the outcomes are as explained in Table 4.7.

Table 4.7: Study ANOVA Model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	27.835	4	6.959	33.908	.000 ^a
	Residual	7.799	38	.205		
	Total	35.634	42			
a. Predictors: (Constant), Risk Mitigation, Transportation Risk, Procurement Risks, Delivery Risk						
b. Dependent Variable: Supply Chain Performance						

Source: Author 2014

The ANOVA test provided a sum of squares for the regression as 27.835 and mean squares as 6.959 which are greater than both the residual sum of squares (7.799) and the residual mean squares (0.205). There is a significant difference between the two values with a p-value for the ANOVA model indicating that the model is extremely significant ($p = 0.00$) at 95% confidence level. This is an indication that the estimated sum of the squares which shows the deviations of the predicted values from the mean value of a response variable, showed a great deviation implying that the regression model variables are highly reliable. A p-value of 0.000 which is less than the expected maximum value 0.05 at 95% confidence level, further confirms the statistical significance of the study outcomes. The regression coefficients were found to be as indicated in Table 4.8.

Table 4.8: Regression Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	.086	.411		.210	.035
Procurement Risks	.832	.197	.794	4.226	.002
Transportation Risk	.039	.129	.038	.299	.007
Delivery Risk	-.398	.235	-.322	-1.693	.049
Risk Mitigation	.580	.154	.416	3.765	.001

a. Dependent Variable: Supply Chain Performance

Source: Author 2014

It was observed that all the independent variables (risk mitigation, transportation risk, procurement risks, and delivery risk) were included in the model indicating both positive and negative coefficients to indicate that they have a high impact on supply chain performance of the petroleum firms. The four variable coefficients and model constant were found to be statistically significant with all the variables indicating p-values of less than the 0.05 optimal levels. The model was found to be such that the model constant, procurement risk, transportation risk and risk mitigation had positive coefficients while delivery risk indicated a negative coefficient. This is an indication that increased consideration of all the risk factors except the delivery risks leads to better performance of the supply chain while increased consideration of delivery risks leads to poorer performance of the supply chain in the petroleum sector. These outcomes can be applied in the model as shown in the following equation.

$$\text{SCP} = 0.086 + 0.832 \text{ PR} + 0.039 \text{ TR}_2 - 0.398 \text{ DR} + 0.580 \text{ RM} + \varepsilon$$

Where:

SCP= Supply Chain Performance

PR = Procurement risk

TR = Transportation risk

DR = Delivery risk

RM = Risk Mitigation

4.6 Discussion of Study Findings

From a target population of 47 respondents that the study targeted, it realized a 91% response rate which was considered sufficient to provide the desired outcomes for the study. It was confirmed that the views that the petroleum sector is dominated by the male gender where the firms representation was majorly by the males while only 10.81% of the firms were presented by females. However, the study did not consider this as a factor that affected the outcomes of the study since the study topic is not gender sensitive. Most of the firms were observed to be privately owned with only a few being public owned, multinationals and government owned. Most of the firms involved in the study were observed to have more than 50 outlets indicating that the firms operating in the petroleum industry of Kenya while only a few are small operating between 1 to 10 outlets. Most of the firms prefer roads as a form of transport with road usage being observed to be preferred by 78.79% of the firms. Pipeline was preferred only by a few firms which might be due to the fact that pipeline usage is not flexible and the pipeline infrastructure in Kenya is not well developed. Most of the firms were observed to have a supply chain manager or an equivalent position. This is in line with the observations in the modern firms where supply chain managers are being considered very vital in enhancing firm competitiveness.

Procurement risk factors were analyzed where the study asked the respondents how they consider the risk factors in their operations within the supply chain. It was observed that the factors are considered in the order: incomplete shipment data; failure to plan demand forecast; protracted contract negotiations; use of right procurement method; incomplete technical testing methods and standards; OMC import ullage allocation; submission of timely procurement requests; and, foreign exchange fluctuations from the most applied to the least applied factor, where all except the last factor were observed to be considered to a large extent in the supply chain. These factors determine the costs incurred in the procurement process and therefore have direct impact on the profitability of the firms since most of these firms operating in the petroleum sector are only intermediaries in the oil trade. Therefore, minimizing of risk in the procurement process is of great importance to the sector as a whole, therefore explaining the high level of consideration of these risks in the firms. Nnadili (2006) had observed some of these factors and concluded that the procurement part of the petroleum sector is highly risky and requires great experience to manage.

Transportation risk factors were observed to be considered such as vandalism of pipeline, choice of transportation mode, terrorism, selection of transport strategy, market speculation, country of origin, and, KPC system product evacuation in the order of the most considered to the least considered. Vandalism of pipeline, choice of transportation mode, terrorism and selection of transport strategy were observed to be considered to a great extent by the firms involved in the study while market speculation, country of origin, and, KPC system product evacuation were considered by the firms to a moderate extent to indicate that the factors might not be that important to the firms. The factors however on average were observed to be considered to a great extent, though with a lower level attached to them than the procurement risks. Transportation

risks might have such low consideration due to the fact that most of the firms outsource this service from transportation firms hence transferring the risks to these firms. This confirms the views by Crist (2003) and Sergio, (2012) who were of the views that consideration of transportation risks have a great impact on the financial performance of the firm and there is some direct impact on firm performance when the transportation risks are reduced.

Delivery risk factors were also considered where the factors were observed by firms as top management support, stabilized power supply, political stability, infrastructure, increased storage capacity, upgrade of existing pipeline, market price fluctuations, and internet connectivity in the order of the most considered to the least considered factor. Factors that firms considers to a large extent in their operations in the petroleum supply chain includes top management support, stabilized power supply, political stability, infrastructure, increased storage capacity, while upgrade of existing pipeline, market price fluctuations, and internet connectivity were observed to be considered moderately in the sector. On overall, the delivery factors were observed to be considered to a large extent, though at a lesser value than the procurement factors but higher than the transportation factors, may be due to the fact that the delivery function is usually done within the firms and the firms acquires part of the risks after the outsourced companies delivers the products and therefore the function cannot be fully outsourced as transportation can be. The study therefore can confirm that delivery risk factors are important in the petroleum supply chain and are thus considered to a large extent in the sector. Fernandes *et al.* (2009) observed closely related findings though usage was lower in their country claiming that the factor enhances efficiency in product delivery and hence influences performance.

Some risk mitigation considerations were also looked at in the study and it was realized that minimizing disruptions, reviewing petroleum chain infrastructure, wide consultations and

interaction among industry players, redesign for customer, construction of more storage facilities, additional investment in the sector, and colour coding of export petroleum products to curb adulteration and unreasonable fuel prices were considered in that order by the firms from the most considered to the least considered in the sector. Minimizing disruptions, reviewing petroleum chain infrastructure, and wide consultations and interaction among industry players were considered by most of the firms to a large extent as risk mitigation while redesign for customer, construction of more storage facilities, additional investment in the sector, and colour coding of export petroleum products to curb adulteration and unreasonable fuel prices were all considered to a moderate extent, indicating that they were considered as less impactful to the sector supply chain performance.

The respondents added that they also considers factors such as: financial constraints; price fluctuations; challenges on planning and procurement; benchmarking with international oil and gas companies; incorporation of leak detection system with loss/gain elements; lack of proper communication and petroleum handling safety; political patronage; product quality, product specification (e.g. are specifically harmonized across consumer countries or not); and, absence of laws and/or reinforcement agents responsible for governing petroleum sector. Manuj and Mentzer (2008) provided similar views in their study on global supply chain risk management strategies, though they defined them as strategies rather than factors that ought to be considered in carrying out the undertakings. It was found that performance of the supply chain was a key consideration for the firms involved in the study with it being considered to a large extent.

The factors were considered as operation cost of the supply chain, order delivery time, perfect order fulfillment, supply chain response time, political risks, supply chain performance, and the level of customer service were all considered to a large extent, indicating high consideration

level. It was therefore observed that supply chain performance is regarded highly by the players in the sector with them being highly sensitive to factors that indicate its progress.

A regression model brought out the relationship between supply chain performance and the risk factors in the petroleum industry of Kenya. It was observed that the factors of transportation risks, procurement risks, delivery risks, and risk mitigation affects the supply chain performance. It was found that these variables are able to explain 78.1% of the dependent variable. Procurement risk transportation risks, and risk mitigation factors showed a direct relationship with a positive coefficient to the supply chain performance. However, Delivery risks showed negative relationship to supply chain performance with a negative coefficient being observed in the study, an indication that increased considerations of the delivery risk factors leads to reduced supply chain performance. This may be because the consideration of such factors decreases the efficiency of the supply chain in this sector. This goes contrary to Defra (2009) and Fernandes *et al.* (2009) views that delivery risk factors have positive impact on supply chain performance. This relationship was brought out by the model:

$$\text{SCP} = 0.086 + 0.832 \text{ PR} + 0.039 \text{ TR}_2 + (-) 0.398 \text{ DR} + 0.580 \text{ RM} + \varepsilon$$

Where: SCP= Supply Chain Performance; PR = Procurement risk; TR = Transportation risk; DR = Delivery risk; RM = Risk Mitigation

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter covers the summary of findings, conclusion and recommendations of the study. The chapter brings out the main issues of interest from the analysis. The chapter discusses the summary of findings, conclusion, recommendations, limitations of the study, and culminates with suggestions for further research.

5.2 Summary of Findings

This study was done with an objective of establishing the risk factors and performance of petroleum products supply chain in Kenya. It obtained a very sufficient and normal representation from the targeted population in the petroleum sector with the demographics considered in the study showing the expected outcomes the sector is believed to display hence indicating the reliability of the study outcomes.

Three risk factors subdivisions were observed that were found to be regularly considered when conducting operations in the supply chain of the sector. Procurement risk factors were observed to include: incomplete shipment data; failure to plan demand forecast; protracted contract negotiations; use of right procurement method; incomplete technical testing methods and standards; OMC import ullage allocation; submission of timely procurement requests; and, foreign exchange fluctuations in the order of their importance from the most applied to the least applied. Transportation risk factors on the other hand were observed to include: vandalism of pipeline, choice of transportation mode, terrorism, selection of transport strategy, market speculation, country of origin, and, KPC system product evacuation in the order of the most considered to the least considered also in the order of importance from the most important to the least important. Finally, Delivery risks were observed to include: top management support,

stabilized power supply, political stability, infrastructure, and increased storage capacity, upgrade of existing pipeline, market price fluctuations, and internet connectivity in the order of the most important to the least important factor.

Risk mitigation factors applied in the sector were also considered and they were observed to include: minimizing disruptions, reviewing petroleum chain infrastructure, wide consultations and interaction among industry players, redesign for customer, construction of more storage facilities, additional investment in the sector, and colour coding of export petroleum products to curb adulteration and unreasonable fuel prices from the least applied to the most applied in the sector. The respondents added factors such as financial constraints; price fluctuations; challenges on planning and procurement; benchmarking with international oil and gas companies; incorporation of leak detection system with loss/gain elements; lack of proper communication and petroleum handling safety; political patronage; product quality, product specification (e.g. are specifically harmonized across consumer countries or not); and, absence of laws and/or reinforcement agents responsible for governing petroleum sector as the ones they also considers when considering risk mitigation in the petroleum sector.

The study observed that the sector's supply chain have been performing well in the past few years and further observed that the firms considers the following when thinking of the supply chain performance: operation cost of the supply chain, order delivery time, perfect order fulfillment, supply chain response time, political risks, supply chain performance, and the level of customer service, where the study indicated high consideration level by the firms which means that the firms are highly sensitive to supply chain performance and is an important factor in the firm performance.

A regression model done in the study indicated that the petroleum sector performance is affected by procurement risks, transportation risks, delivery risks and the risk mitigation undertakings. It was found that increase in procurement risks consideration, transportation risks consideration and the consideration of risk mitigation measures improves the performance of the supply chain performance, though an increase in consideration of delivery risks leads to decline in supply chain performance.

5.3 Conclusion

The study concludes that the Kenyan petroleum industry is versatile and highly complex, and is regulated by more than one government body, hence it is highly regulated. Most of the firms operating here are well developed and large with many outlets, with international conglomerates doing very well in the sector. The study therefore observed that the sectors' supply chain is very important to the sector development.

It was found that various risk factors are considered by firms in this sector which were subdivided into three subgroups: procurement risk factors, transport risk factors, and delivery risk factors. Procurement risk factors that affect supply chain performance include incomplete shipment data, failure to plan demand forecast, protracted contract negotiations, use of right procurement method, incomplete technical testing methods and standards, OMC import ullage allocation; submission of timely procurement requests, and, foreign exchange fluctuations. Transport risk factors that affect supply chain were observed to include vandalism of pipeline, choice of transportation mode, terrorism, selection of transport strategy, market speculation, country of origin, and, KPC system product evacuation. Delivery risk factors on the other hand that the found to affect the supply chain performance include top management support, stabilized

power supply, political stability, infrastructure, increased storage capacity, upgrade of existing pipeline, market price fluctuations, and internet connectivity.

It was found that petroleum sector supply chain performance is affected by various risk factors and the mitigation measures and therefore are effective in improving the performance of the supply chain. The study found that procurement risk factors have a positive impact on supply chain performance and transportation risk factors as well; however, delivery risk factors have a negative impact on the supply chain. The risk mitigation measures were also observed to affect the performance of the petroleum sector where their improved consideration was observed to cause improved performance of the supply chain.

It was also found that the risk mitigation measures are widely applied in the sector and have a significant impact on the performance of the sectors' supply chain. It was observed that the risk mitigation factors improve supply chain performance if observed and they are observed in the sector widely, confirming that the mitigation measures are highly effective in shielding the firms from supply chain risks. The study therefore concludes that the risk mitigation measures applied in the petroleum sector are impactful on the supply chain performance.

It can therefore be concluded that the petroleum supply chain performance have to consider various procurement, transportation, delivery risk, since they all have an impact on the performance of the supply chain. It is also observed that the application of risk mitigation measures arising from the consideration of these factors is highly impactful on the firm performance.

5.4 Recommendations

The study observed that various risk factors have an impact on petroleum sectors' supply chain performance and therefore it recommends that firms operating in the industry should consider all the risk factors such as the procurement risk factors and transport risk factors so as to be able to maximize the supply chain performance in the sector. It recommends extensive look into these factors to determine which are applicable at the firm level by the supply chain managers in the firms.

However, delivery risk factors were found to have a negative impact on the supply chain performance indicating that the factor might bring about failure of the supply chain than improvement. It is therefore recommended that firms should avoid considering too many of the delivery risk factors so as to gain improved supply chain in the petroleum industry in Kenya. The delivery risk factors may be substituted with some of the procurement risk factors that are applicable at the delivery level so as to ensure that the firms; delivery is also risk averse.

It is recommended that the current risk mitigation measures be upheld in the petroleum firms. One of these measures being political influence, the government should help in mitigating this risk by ensuring that requisite legislation is in place to ensure that the measure is upheld and the sectors' supply chain is able to develop. The risk mitigation factors were found effective in improving the performance of supply chain and they should be applied more in the sector.

5.5 Limitations of the Study

Lack of adequate resources mainly time and finances meant the research was limited to a few OMCs. In addition lack of resources meant the researcher could not be able to reach all the OMCs of supply chain importers to be able to get their opinion. The respondents in the areas

being researched were also very sensitive to the existing business environment and required to be thoroughly guided on the area of study before filling the questionnaires. This made the data collection task to be quite complicated and data access being limited in some cases.

This study relied fully on primary data in the analysis to come up with the study findings, hence mainly relied on perceived rather than the real values. However, some of the variables such as the supply chain performance can also be assessed by use of secondary data on a time series format collected from the firms, which would show the real performance of the supply chain in the firms. Use of this measure might provide different results from what the study has achieved, though the study expects that the outcomes would be highly similar to the current findings since the perceived performance in this study was expected to be very close to the real value.

The study was limited to the Kenyan petroleum sector, therefore outcomes might differ in other regions of the world, and therefore the study outcomes might not be applicable in these areas and cannot be generalized into the global sector, as they are only applicable in the Kenyan sector.

5.6 Suggestions for Further Research

Further research should be done to fully further define the relationship between delivery risk factors and the performance of the supply chain in the petroleum sector. The study found a conflicting observation with previous studies that delivery risk factors induces negative relationship with the supply chain performance and therefore further clarification of the same would be highly welcome to ensure that the relationship is well understood. Therefore the study calls upon interested individuals to carry out a study that finds the relationship between delivery risk factors and the performance of petroleum sector supply chain.

Further study on supply chain risk factors and performance in petroleum industry in Kenya should also be done to find out the relationship of risk factors and the supply chain performance this time utilizing secondary materials to determine the supply chain performance, so as to further provide a deeper understanding of this relationship. Such a study would be important in the decision of what data source is best applicable for a study between primary and secondary data sources in future.

Suggestions on the investors currently engaging in oil and gas exploration in Kenya needs to embrace a comprehensive supply chain risk assessment both to the industry and to the operating environment. Therefore, a study should be done on the performance of the Tullow Oil reservoirs and the supply chain risks in the disbursement of gains from the oil and the impact of the new proposed oil refineries and pipeline under the LAPSSET project.

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APPENDICES

Appendix I: Letter of Introduction



UNIVERSITY OF NAIROBI
SCHOOL OF BUSINESS
MBA PROGRAMME

Telephone: 020-2059162
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DATE 30/9/2014

TO WHOM IT MAY CONCERN


The bearer of this letter JOHN MUYA CHEUNG
Registration No. DB1/63536/2010

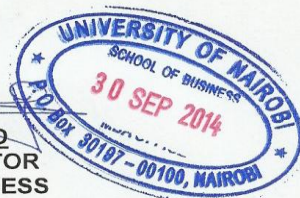
is a bona fide continuing student in the Master of Business Administration (MBA) degree program in this University.

He/she is required to submit as part of his/her coursework assessment a research project report on a management problem. We would like the students to do their projects on real problems affecting firms in Kenya. We would, therefore, appreciate your assistance to enable him/her collect data in your organization.

The results of the report will be used solely for academic purposes and a copy of the same will be availed to the interviewed organizations on request.

Thank you.


PATRICK NYABUTO
MBA ADMINISTRATOR
SCHOOL OF BUSINESS



Appendix II: Study Questionnaire

SECTION A: Bio - Data Information

1. Name of organization.....
2. Kindly indicate your gender Male (), Female ()
3. Ownership type
 - a) Multinational ()
 - b) Government ()
 - c) Public ()
 - d) Private ()
4. Number of petroleum outlets the organization operates
 - a) 1-10 ()
 - b) 10-30 ()
 - c) 30-50 ()
 - d) Above 50 ()
5. What is your organizations most preferred mode of transport?
 - a) Pipeline ()
 - b) Road ()
 - c) Railway ()
 - d) All the above ()

6. Does your organizations have a supply chain manager or equivalent

a) Yes ()

b) No ()

7. If no, why not.....

SECTION B: PROCUREMENT RISK FACTORS

8 Please indicate the extent to which you consider the following as risk factors in petroleum products procurement chain.

Use the scale of 1-5 and tick on the appropriate column

- 1. To a very large extent
- 2. Large extent
- 3. Moderate extent
- 4. Small extent
- 5. Very small extent

	Procurement Risk Factors	1	2	3	4	5
1	Failure to plan demand forecast					
2	Submission of timely procurement requests					
3	Use of right procurement method					
4	Incomplete shipment data					
5	Incomplete technical testing methods and standards					
6	Protracted contract negotiations					
7	Foreign exchange fluctuations					
8	OMC import ullage allocation					

SECTION C: TRANSPORTATION RISK FACTORS

9. Please, indicate the extent to which you consider the following as risk factors in petroleum products transportation chain.

Use the scale of 1-5 and tick on the appropriate column

1. To a very large extent
2. Large extent
3. Moderate extent
4. Small extent
5. Very small extent

	Transportation Risk Factors	1	2	3	4	5
1	Country of origin logistics					
2	Terrorism					
3	KPC system product evacuation					
4	Market speculation					
5	Vandalism of the pipeline					
6	Selection of transporting strategy					
7	Choice of transportation mode					

SECTION D: DELIVERY RISK FACTORS

10. Please indicate the extent to which you consider the following as risk factors in petroleum products delivery chain.

Use the scale of 1-5 and tick on the appropriate column

1. To a very large extent
2. Large extent
3. Moderate extent
4. Small extent
5. Very small extent

	Delivery Risk Factors	1	2	3	4	5
1	Political stability					
2	Infrastructure					
3	Internet connectivity					
4	Top management support					
5	Stabilized power supply					
6	Upgrade of existing pipeline					
7	Increased storage capacity					
8	Market price fluctuations					

SECTION E: RISK MITIGATION FACTORS

11. Please indicate the extent to which you consider the following as risk mitigation factors in the procurement, transportation and delivery of petroleum products chain in Kenya.

Use the scale of 1-5 and tick on the appropriate column

- 1. To a very large extent
- 2. Large extent
- 3. Moderate extent
- 4. Small extent
- 5. Very small extent

	Risk Mitigation Factors	1	2	3	4	5
1	Minimizing disruptions					
2	Redesign for customer					
3	Reviewing petroleum chain infrastructure					
4	Additional investment in the sector					
5	Construction of more storage facilities					
6	Wide consultations and interaction among industry players					
7	Colour coding of export petroleum products to curb adulteration and unreasonable fuel prices					

12. What other risk factors within your organization that affect petroleum products supply chain?

.....

.....

.....

SECTION F: FACTORS THAT AFFECT SUPPLY CHAIN PERFORMANCE

13 Please indicate the extent to which you consider the following factors vital to the performance effectiveness in supply chain Kenya.

Use the scale of 1-5 and tick on the appropriate column

- 1. To a very large extent
- 2. Large extent
- 3. Moderate extent
- 4. Small extent
- 5. Very small extent

	Performance Measures	1	2	3	4	5
1	Operation cost of the supply chain					
2	Political risks					
3	Level of Customer service					
4	Order Delivery time					
5	Perfect Order Fulfillment					
6	Supply Chain Response Time					
7	Supply Chain performance					

12. What other risk factors within your organization that affect petroleum products supply chain?

.....

.....

.....

Appendix III: Registered OMCs Petroleum Importers

NO.	NAME	NO	NAME	NO	NAME
1	Addax(K) Ltd	19	Kenol Kobil	37	Dalbit
2	Ainushaml Energy Ltd	20	Keroka Petroleum	38	Chevron (K) Ltd
3	Alba petroleum	21	Libya Oil	39	Triad Energy Ltd
4	Al-layh Ltd	22	Mogas International	40	Triton
5	Astrol Petroleum Ltd	23	Moco (K) Ltd	41	Total (K) LTD
6	Bahrya Ltd	24	Mul oil(K) Ltd	42	Royal Petroleum
7	Bakri International Ltd	25	NOCK (K) Ltd	43	Riva Petroleum Dealers
8	Banadoi oil Ltd	26	Oil Market Traders	44	Shell(VIVO)
9	Cape petroleum products	27	Olympic Petroleum Ltd	45	South west
10	EA gasoil ltd	28	Oil City Services Ltd	46	Topaz Petroleum
11	Engen	29	One Petroleum Ltd	47	Tosha Petroleum
12	Fast energy	30	Orix Oil Ltd	48	Trojan international limited
13	Fossil Fuels ltd	31	Olympic Petroleum	49	Knecor
14	Fuelex (K) Ltd.	32	Petrol City (K) Ltd	50	Gapco
15	Galana	33	Ranway Traders Ltd	51	Gulf Energy
16	Global Petroleum Products	34	Regnol Oil (K) Ltd	52	Intoil (K) Ltd
17	Hashi Energy Ltd	35	Hass	53	Kamkis Trading Co.Ltd
18	Jade petroleum Limited	36	Jovena		

Source: Source Petroleum Insight 2012