CAPACITY CONSTRAINT MANAGEMENT STRATEGIES AND SUPPLY CHAIN PERFORMANCE OF PETROLEUM INDUSTRY IN KENYA

BY

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DECLARATION

STUDENT'S DECLARATION

This is my original work and has not been presented for award of a degree in any other University.

Yonis Hassan Mohamud

D61/75782/2012

Sign…….. Date…….....

SUPERVISOR(S) DECLARATION

This has been submitted with my approval as the university supervisor

Sign…….. Date…….....

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DEDICATION

I dedicate this research work to the Almighty God for His provision. To my Mum, Dad, Brothers Sisters and Friends, they made me believe in myself.

ACKNOLWDGEMENT

I would like to thank University of Nairobi facilitators who helped take me through the demanding course modules. My special thanks go to my supervisors, Dr. Magutu Peterson who tirelessly and wholeheartedly offered me her assistance without reservations.

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ABBREVIATIONS AND ACRONYMS

TOC	Theory of Constraints
CBA	Constraint-Based Approach
KPI	Kenya Petroleum Industry
VMI	Vendor-managed inventory
NOC	National Oil Company
OMS	Order Management System
MRP	Manufacturing Resource(s) Planning
KPC	Kenya Petroleum Company
CEO	Chief Executive Officer
OPEC	Organization of Petroleum Exporting Countries

ABSTRACT

Operational research methods have being used to support day-by-day decisions for batch sizing and job sequencing problems, while what-if analysis has being adopted as a decision support system in the field of supply chain. This study aimed to investigate the capacity constraint management strategies and supply chain performance of petroleum industry in Kenya and to determine the relationship between capacity constraint management strategies and supply chain performance of petroleum industry in Kenya. The study was guided by theory of constraints and the theory of supply chain management. the study adopted a descriptive cross-sectional research design which was used to establish the relationship between capacity constraint management strategies and supply chain performance in Kenyan petroleum industry. The target population included 55 oil marketing companies in Kenya. Primary data was collected by means of a semi-structured questionnaire. The questionnaires was self-administered via drop and pick later method to the respective departments in Kenya Pipeline Company, Energy Regulation Commission and the Ministry of Energy. The data collected was analysed using descriptive statistics (measures of central tendency and measures of variations) and regression analysis to achieve the objectives of the study. The dependent variable in the study was supply chain performance. The independent variables for the study include the various capacity constraint management strategies used by firms in the Kenyan petroleum industry, among them: Inventory Planning Strategy, Price Control Strategy, Order Management Strategy, Material Planning Strategy and Market Readiness Strategy. the study found a positive correlation coefficient between inventory planning strategies and supply chain performance of petroleum industry in Kenya. The study further revealed that companies that use the inventory planning strategies, produce only enough goods to meet or exactly match the demand for goods. The study further found a positive correlation coefficient between price control strategy and supply chain performance of petroleum industry in Kenya. The study further revealed that it costs a firm money to keep supplies and inventory in a warehouse. A positive correlation coefficient between order management strategy and supply chain performance of petroleum industry in Kenya was revealed. The study further found that order management strategies improves customer loyalty. On material planning strategy, the study revealed that material planning strategy influences supply chain performance of petroleum industry in Kenya positively. The study further revealed that the material planning strategy contains targeted sales forecasts, production levels, inventory levels, and customer backlogs. The study found that market readiness strategy was found to have a positive correlation coefficient on supply chain performance of petroleum industry in Kenya. Supply chain performance measures have a significant impact on supply chain performance of petroleum industry in Kenya. The study recommends that oil marketing companies in the petroleum industry need to take the capacity constraint management strategies idea a step further to collaborate with competitors so as to find shared solutions to their supply chain management challenges.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

In the last decades many researchers have explored the relation between supply chain performance and capacity constraint. Operational research methods have being used to support day-by-day decisions for batch sizing and job sequencing problems, while what-if analysis has being adopted as a decision support system in the field of supply chain reengineering as it enables to explore the impact of constrained capacity on the global performance of the whole structure. In the field of methods based on the system, the seminal work of Gavirneni, Hooykaas, & Morrice (2009), investigated the relation between capacity constraint and supply chain performance in terms of demand amplification for a step increase in sales.

In the constrained capacity, optimization approaches are typically used to solve batch sizing and job sequencing problems, while the impact of limited capacity on the global performance of the whole supply chain is generally assessed using control theory and what-if analysis, such as continuous simulation and discrete event simulation (Disney & Gubbstrom, 2004). Vlachos and Tagaras (2000), present an optimization procedure of a periodic review inventory system with regular and emergency replenishments.

The Theory of Constraints (TOC) has been widely known as a management philosophy coined by Goldratt (1990) that aims to initiate and implement breakthrough improvement through focusing on a constraint that prevents a system from achieving a higher level of

performance. The TOC paradigm essentially states that every firm must have at least one constraint. Goldratt & Cox (1992) define a constraint as any element or factor that limits the system from doing more of what it was designed to accomplish (i.e., achieving its goal). The owner of a system is assumed to establish its goal. The fundamental goal of most business entities is to make money now and in the future. Other stakeholders may develop necessary conditions that must be met to allow the system to continue operating.

1.1.1 Capacity Constraint Management Strategies

Capacity is the ability to produce work in a given time, must be measured in the unit of work (Disney & Gubbström, 2004). Capacity is defined by Christopher (2008) as the amount of activity or use that can be handled by a system before it begins to deteriorate. Another way to describe capacity is determining how much use a given setting can absorb, before unacceptable impacts occur. Capacity provides a basis for examining several important interactions between supply and demand considerations, between concerns about resource conditions and perceived quality of impacted resources, and between the quantity of opportunities supplied and the quality of the experience derived from them. Carrying capacity is supported by factors and thresholds developed by stakeholders.

Capacity constraint is any factor that limits the performance of a system and restricts its output. The constraint-based approach can be defined as a way of realizing productive change that alleviates the detrimental impact of the constraint(s) on supply chain profitability (Graves & Willems, 2003). The productive change focusing on actions of managing constraints(s) can directly contribute to profitability. There are two ways in which the constraint-based approach can help managers improve the supply chain: by

providing reliable global performance measures that help the chain members to measure the progress of accomplishing the total revenue of the supply chain and by focusing on improvement efforts that have a dramatic impact on the supply chain performance (Humair & Willems, 2006). The existence of constraint causes capacity imbalance and as a result, the overall performance of an organization will suffer. This can occur anywhere within your supply chain, that is, your suppliers or customers, or within one of your internal processes.

Capacity constraint management strategies recognizes that constraint limit what we can do in any circumstance, and it provides the vehicle to understand why this happens and what can be done about the constraint we face. The capacity constraint management strategies include Inventory Planning Strategy, price control strategies, material planning strategies, order management strategies and market readiness strategy (Humair & Willems, 2006). These principles and concepts are a blend of both existing and new ideas. The new ideas build upon older ones to produce a robust, holistic approach to understanding and managing complex systems.

1.1.2 Supply Chain Performance

A supply chain is commonly defined as a network of firms involved in upstream and downstream flows from sub-supplier to ultimate customer (Mentzer, DeWitt, Keebler, Min, Nix, Smith, & Zacharia, 2001). However, these definitions do not consider the fact that, by definition, the boundaries are blurred in a network, since it is an open system and firms are interconnected in a wider context as well. Delimitations of networks are made in different ways. Either the delimitation is based on a focal firm perspective or a spatial delimitation, or based on technological interdependencies (Mattsson, 2002). As for the

supply chain, the basis would be the technological interdependencies from sub-suppliers and the ultimate customers. Since not only firms are interacting but also their resources and activities in the network perspective (Håkansson & Snehota, 1995), the depicting of supply chain networks should include these considerations. We have chosen to depict the supply chain starting from a specific customer or group of customers for a type of product/services offered. The chain includes a combination of resources, activities and actors that are involved in delivering these products/ services to customers.

Supply Chain measurements are metrics such as Inventory Turns, price control, material planning, and order control are used to track supply chain performance. Commonly used by Supply Chain Management, measurements can help you to understand how your company is operating over a given period of time (Sunil & Peter, 2007). Supply Chain Measurements can cover many areas including Procurement, Production, Distribution, Warehousing, Inventory, Transportation, and Customer Service - any area of the supply chain. However, a good performance in one part of the Supply Chain is not sufficient (Cecil & Robert, 2006).

Measurement is important, as it affects behavior that impacts supply chain performance. As such performance measurement provides the means by which a company can assess whether its supply chain has improved or degraded. The importance of using measures to help ensure that a supply chain is performing well. Measurements are important to directly controlling behavior and indirectly to performance. A few key measurements will go a long way toward keeping a company on track towards achieving its supply chain improvement objectives (Michael, 2006).

1.1.3 Kenyan Petroleum Industry

The oil industry is usually divided into three major components: upstream, midstream and downstream. Midstream operations are usually included in the downstream category. The first part covers the exploration, production and transportation of crude oil and gas to the point of transformation into final products (mainly refineries). The downstream activities deal with the processing of crude oil in refineries, the distribution and the marketing activities of all the oil derived products, Raed (2006). As petroleum is a nonrenewable natural resource. The industry is faced with an inevitable eventual depletion of the world's oil supply

A typical oil supply chain begins with the crude oil producer, next, the oil moves to the refiner, the transporter, the retailer and finally to the gas pump where a customer receives the product. This oil industry is strategic as the base of transportation and other essential activities of the economy of any country. As a result of these strategic issues, it is in the center of the international geopolitical and macroeconomic panorama and most of the governments maintain careful control of the evolution of the industry or even directly manage the operations in their respective countries. The Organization of the Petroleum Exporting Countries (OPEC) controls major crude oil by setting production quotas. The values (revenue opportunities) are added by processing and chemically changing the crude oil, which is called "refining." It is important to note that greater economic rewards can be gained only with well-integrated global oil supply chain.

The Kenyan government is encouraging foreign interest in oil exploration and there is a modest upstream oil activity. It is endowed with other energy sources including wood fuel, coal, solar and wind power, much of which is untapped. According to encyclopedia

of nations (2014), the government of Kenya has spent over $400 million on oil exploration by 2014. The oil refinery in Mombasa, built in 1959 and half-owned by the government, and major oil marketing companies, typically operates at around 65% of its total capacity (averaging 95,000 barrels per day) and is supposed to serve Kenya, Tanzania, Uganda, the DRC, Rwanda, Burundi, and offshore islands. Kenya deregulated its oil industry in 1994. Refinery products include gasoline, jet/turbo fuel, light diesel oil and fuel oil. The refinery's future is an important domestic issue in Kenya, and management is considering upgrading the facility rather than allowing the refinery to close.

Petroleum is Kenya’s major source of commercial energy and has, over the years, accounted for about 80% of the country’s commercial energy requirements. The domestic demand for various petroleum fuels on average stands at 2.5 million tons per year, all of it imported from the Gulf region, either as crude oil for processing at the Kenya Petroleum Refineries Limited or as refined petroleum products (Nairobi Business Daily, 2010).

1.2 Research Problem

In the constrained capacity supply chain analysis, optimization approaches are typically used to solve batch sizing and job sequencing problems while the impact of limited capacity on the global performance of the whole supply chain is generally assessed using control theory and what-if analysis, such as continuous simulation and discrete event simulation. The constraint on the capacity has a significant effect on the system performance under emergency ordering policies, especially when the review period and the regular replenishment lead time are long.

Helo (2000), examined capacity analysis as methods of improving the responsiveness of a supply chain, this study only examined capacity analysis but did not look at other strategies that can be used in capacity constraint. Gubbstrom (2004), analyzed the economic impact of order and inventory-related cash flows resulting from a generalized order-up-to policy, considering costs associated with the production order rate within and above a capacity constraint. This study did not highlight the performance in a capacity constrained.

Wikner (2007), found out that under capacity constraint, existing production planning and control systems should accommodate a comparator to utilize the difference in the target and actual backorders in the ordering rule. This study did not look at the performance in a capacity constrained and was not in the petroleum industry. Wikner, Naim & Rudberg (2007), highlight that by developing an ordering policy that accounts for capacity flexibility, plus the feedback monitoring of the backlog state, it is possible to ensure lead time expectations.

Simchi-Levi & Zhao (2003), found out that when product capacity is constrained, it might imply lack of information sharing. However this study was not on capacity constraint management strategies and it was not in the petroleum industry. Disney, Naim and Potter (2004), examine a single stage system with fixed ordering costs and capacity constraint, and find that the optimal policy takes a single-stage form. Disney, Naim and Potter (2004) found on a single stage system for order capacity planning how that the optimal policy is a threshold policy but this study was limited to order management and not the strategies to manage the entire supply chain.

Wamugunda & Odhiambo (2008), found that capacity constraint provide dampening of demand amplification, but in the meantime do not improve customer service levels with respect to the unconstrained case but this study did not highlight on the strategies that can be used in capacity constrained supply chain.

The study found that there is gap since no study has been done on constraint management strategies and supply chain performance in Kenya Petroleum Industries and it is for this reason that this study sought to investigate: what are the capacity constraint management strategies used by Kenya Petroleum Industries? Is there any relationship between capacity constraint management strategies and supply chain performance of the Kenyan petroleum industry?

1.3 Research Objective

The main objective of this study is to investigate the capacity constraint management strategies and supply chain performance of petroleum industry in Kenya

To determine the relationship between capacity constraint management strategies and supply chain performance of petroleum industry in Kenya

1.4 Value of the Study

The study will go a long way into providing information on constraint management strategies and supply chain performance of Kenya Petroleum Industry considering that Kenya is affected by real issues which include high political turbulence, challenging logistical problems, poor road network. The kind of constraint that may be experienced by third world countries may by far differ from those experienced by the western

countries. It’s in this light that this research is going to be of great significance to the petroleum marketing companies and petroleum industry players.

It’s hoped that the study will be useful to the policy makers and the management of organizations in addressing the challenges in organizations and the industry so as to guard against the danger of affecting the performance of the organizations. The findings and the recommendations of the study shall also be useful to managers. From now hence, they will not rely on expert judgement, haphazard personal experiences or traditions, but rather base their methods, decisions and actions on concrete knowledge of issues of capacity constraint supported by study findings

The study is expected to contribute to the existing literature in the field of capacity constraint management strategies and supply chain performance in Kenya Petroleum Industry. It’s also hoped that the study will form the basis for further research in the area of capacity constraint management strategies and supply chain performance in Kenya Petroleum Industry.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a literature review of capacity constraint management strategies and supply chain performance. The chapter also provides the theories underpinning the study.

2.2 Theoretical Framework

This section examines the various theories that are used to inform the study on capacity constraint management strategies and supply chain performance. The following theories are related to capacity constraint management and supply chain performance; theory of constraints and theory of supply chain management.

2.2.1 Theory of Constraints

The theory of constraints is a systems-management philosophy developed by Eliyahu Goldratt in the early 1980s. The fundamental thesis of theory of constraints is that constraints establish the limits of performance for any system. Most organizations contain only a few core constraints. Theory of constraints advocates suggest that managers should focus on effectively managing the capacity and capability of these constraints if they are to improve the performance of their organization (Budiman, 2004).

Theory of constraints challenges managers to rethink some of their fundamental assumptions about how to achieve the goals of their organizations, about what they consider productive actions, and about the real purpose of cost management. Emphasizing the need to maximize the throughput revenues earned through sales theory

of constraints focuses on understanding and managing the constraints that stand between an organization and the attainment of its goals. Once the constraints are identified, theory of constraints subordinates all the no constraining resources of the organization to the needs of its core constraints. The result is optimization of the total system of resources. As organizations and the financial practitioners who support them continue to learn which questions to ask, as well as which information best addresses these concerns, the need to add new models to the information toolkit grows (Shah & Ierapetritou, 2011). Theory of constraints is a vital part of this expanded toolkit, providing unique insights and focus into the ongoing challenges of identifying the products and services that will maximize customer value-added and organizational profitability.

Each component of the supply chain is a specialist at their process. Many processes are complicated or expensive and would be virtually impossible without the supply chain. In the typical supply chain, individual components are separate entities that depend upon each other. They pass money and materials back and forth each component adds value to the product. But, enlightened members of the chain understand there is no real value produced until a customer is satisfied (Leary, 2001). In a free market, the 'added value' contributed by each component is determined by competitive situations and alternative methods. The profit margin at any component is determined by the environment and the effectiveness/efficiency of the individual component. Component managers focus on local optima and have little influence over the rest of the supply chain. The theory of constraints solution to supply chain management has several components. And, the application of the components depends upon the nature of the relationship between components of the supply chain.

2.2.2 Theory of Supply Chain Management

Theory of supply chain management was developed by Tranfield and Starkey (1998).The connections and nodes in a supply chain achieve functions that contribute to the value of the goods transporting through the chain and thus its achievement. Any connection that does not carry out well reduces the overall effectiveness of the whole supply chain. the notion of supply chain management as used in many research is usually linked with the globalization of producing and the penchant for manufacturers to source their inputs planetary, which necessitates management of profitable ways of regulating worldwide flows of inputs or outputs (Grant, 2006). The principal focus of market competition in such situations is not only between goods, but between the supply chains delivering the goods. As competition in international markets is progressively dependent upon the of arrival time of goods as well as their quality, coordination between suppliers and distributors has become an important characteristic of the supply chain. As the customer satisfaction is a crucial benchmark of the success of the Supply Chain, effective management of the linking processes is crucial (Trkman & Jaklic, 2005).

Additionally, market uncertainty necessitates supply chains to be easily flexible to changes in the situation of trade. Such flexibility in supply requires effective supply chain management. According to Grant (2006), supply chain management refers to corporate business processes integration from end users through suppliers that provide information, goods, and services that add value for customers. Supply chain can be summed up as a series of interconnected activities which are concerned with planning, coordinating and controlling materials, parts and finished products from supplier to customer (Lourenco, 2001). The key success of supply chain management will rely on the incorporation of the

activities of the supply chain, meaning cooperation, information sharing and organization throughout the entire supply chain. The supply chain in the oil industry is considered a complex one where there exists a linkage between upstream suppliers, downstream distributors, information capital and flow through the chain.

2.2 Capacity Constrain Management Strategies

Any disruptions arising in the global supply chain can have tremendous adverse effects in achieving operational efficiency, maintaining quality, profitability, and customer satisfaction. The adverse events may happen due to uncertainty in supply of crude, demand, transportation, market volatility, and political climate. Budiman (2004) found that supply fluctuation was due to capacity adjustment lead time, production lead time, order processing delay and order wait time. Svenson (2005) observes that the reversed bullwhip effect is caused by factors such as deficient information sharing, insufficient market data, deficient forecasts and capacity issues. Facilities with mass production are responsive to supply variability while customization platforms are prone to longer production lead times. Business processes sub optimization by design or default can lead to a butterfly effect where a small variation can lead to system wide variation. Most companies are no longer simply contented with price as a determinant in procurement services but also sustainability of the supply and ability to meet unpredictable and short notice supply instructions. Ability and expertise override costs where the cost curve minimization is already achieved.

2.2.1 Inventory Planning Strategy

There are several classifications for the policies that regulate the flow of materials within the supply chain. Gallego & Scheller-Wolf (2000), distinguish two main types of

inventory control: the centralized and the decentralized. The centralized policy takes into account the inventory levels in the supply chain as a whole. The ability to access information on inventory levels at other trading partners in the supply chain is a fundamental requirement for implementing the centralized management. A typical centralized supply chain is the Vendor Managed Inventory (Sari, 2007; Vigtil, 2007). On the contrary, in the decentralized inventory control the replenishment rule takes into account only the information on local inventory status.

A further classification of inventory control policies is based on the replenishment rule: the periodic review/order-up-to/base-stock policy, and the continuous review/reorder point/order quantity model (Boute et al., 2007). In a base-stock policy the review period is fixed, and the size of the order is such that the inventory position is raised up to a target level. A modification to the classical order-up-to policy is obtained by introducing a proportional controller in the inventory position feedback loop (Chen & Disney, 2007). This kind of inventory control policy is called smoothing replenishment rule.

2.2.2 Price Control Strategy

The stabilization fund ran up a large deficit in 2008 (Kojima & Masami, 2009). Kenya Association of Manufacturers (2002) posits that removal of price controls, foreign exchange controls and introduction of investment incentives have, however, not resulted in major changes in the overall economy. In particular, they have not improved the manufacturing performance. Therefore, to build a self-sustaining industrial sector, it is necessary to establish strategic linkages within the domestic economy. Some efforts have to be made to promote strategic options among supply chains so as to enhance spread effects of industrial growth and to facilitate transfer of technology, skills and growth of

small and medium scale sub-contractors. According to Rong et al. (2009), when customers react not only to price itself but changes in the price, some pricing strategies implemented by the supplier may lead to reversed bullwhip effect. Where there is a central pricing authority like in price controls, price change anticipations can result in supply shocks as every supply chain element seeks to maximize on the price differentials. Under imperfect market conditions like in the oligopolistic markets, collusions by the market players can set supply quotas that are preservative of desired price levels. However price variations under perfect market conditions are a reflection of market forces of demand and supply and reverse bull whip effect plays the causal role on pressure on price.

Wabwoba (2011), did a research on the impact of oil price regulation on the financial performance of NOCK. It was observed that when the international crude oil prices were rising, oil marketing companies quickly passed on these increased costs to consumers but took long to pass on cost reduction benefits to consumers when international oil prices were on a downward spiral. Hence the government through its agency the ERC (Energy Regulatory Commission) came up with a way of regulating the fuel prices by setting the maximum prices which the oil marketers are to charge. The ERC in addition developed a concept paper enumerating the petroleum supply chain logistics and their cost implications on downstream retail prices (ERC, 2011).

2.2.3 Order Management Strategy

In the era of agile commerce, order management tools are becoming strategic. Dealing with a diverse set of customer touch points and fulfillment nodes is no longer a high-class problem reserved for the top-tier retailers and businesses. This is now an issue for

businesses large and small. While in the past order management may have been an afterthought to the e-Commerce platform, many clients today may be best served to first implement next-gen OMS capability before their next-gen commerce platform, simplifying the migration to and integration of that new platform while enabling more complex order fulfillment and inventory optimization (Bacon, 2001).

It's interesting to see innovation on the (relative) back burner for so many firms. With the drive to continue spurring experimentation and optimizing every facet of the chain accelerating, it's difficult for many organizations to rein in their focus to continuously enhance the foundation of their direct procurement and supply chain approach. It's an issue, Mitchell wrote, that has stemmed from years of workarounds, less-than-productive divisions of labor and other stopgap measures that leave many companies lagging behind on technological, communication and cost-efficient fronts. In the effort to continuously reverse-engineer the supply chain in order to align with fleeting demand, many organizations have created obstructions between production and fulfillment (William, 2001).

2.2.4 Material Planning Strategy

To manage and produce the finished products in a specific time period is not an easy task. It takes into account the number of components to be assembled (quantities), at which level and particularly when they are needed (timing). Producing the parts/component before the time they are needed might lose some aspects which are necessary for a customer. On the other hand producing these components afterwards the customer order, take larger manufacturing lead time. However this type of production process is more effective when there is a certainty in the change of customer product design. Complex

product structure and multiple level of BOM lead two level of production system which are component manufacturing and final assembly of the manufactured components (Chen & Disney, 2007).

Material requirement planning plays a vital role in material planning and control. It converts the overall plans into time phase production for each product/sub-assemblies and gives information for developing the capacity plans. The aim of the MRP is to keep lowest possible inventory level by releasing the orders to the production and suppliers only if there is a need for it. In addition to that different types of inventories (finished goods, components, raw materials) the system also plans purchasing (for raw materials and finished components), production activities and delivery activities. Using information about inventory level, production lead time, order receipts etc. It generates planned order quantities and the time of planned order released for different models in order to satisfy the final customer (William, 2001).

2.2.5 Market Readiness Strategy

Many agencies are incorporating market literacy and market readiness training into their programming with very poor populations. Practical Action, for instance, worked with male and particularly female hibiscus farmers in Southern Sudan to better engage with market opportunities. It recognized that in order to improve weak market relationships, significant capacity building and organization was required of isolated producers who lacked common membership organizations, effective risk mitigation strategies, and awareness of what services were available and how to access them. Activities to strengthen market readiness included the development of village development committees, which represented small groups of producers and facilitated their training.

These committees were strengthened so as to legitimately represent even very poor farmers, and particularly women, who despite their role in the value chain were often excluded from decision making. Once organized, extensive exposure visits and training on negotiation skills and marketing helped the committees to engage with other market actors in a way that increased benefits for all market actors (William, 2001).

2.3 Supply Chain Performance

Supply chain performance can be considered as the extent to which the chain is able to realize its predetermined goals at the sacrifice of a minimum of the organization's resources. Supply chain performance has to do with; measuring and evaluating: quality, effectiveness, and efficiency by using output and outcome indicators. Hence, the four dimensions which measurement and evaluation of supply chain activities can be based on are: a price/cost dimension; a product/quality dimension; a logistics dimension and an organization dimension (Tutu & Manu, 2010).

In order for an organization to achieve its goals to satisfy its customers, the two most fundamental dimensions of performance are efficiency and effectiveness. According to them, efficiency measures how successfully the inputs have been transformed into outputs while, effectiveness measures how successfully the system achieves its desired output (Murray, 2008).

Boraya (2013) portends that; measurement areas of purchasing Efficiency should include; personnel, management, procedures and policies and information system. In order to measure supply chain performance, three main considerations are proposed: representation of the supply link; efficiency of the supply link and effectiveness of the

supply link. The representation of the supply link is described in terms of its environment and structure, and what activities and flows take place in the supply link. Finally, generic performance indicators of the supply link in terms of time, quality, flexibility and cost are used to measure efficiency and effectiveness. The efficiency in the supply link explains how well the resources are utilized. The effectiveness of the supply link explains how well the objectives are achieved (Kumar et al., 2005).

A performance measurement system in supply chain constitutes of three components in the supply link collectively with the resources, procedures and output, to develop a supply chain performance measurement model. The Components of measurement model include: Generic measures like: - the measurements of resources utilization (efficiency) and the degree of fulfilled objectives (effectiveness) are carried out in areas like time, quality, costs and flexibility; Environment & structure: - which has to do with the description of internal customer, suppliers and the purchasing department; and Procedures: - Which measures activities and objective flows of processes. Objectives must be closely aligned with the strategies of the organizations (Kumal et al., 2005).

Choi (2009) argues that the measurement dimensions can be divided into: a description of the structure of the individual components in the supply link; a description of the guidelines to collect the data and the activities and flow of the purchasing department; and a measurement part comprising the generic measures to measure the varying dimensions of the procedures and their output. The relationships between the individual components of the supply links are also taken into consideration through measurement of the purchasing process and activities.

2.4 Capacity Constrain and Supply Chain Performance

Bicheno, Holweg, and Niessman et al. (2001), present an algorithm to minimize inventory levels under constrained total capacity, determining optimal product-individual batch sizes and replenishment cycles under the constraint of limited available changeover time in an automotive steel supply network. The optimal batch sizes are found to be a function of all lead times; all demand volumes, all costs per unit, and the total available changeover time. The authors conclude that a change in the batch sizing policy combined with lead time reduction could provide savings in inventory of about 60% compared to the original situation. Simchi-Levi & Zhao (2003) develop a dynamic programming model to analyze a single product, periodic review, two-stage production-inventory system with a single capacitated manufacturer and a single retailer facing demand, under three different information strategies.

The impact of information sharing on the manufacturer is studied as a function of the production capacity. They conclude that for the model with infinite production capacity the information sharing strategy has the same fill rate as the no information sharing strategy. When the production capacity is tightly constrained, the savings provided by information sharing with the optimal policy is relatively high. Kumar (2007) develops a dynamic programming algorithm to study an integrated decision making model for a supply chain system where a manufacturer faces a price-sensitive demand and multiple capacitated suppliers. The goal is to maximize total profit by determining an optimal selling price and at the same time acquiring enough supplying capacity. He concludes that, when the sourcing information is not available, it is better to make a conservative production plan, and when the market demand information is unknown, it is better to

make an aggressive production plan. Evans and Naim (1994) develop a continuous time differential equation model of a three-tier Forrester (1961) supply chain. Eight combinations of three capacity levels are used to study the response of constrained traditional serially-linked structures for a step input in customer demand. Their most notable result is that the unconstrained case is not the highest ranked system in the simulations performed, as it is characterized by the presence of demand amplification, commonly known as bullwhip effect (Lee et al., 1997; Chen et al., 2000; Disney and Towill, 2003a, 2003b; Chatfield et al., 2004; Holweg and Disney, 2005; Geary et al., 2006; Miragliotta, 2006).

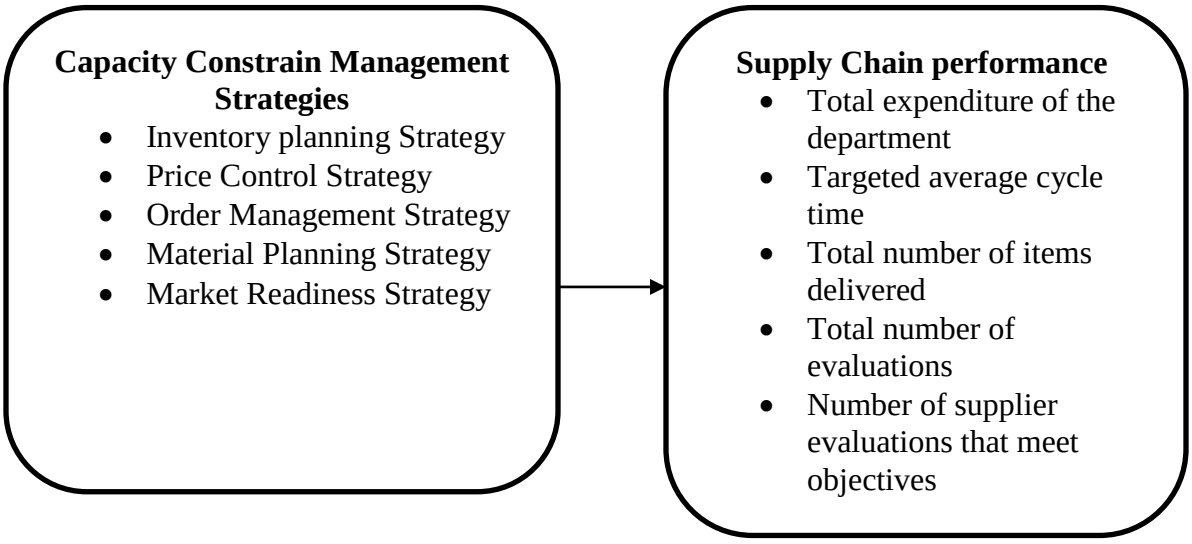
Helo (2000) discusses, by using a system dynamics (Sterman, 2000) simulation, the trade-off between capacity utilization and lead times. The analysis recommends smaller order sizes, echelon synchronization and capacity analysis as methods of improving the responsiveness of a supply chain. Disney and Gubbström (2004) use *z*-transforms and probability density functions to analyze the economic impact of order and inventory-related cash flows resulting from a generalized order-up-to policy, considering costs associated with the production order rate within and above a capacity constraint. They conclude that the classical order-up-to policy is no longer optimal when a broader range of costs is considered in the objective function.

2.5 Conceptual Framework

The conceptual framework is a diagrammatical presentation of variables in the study. The framework illustrates the interrelationship between dependent and independent variables

The dependent variable in this study is supply chain performance of petroleum industry in Kenya. Supply chain performance of petroleum industry in Kenya is influenced by several capacity constraint management strategies that constitute the independent variables. Based on the literature review the capacity constraint management strategies that influence supply chain performance of petroleum industry in Kenya include inventory planning strategy, price control strategy, order management strategy, material planning strategy and market readiness strategy. The moderating variables, which according to Kothari (2004) are independent variables that are not related to the purpose of the study but can have an effect on the dependent variable, includes government policies and market forces (demand and supply). Figure 2.1 shows the relationship between the independent variables and the dependent variable. To ensure that the moderating variables will not influence the dependent variable, the variables will be controlled.

Independent Variables **Dependent Variables**



Source; Research findings 2015

Figure 2.1: Capacity constraint management strategies and supply chain performance of petroleum industry in Kenya

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research methodology that was used to carry out the survey, the selection of the research design, the target population, data collection and data analysis.

3.2 Research Design

A descriptive cross-sectional research design was used to establish the relationship between capacity constraint management strategies and supply chain performance in Kenyan petroleum industry. A similar research design was used by Nyangweso (2013), successfully. A descriptive research design was adopted because the study is concerned about a univariate question in which the respondents were asked about the collaboration, integration, flexibility, information sharing and visibility in supply chain performance. This permitted the researcher to make statistical inference on the broader population and generalize the findings to real life situations and thereby increase the external validity of the study.

3.3 Population of the Study

The target population included 55 oil marketing companies in Kenya. Given the relatively small number of the population a census survey was conducted. Since capacity constraint management strategies is seen as the prerogative of top management and more importantly, it is seen as a rational exercise involving the objective analysis of company

resources and the external environment in which the firm operates; a convenience sampling method were utilized. The respondents included one member of the top management consisting of the chief executive officer (CEO) or their equivalent, the heads of departments (Procurement, business planning, scheduling and storage).

3.4 Data Collection

Primary data was collected by means of a semi- structured questionnaire. The questionnaires was self-administered via drop and pick later method to the respective departments in Kenya Pipeline Company, Energy Regulation Commission and the Ministry of Energy. The questionnaire had three parts; Part A covered the firm's demographic and respondent's profile; Part B established capacity constraint management strategies used by firms in the Kenyan petroleum limited and part C determined the relationship between capacity constraint management and supply chain performance

The questionnaire allowed greater uniformity in the way questions were asked, ensuring greater compatibility in the responses. The use of structured questions on the questionnaire allow for uniformity of responses to questions; while unstructured questions gave the respondent freedom of response which help the researcher to gauge the feelings of the respondent, he or she used his or her own words. The structured questions were in form of a five point Likert scale, whereby respondents were required to indicate their views on a scale of 1 to 5.

3.5 Data Analysis

The data collected was analysed using descriptive statistics (measures of central tendency and measures of variations) and regression analysis to achieve the objectives of the study. The dependent variable in the study was supply chain performance. The independent variables for the study include the various capacity constraint management strategies used by firms in the Kenyan petroleum industry, among them: Inventory Planning Strategy, Price Control Strategy, Order Management Strategy, Material Planning Strategy and Market Readiness Strategy. The regression equation assumed the following form:

Regression model

$Y = \beta_0 + \beta_1 X1 + \beta_2 X2 + \beta_3 X3 + \beta_4 X4 + \beta_5 X5 + €$

Where; Y= supply chain performance in Kenya Petroleum Industries,

$\beta_{0=}$ Constant Term,

$\beta_{1-} \beta_{5\,(}$Coefficients$_{),}$

X1 - X5- capacity constraint management strategies

€- error

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the analysis and interpretation of the data collected pertaining to the study's research objectives. It explains how the data has been analyzed and findings and interpretations of the same. Descriptive and inferential statistics were used in the analysis of the data obtained, presented in tables and explanations given in prose. The findings are summarized and presented in their respective sections covering respondent profiles and extent to which capacity constraint management strategies influence supply chain performance of petroleum industry in Kenya

4.2 Background Information

The study sought to establish the background information of the respondents in terms of; level of education, level of management, gender and period of service.

4.2.1 Gender

Table 4.1: Gender Distribution

Gender	**Frequency**	**Percentage**
Males	42	80.77
Females	10	19.23
Total	**52**	**100**

The study sought to establish the gender distribution of the respondents, from the research findings in table 4.1 majority where males 80.77% whereas 19.23% were

females. This implies that respondents were fairly distributed in terms of their gender.

4.2.2 Age Distribution

Table 4. 2 : Age Distribution

Age	**Frequency**	**Percentage**
31 to 40 years	2	3.85
41 to 50years	3	5.77
51 to 60 years	37	71.15
Over 61 years	10	19.23
Total	**52**	**100**

The study sought to establish the age distribution of the respondents, from the research findings in table 4.2 majority of the respondents as shown by 71.15% were in the age bracket, 51 to 60 years, 19.23% of the respondents were over 61 years, and 5.77% were in the bracket 41 to 50years while 3.85% were between 31 to 40 years. No respondents were aged between 21 to 30 years. This this implies that respondents were fairly distributed in terms of their age.

4.2.3 Level of Education

Table 4. 3 : Level of Education

Level of Education	**Frequency**	**Percentage**
Diploma	2	3.84
Bachelor degree	40	76.92
Master's degree	10	19.23
Total	**52**	**100**

The study sought to establish the level of education of the respondents, from the research findings in table 4.3 majority of the respondents as shown by 76.92% had bachelor degrees, 19.23% had master's degree and only 3.84% had diplomas. This implies that respondents were well educated and therefore they were in position to respond to the research questions with ease.

4.2.4 Period of Service

Table 4. 4: Period of Service

Period of Service	**Frequency**	**Percentage**
0 to 10years	2	3.85
11to 20 years	10	19.23
21 to 30 years	35	67.31
31 to 40 years	5	9.62
Total	**52**	**100**

The study sought to establish the period which the respondents had served for in the company. From the research findings, in table 4.4 majority of the respondents as shown by 67.31 % had served the company for 21 to 30 years whereas 19.23 % of the respondents had served the company for a period of 11to 20 years. 9.62% of the respondents had served the company for a period of 31 to 40 years and 3.85 % had served the company for a period of 0 to 10years. This implies that majority of the respondents had served the company for a considerable period of time and thus they were in a position to give credible information rating to this research.

4.2.5 Level of Management

Table 4. 5: Level of Management

Level of Management	**Frequency**	**Percentage**
Operational level	2	3.85
Middle level management	15	28.84
Senior level management	35	67.31
Total	**52**	**100**

On respondent's level of management, the study revealed in table 4.5 majority of the respondents as shown by 67.31 % were from the senior level management, 28.84 % of the respondents were from the middle management level whereas 3.85 % of the respondents were from the operational level. This implies that respondents were fairly drawn from all level of management.

4.3 Capacity Constraint Management Strategies

Table 4. 6: Capacity Utilization and Efficiency

	2010	2011	2012	2013	2014	Mean
Actual output (m^3)	110,000	131,000	142,000	148,000	150,000	136,200
Design capacity	150,000	158,000	161,000	163,000	167,000	159,800
Effective capacity	419,000	428,000	525,000	582,000	635,000	517,800

The study sought to establish the capacity utilization and efficiency of petroleum industry in Kenya. From the research findings, in table 4.6 the actual output of the five years was136200 m^3, the design capacity mean for five years was 159800 m^3 and the effective capacity for the five years was 517800 m^3. This implies that the demand for petroleum has been increasing. The petroleum industry is expanding the country's petroleum storage facilities to match the growing demand for products.

4.3.1 Extent to which the industry use inventory planning strategies

Table 4. 7: Statements Relating to Inventory Planning Strategies

Inventory Planning Strategies	Mean	Std deviation
The time-varying optimal flow is characterized in terms of the time-varying dual variables of a corresponding network optimization problem	4.54	0.250
A dynamic feedback controller has to flows asymptotically to the optimal level and achieves the additional balancing of all storage levels	4.28	1.373
The firm has to but measure in place to allow its trading partners to access information in inventory levels	4.58	1.297
The firm uses the periodic review/order-up-to/base-stock policy for replenishment	4.42	1.277

The firm fixes the review period to raise the inventory position up to a target level	4.31	1.260
The firm has implemented a centralized inventory management policy to monitor the inventory level in its supply chain	4.23	1.202
The firm has a fixed stock policy and reviews inventory position to raise up the target level	4.61	1.315
the Implementation of the centralized management depends on accessibility of information on inventory levels at other trading partners in the supply chain	4.15	1.15

The study sought to establish the extent to which respondents agreed in table 4.7 relating to inventory planning strategies and supply chain performance of petroleum industry in Kenya. From the research findings, majority of the respondents strongly agreed that; the firm has a fixed stock policy and reviews inventory position to raise up the target level as shown by a mean of 4.61,the firm has to but measure in place to allow its trading partners to access information in inventory levels as shown by a mean of 4.58,The time-varying optimal flow is characterized in terms of the time-varying dual variables of a corresponding network optimization problem as shown by a mean of 4.54, the firm uses the periodic review/order-up-to/base-stock policy for replenishment as shown by a mean of 4.42, the firm fixes the review period to raise the inventory position up to a target level as shown by a mean of 4.31, a dynamic feedback controller has to flows asymptotically to the optimal level and achieves the additional balancing of all storage levels as shown by a mean of 4.28, The firm has implemented a centralized inventory management policy to monitor the inventory level in its supply chain as shown by a mean of 4.23 and the Implementation of the centralized management depends on accessibility of information on inventory levels at other trading partners in the supply chain as shown by a mean of 4.15

The study further revealed that companies that use the inventory planning strategies, produce only enough goods to meet or exactly match the demand for goods. The study findings are in line with Gallego and Scheller-Wolf (2000), to effectively manage the forward and reverse flows in the supply chain, firms have to deal with upstream supplier exchanges and downstream customer demands. This puts an organization in the position of trying to strike a balance between fulfilling the demands of customers, which is often difficult to forecast with precision or accuracy, and maintaining adequate supply of materials and goods. This balance is often achieved through inventory.

4.3.2 Extent to Which the Industry Use Price Control Strategies

Table 4. 8: Statements Relating to Price Control Strategies

Price Control Strategy	**Mean**	**Std deviation**
Removal of price controls do not result in major changes in the overall economy	4.47	1.30
The implementation of pricing strategies by the supplier may lead to reversed bullwhip effect when customers react to changes in the price	4.63	1.27
The anticipations of price change strategy by the ERC sometimes result in supply shocks	4.28	1.32
Every supply chain element seeks to maximize on the price differentials made by the ERC	4.40	1.18
The government has set the maximum prices which the oil marketers are to charge.	4.31	1.02
Self-sustaining industrial sector requires, establishment of strategic linkages within the domestic economy.	4.09	1.16
Under imperfect market conditions, agreements by the market players can set supply quotas that are preservative of desired price levels.	4.39	1.36
Kenya Association of Manufacturers have not improved the manufacturing performance.	4.59	1.35
Central pricing authority can result in supply shocks as every supply chain element seeks to maximize on the price differentials.	4.23	1.07

The study sought to establish the extent to which respondents agreed in table 4.8 relating to price control strategy and supply chain performance of petroleum industry in Kenya. From the research findings, majority of the respondents strongly agreed that; the implementation of pricing strategies by the supplier may lead to reversed bullwhip effect when customers react to changes in the price as shown by a mean of 4.63,as shown by a mean of, 4.59,Removal of price controls do not result in major changes in the overall economy as shown by a mean of 4.47,Every supply chain element seeks to maximize on the price differentials made by the ERC as shown by a mean of 4.40,Under imperfect market conditions, agreements by the market players can set supply quotas that are preservative of desired price levels.as shown by a mean of 4.39,

The government has set the maximum prices which the oil marketers are to charge as shown by a mean of 4.31,The anticipations of price change strategy by the ERC sometimes result in supply shocks as shown by a mean of 4.28,Central pricing authority can result in supply shocks as every supply chain element seeks to maximize on the price differentials as shown by a mean of 4.23 and Self-sustaining industrial sector requires, establishment of strategic linkages within the domestic economy.as shown by a mean of 4.09. The study further revealed that it costs a firm money to keep supplies and inventory in a warehouse. The study findings are in line with Rong et al. (2009), if a firm conducts an analysis of how well it uses storage space, it may find that it is paying for too much space. Companies may also be wasting money paying personnel to search for stored items. A more efficient storage strategy could reduce the amount of space used and the amount of time it takes to find and pull items. This could result in reduced rent and payroll costs.

4.3.3 Extent to which the Industry Use Order Management Strategies by the Firm

Table 4. 9: Statements on Order Management Strategies

Order Management Strategies	Mean	Std deviation
The firm deals with a diverse set of customer touch points and fulfilment nodes	4.54	1.28
The firm uses innovation to continuously enhance the foundation of their direct procurement and supply chain approach	4.42	1.22
The firm has created obstructions between production and fulfilment in order to reverse-engineer the supply chain in order to align with fleeting demand	4.56	1.29
The firm has simplified the migration to and integration of the commerce platform while enabling more complex order fulfilment and inventory optimization	4.40	1.28
The firm has adopted technology, communication and cost-efficient strategies for its supply chain	4.27	1.17
Many clients in a firm are best served to first implement next-gen OMS capability before their next-gen commerce platform.	4.37	1.11
In the period of responsive commerce, order management tools are strategic	4.50	1.30

The study sought to establish the extent to which respondents agreed in table 4.9 relating to order management strategies and supply chain performance of petroleum industry in Kenya. From the research findings, majority of the respondents strongly agreed that; the firm has created obstructions between production and fulfilment in order to reverse-engineer the supply chain in order to align with fleeting demand as shown by a mean of 4.56,the firm deals with a diverse set of customer touch points and fulfilment nodes as shown by a mean of 4.54,in the period of responsive commerce, order management tools are strategic as shown by a mean of 4.50,the firm uses innovation to continuously enhance the foundation of their direct procurement and supply chain approach as shown by a mean of 4.42, the firm has simplified the migration to and integration of the

commerce platform while enabling more complex order fulfilment and inventory optimization as shown by a mean of 4.40, many clients in a firm are best served to first implement next-gen OMS capability before their next-gen commerce platform.as shown by a mean of 4.37 and the firm has adopted technology, communication and cost-efficient strategies for its supply chain as shown by a mean of 4.27.

The study further revealed that order management strategies improves customer loyalty. The study findings concurs with Bacon (2001), that a company must understand that an order management system is essential in improving customer loyalty and adheres to the notion that an order management initiative is one of the most important and influential action a firm will ensue. When putting an order management strategies is in place, one must make a commitment to organizational development in order to follow the principles order management entails. A well trained workforce will discover the metrics that sheds light on where buying patterns and customer touch points interact and which initiatives are necessarily working as once thought. Ultimately, managers will identify which business practices work and which ones don't.

4.3.4 Extent to which the Industry Use Material Planning Strategy by the Firm

Table 4. 10: Statements on Material Planning Strategy

Material Planning Strategy	Mean	Std deviation
The firm converts the overall plans into time phase production for each product/sub-assemblies and gives information for developing the capacity plans	4.38	1.15
The firm keeps lowest possible inventory level by releasing the orders to the production and suppliers only if there is a need for it	4.02	1.22
The firm plans purchasing, production activities and delivery activities	4.40	1.18
The firm generates planned order quantities and the time of planned order released for different models in order to satisfy the final customer	4.31	1.21

Producing the parts/component before the time they are needed might lose some aspects which are necessary for a customer	4.46	1.23
Producing parts/components afterwards the customer order, take larger manufacturing lead time	4.27	1.11
Producing parts/components afterwards is more effective when there is a certainty in the change of customer product design.	4.12	1.32
Information about inventory level, production lead time, order receipts in a firm generates planned order quantities and the time of planned order released for different models in order to satisfy the final customer	4.21	1.12

The study sought to establish the extent to which respondents agreed in table 4.10 relating to material planning strategy and supply chain performance of petroleum industry in Kenya. From the research findings, majority of the respondents strongly agreed that; producing the parts/component before the time they are needed might lose some aspects which are necessary for a customer as shown by a mean of 4.46, the firm plans purchasing, production activities and delivery activities as shown by a mean of 4.40, the firm converts the overall plans into time phase production for each product/sub-assemblies and gives information for developing the capacity plans as shown by a mean of 4.38, the firm generates planned order quantities and the time of planned order released for different models in order to satisfy the final customer as shown by a mean of 4.31,producing parts/components afterwards the customer order, take larger manufacturing lead time as shown by a mean of 4.27,information about inventory level, production lead time, order receipts in a firm generates planned order as shown by a mean of 4.21,producing parts/components afterwards is more effective when there is a certainty in the change of customer product design.as shown by a mean of 4.12 and the firm keeps lowest possible inventory level by releasing the orders to the production and suppliers only if there is a need for it as shown by a mean of 4.02

The study further revealed that the material planning strategy contains targeted sales forecasts, production levels, inventory levels, and customer backlogs. The study findings are in line with Chen and Disney (2007), planning strategy attempts to balance capacity and demand in such a way that costs are minimized. For example, as a product line or family Aggregate resources could be total number of workers, hours of machine time, or tons of raw materials. Aggregate units of output could include gallons, feet, pounds of output, as well as aggregate units appearing in service industries such as hours of service delivered, number of patients seen.

4.3.5 Extent to which the Industry Use Market Readiness Strategy by the Firm

Table 4. 11: Statements on Market Readiness Strategy

Market Readiness Strategy	Mean	Std deviation
The firm has incorporated market literacy and market readiness training into its programming with very poor populations	4.06	1.26
The firm has used significant capacity building and organization in order to improve weak market relationships	4.58	1.18
Extensive exposure visits and training on negotiation skills and marketing helps the firm to engage with other market actors	4.17	1.31
The firm tests the willingness of the customers to pay at various price points	4.31	1.34
The firm provides a platform for sharing experience for the various players in the supply chain	4.46	1.23
To improve weak market relationships in a firm, significant capacity building and organization is required	4.37	1.11
Extensive exposure visits and training on negotiation skills and marketing help the firm committees to engage with other market actors in a way that increased benefits for all market actors	4.23	1.15

The study sought to establish the extent to which respondents agreed in table 4.11 relating to market readiness strategy and supply chain performance of petroleum industry

in Kenya. From the research findings, majority of the respondents strongly agreed that; the firm has used significant capacity building and organization in order to improve weak market relationships as shown by a mean of 4.58, the firm provides a platform for sharing experience for the various players in the supply chain as shown by a mean of 4.46 to improve weak market relationships in a firm, significant capacity building and organization is required as shown by a mean of 4.37, the firm tests the willingness of the customers to pay at various price points as shown by a mean of 4.31,to improve weak market relationships in a firm, significant capacity building and organization is required as shown by a mean of 4.23,extensive exposure visits and training on negotiation skills and marketing help the firm to engage with other market actors as shown by a mean of 4.17 and the firm has incorporated market literacy and market readiness training into its programming with very poor populations as shown by a mean of 4.06. The study further revealed that activities to strengthen market readiness included the development of village development committees, which represented small groups of producers and facilitated their training. The study findings are in line with William (2001), market readiness strategy lets a company know how attractive a chosen market is from the company's perspective, and it can also lead to discovery and analysis of additional markets. The strategy itself is not meant to help determine specific market potential, nor is it a be-all-end-all market selector. This strategy is not a substitute for market research. It is a solid starting point for companies to become well-prepared for journeys into markets that are a strong fit for their offerings.

4.4 Supply Chain Performance

Table 4. 12: Measures of Supply Chain Performance

Supply chain performance	2010	2011	2012	2013	2014	Mean
Cost of the material (KsH)	0.42	0.49	0.37	0.39	0.48	0.43
Revenue from goods sold (KsH)	1.45	1.63	1.41	1.39	1.84	1.54
Activity-based costs of material handling (KsH)	0.78	0.92	0.89	0.71	0.68	0.80
Activity-based costs of manufacturing (KsH)	0.21	0.25	0.2	0.18	0.24	0.22
Activity-based costs of assembling (KsH)	0.35	0.32	0.28	0.3	0.34	0.32
Inventory holding costs (KsH)	0.12	0.1	0.14	0.17	0.13	0.13
Transportation costs (KsH)	0.19	0.21	0.17	0.22	0.25	0.21

The study sought to establish effect of the supply chain performance measures of petroleum industry in Kenya for a period of five years. From the findings, in table 4.12 revenue from goods sold was highest as shown by a mean of 1.54, activity-based costs of material handling as shown by a mean of 0.80, cost of the material as shown by a mean of 0.43, activity-based costs of assembling as shown by a mean of 0.32, activity-based costs of manufacturing as shown by a mean of 0.22, transportation costs as shown by a mean of 0.21 and inventory holding costs were lowest as shown by a mean of 0.13. The study further revealed that, Supply chain performance measures have a significant impact on supply chain performance of petroleum industry in Kenya. Petroleum industry supply chain performance have to consider various procurement, transportation, delivery, assembling since they all have an impact on the performance of the supply chain. It is

also observed that the application of other measures arising from the consideration of these measures is highly impactful on the firm performance. Due to the scramble for resources, many oil companies have been driven to and produce in some of the most hostile and harsh environments, which in turn tend to be extremely costly.

4.5 Inferential Statistics

Inferential statistics is used to try to infer from the sample data what the population might think or to make judgments of the probability that an observed difference between groups is a dependable one or one that might have happened by chance in a study. The study sought to carry out an inferential statistics of inventory planning strategy, price control strategy, order management strategy, material planning strategy and market readiness strategy.

4.5.2 Regression Analysis

Model Analysis

In this study, a multiple regression analysis was conducted to test the influence among predictor variables. The research used statistical package for social sciences (SPSS V 21.0) to code, enter and compute the measurements of the multiple regressions.

Model Summary

The model summary are presented in the table 4.13

Table 4.13: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.872 [a]	.760	.728	.3238

Source; Research findings, 2015

The study used coefficient of determination to evaluate the model fit. The adjusted $R^{2,}$ also called the coefficient of multiple determinations, is the percent of the variance in the dependent explained uniquely or jointly by the independent variables. The model had an average adjusted coefficient of determination (R^2) of 0. 728 and which implied that 72.8% of the variations in supply chain performance are explained by the independent variables understudy (inventory planning strategy, price control strategy, order management strategy, material planning strategy and market readiness strategy).

4.5.3 Analysis of Variance

The study further tested the significance of the model by use of ANOVA technique. The findings are tabulated in table 4.14

Table 4.14: Summary of One-Way ANOVA Results.

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	26.289	5	5.257	5.476	.001[b]
Residual	48.165	46	1.047		
Total	74.454	51			

Critical value = 2.40

Source; Research findings, 2015

From the ANOVA statics, the study established the regression model had a significance level of 0.1% which is an indication that the data was ideal for making a conclusion on the population parameters as the value of significance (p-value) was less than 5%. The calculated value was greater than the critical value (5.476> 2.40) an indication that Inventory planning strategy, price control strategy, order management strategy, material planning strategy and market readiness strategy all have a significant effects on supply chain performance. The significance value was less than 0.05 indicating that the model was significant.

Coefficients

In addition, the study used the coefficient table to determine the study model. The findings are presented in the table 4.15.

Table 4.15: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.284	0.3142		4.7231	0
	inventory planning strategy	0.077	0.0561	0.438	5.3101	0.021
	price control strategy	0. 082	0.1132	0.327	5.1256	0.061
	order management strategy	0. 195	0.0691	0.436	7.1575	0.013
	material planning strategy	0. 167	0.1822	0.165	5.203	0.022
	market readiness strategy	0. 142	0.1855	0.183	4.275	0.042

Source; Research findings, 2015

Inventory planning strategy, price control strategy, order management strategy, material planning strategy and market readiness strategy as per the SPSS generated output as presented in table 4.15, the equation becomes:

$Y= 1.284 + 0.077X_1 + 0.\ 082X_2 + 0.\ 195X_3 + 0.\ 167X_4 + 0.\ 142X_5$

From the regression model obtained above, a unit change in Inventory planning strategy while holding the other factors constant would lead to an increase in supply chain performance by a factor of 0.077, a unit increase in price control strategy while holding the other factors constant would lead to an increase in supply chain performance by a factor of 0. 082, a unit change in order management strategy while holding the other factors constant would lead to an increase in supply chain performance by a factor of 0. 195 a unit increase in material planning strategy while holding the other factors constant would lead to an increase in supply chain performance by a factor of 0. 167, a unit increase in market readiness strategy while holding the other factors constant would lead to an increase in supply chain performance by a factor of 0. 142,

The analysis was undertaken at 5% significance level. The criteria for comparing whether the predictor variables were significant in the model was through comparing the obtained probability value and $\alpha = 0.05$. If the probability value was less than α, then the predictor variable was significant otherwise it wasn't. All the predictor variables were significant in the model as their probability values were less than $\alpha = 0.05$

4.6 Discussion of the Findings

The study revealed a positive correlation coefficient between inventory planning strategies and supply chain performance of petroleum industry in Kenya, (correlation factor of (0.077 p- value.291). The study further revealed that companies that use the

inventory planning strategies, produce only enough goods to meet or exactly match the demand for goods. The study findings are in line with Gallego and Scheller-Wolf (2000), to effectively manage the forward and reverse flows in the supply chain, firms have to deal with upstream supplier exchanges and downstream customer demands. This puts an organization in the position of trying to strike a balance between fulfilling the demands of customers, which is often difficult to forecast with precision or accuracy, and maintaining adequate supply of materials and goods. This balance is often achieved through inventory.

On the price control strategy, the study revealed a positive correlation coefficient between price control strategy and supply chain performance of petroleum industry in Kenya, (correlation factor of (0.082 p- value.225). The study further revealed that it costs a firm money to keep supplies and inventory in a warehouse. The study findings are in line with Rong et al. (2009), if a firm conducts an analysis of how well it uses storage space, it may find that it is paying for too much space. Companies may also be wasting money paying personnel to search for stored items. A more efficient storage strategy could reduce the amount of space used and the amount of time it takes to find and pull items. This could result in reduced rent and payroll costs.

The study revealed a positive correlation coefficient between order management strategy and supply chain performance of petroleum industry in Kenya, (correlation factor of (0. .195 p- value.174). The study further revealed that order management strategies improves customer loyalty. The study findings concurs with Bacon (2001), that a company must understand that an order management system is essential in improving customer loyalty and adheres to the notion that an order management initiative is one of the most

important and influential action a firm will ensue. When putting an order management strategies is in place, one must make a commitment to organizational development in order to follow the principles order management entails. A well trained workforce will discover the metrics that sheds light on where buying patterns and customer touch points interact and which initiatives are necessarily working as once thought. Ultimately, managers will identify which business practices work and which ones don't.

The study revealed a positive correlation coefficient between material planning strategy and supply chain performance of petroleum industry in Kenya, (correlation factor of (0. 167 p- value. 345). The study further revealed that the material planning strategy contains targeted sales forecasts, production levels, inventory levels, and customer backlogs. The study findings are in line with Chen and Disney (2007), planning strategy attempts to balance capacity and demand in such a way that costs are minimized. For example, as a product line or family Aggregate resources could be total number of workers, hours of machine time, or tons of raw materials. Aggregate units of output could include gallons, feet, pounds of output, as well as aggregate units appearing in service industries such as hours of service delivered, number of patients seen.

The study revealed a positive correlation coefficient between market readiness strategy and supply chain performance of petroleum industry in Kenya, (correlation factor of (0.142p- value .256). The study further revealed that activities to strengthen market readiness included the development of village development committees, which represented small groups of producers and facilitated their training. The study findings are in line with William (2001), market readiness strategy lets a company know how attractive a chosen market is from the company's perspective, and it can also lead to

discovery and analysis of additional markets. The strategy itself is not meant to help determine specific market potential, nor is it a be-all-end-all market selector. This strategy is not a substitute for market research. It is a solid starting point for companies to become well-prepared for journeys into markets that are a strong fit for their offerings.

On the supply chain performance the study further revealed that, supply chain performance measures have a significant impact on supply chain performance of petroleum industry in Kenya. Petroleum industry supply chain performance have to consider various procurement, transportation, delivery, assembling since they all have an impact on the performance of the supply chain. It is also observed that the application of other measures arising from the consideration of these measures is highly impactful on the firm performance. Due to the scramble for resources, many oil companies have been driven to and produce in some of the most hostile and harsh environments, which in turn tend to be extremely costly.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents summary of the study findings, conclusion and recommendations. The chapter is presented in line with the objective of the study which was to investigate the capacity constraint management strategies and supply chain performance of petroleum industry in Kenya

5.2 Summary of Findings

From the discussion, the study found that there is a positive correlation coefficient between inventory planning strategies and supply chain performance of petroleum industry in Kenya. The study further revealed that companies that use the inventory planning strategies, produce only enough goods to meet or exactly match the demand for goods. The study findings are in line with Gallego and Scheller-Wolf (2000), to effectively manage the forward and reverse flows in the supply chain, firms have to deal with upstream supplier exchanges and downstream customer demands. This puts an organization in the position of trying to strike a balance between fulfilling the demands of customers, which is often difficult to forecast with precision or accuracy, and maintaining adequate supply of materials and goods.

From the discussion the study revealed a positive correlation coefficient between price control strategy and supply chain performance of petroleum industry in Kenya. The study further revealed that it costs a firm money to keep supplies and inventory in a warehouse. The study findings are in line with Rong et al. (2009), if a firm conducts an analysis of

how well it uses storage space, it may find that it is paying for too much space. Companies may also be wasting money paying personnel to search for stored items.

The study found a positive correlation coefficient between order management strategy and supply chain performance of petroleum industry in Kenya. The study further revealed that order management strategies improves customer loyalty. The study findings concurs with Bacon (2001), that a company must understand that an order management system is essential in improving customer loyalty and adheres to the notion that an order management initiative is one of the most important and influential action a firm will ensue.

On material planning strategy, the study revealed that material planning strategy influences supply chain performance of petroleum industry in Kenya positively. The study further revealed that the material planning strategy contains targeted sales forecasts, production levels, inventory levels, and customer backlogs. The study findings are in line with Chen and Disney (2007), planning strategy attempts to balance capacity and demand in such a way that costs are minimized.

The study found that market readiness strategy was found to have a positive correlation coefficient on supply chain performance of petroleum industry in Kenya. The study further revealed that activities to strengthen market readiness included the development of village development committees, which represented small groups of producers and facilitated their training. The study findings are in line with William (2001), market readiness strategy lets a company know how attractive a chosen market is from the company's perspective, and it can also lead to discovery and analysis of additional markets.

From the discussion the study found that supply chain performance measures have a significant impact on supply chain performance of petroleum industry in Kenya. Petroleum industry supply chain performance have to consider various procurement, transportation, delivery, assembling since they all have an impact on the performance of the supply chain. It is also observed that the application of other measures arising from the consideration of these measures is highly impactful on the firm performance.

5.3 Conclusion

The study concludes that the practice of inventory planning strategies leads to efficiency and effectiveness in supply chain performance of petroleum industry in Kenya. Study further concludes that companies that use the inventory planning strategies, produce only enough goods to meet or exactly match the demand for goods. To effectively manage the forward and reverse flows in the supply chain, firms have to deal with upstream supplier exchanges and downstream customer demands.

The study concludes that supply chain performance of petroleum industry in Kenya can improve positively if petroleum firms implement price control strategy. The study further concludes that it costs a firm money to keep supplies and inventory in a warehouse. if a firm conducts an analysis of how well it uses storage space, it may find that it is paying for too much space. Companies may also be wasting money paying personnel to search for stored items.

On the order management strategy, the study concludes that implementation of this strategy leads to efficient and effective supply chain performance of petroleum industry in Kenya. The study further concludes that order management strategies improves customer loyalty. A company must understand that an order management system is

essential in improving customer loyalty and adheres to the notion that an order management initiative is one of the most important and influential action a firm will ensue.

The study concludes that material planning strategy implementation can be of essence to the petroleum companies since influences supply chain performance of petroleum industry in Kenya positively. The study further concludes that the material planning strategy contains targeted sales forecasts, production levels, inventory levels, and customer backlogs. Material planning strategy attempts to balance capacity and demand in such a way that costs are minimized.

On the market readiness strategy the study concludes that supply chain performance of petroleum industry in Kenya is positively influenced by this strategy.The study further concludes that activities to strengthen market readiness included the development of village development committees, which represented small groups of producers and facilitated their training.

5.4 Recommendations

Oil marketing companies in the petroleum industry need to take the capacity constraint management strategies idea a step further to collaborate with competitors so as to find shared solutions to their supply chain management challenges. Oil marketing companies in Kenya needs to train their personnel so as to appreciate the concept of supply chain management and the best practices and systems that will be significant in mitigating the challenges in their supply chain management.

The study also recommends oil marketing companies need to engage in closer cooperation between companies and government and formulate facial policies. This

cooperation would help bring understanding on policy issues, infrastructural improvement and maintenance and bring about equity in the open tendering systems on supply.

Mangers of oil marketing companies should invest in IT systems which is a requirement in the modern business world and especially in the area of supply chain. Such technologies have the potential to aid enterprises internally by aiding in inventory management, product quality and expiration monitoring, market trend analysis and by generally improving the information available to supply chain management. An advantage can be achieved by implementing IT to improve and enable external communications with other members of the supply chain by linking IT systems.

5.5 Limitations of the Study

The study focused on the oil marketing companies in Kenya. The petroleum industry in Kenya has other stakeholders who play an important role in the downstream supply chain. These include the Kenya Petroleum Refineries Ltd, Kenya Revenue Authority (KRA) and Kenya Ports Authority (KPA). The inclusion of these stakeholders to the study data would give a more elaborate analysis of the whole industry.

5.6 Suggestions for Further Research

This study investigated capacity constraint management strategies and supply chain performance of petroleum industry in Kenya. The study recommends that further studies be carried out on the effect of the Lamu Port-Southern Sudan-Ethiopia Transport Project on the Supply Chain of petroleum products. Further studies could examine the future of the petroleum business in Kenya and in the region in the long term after the discovery of crude oil in Uganda and Kenya and the discovery of natural gas in Tanzania.

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RESEARCH QUESTIONNAIRE

Kindly answer all the questions by filling in the space provided.

SECTION A: Background Information

1. Name of organization …….
2. Gender: Male [ ] Female [ ]
3. 21 to 30 years [ ] 31 to 40 years [ ]

   41 o 50years [ ] 51 to 60 years [ ] Over 61 years [ ]

4. Kindly indicate your highest level of education

   Certificate [ ] Diploma [ ]

   Bachelor degree [ ] Master's degree [ ] other, please specify……

5. How long have you worked for the organization?

   0 to 10years [ ] 11to 20 years [ ] 21 to 30 years [ ]

   31 to 40 years [ ]

6. Your level of Management

   Operational level [ ] Middle level management [ ]

   Senior level management [ ] other, please specify……

SECTION B: CAPACITY CONSTRAINT MANAGEMENT STRATEGIES

7. Kindly provide us with the following information to allow us compute the capacity utilization and efficiency.

	2010	**2011**	**2012**	**2013**	**2014**
Actual output (m^3)					
Design capacity					
Effective capacity					

8. To what extent has the industry used the following inventory planning strategies in an effort to manage its capacity constraints? Use a scale of 1-5, where 1- Very small extent, 2- Small extent, 3- moderate extent, 4- Great extent, 5- very great extent.

Inventory planning strategies	**1**	**2**	**3**	**4**	**5**
1. The time-varying optimal flow is characterized in terms of the time-varying dual variables of a corresponding network optimization problem					
2. A dynamic feedback controller has to flows asymptotically to the optimal level and achieves the additional balancing of all storage levels					

3. The firm has to but measure in place to allow its trading partners to access information in inventory levels					
4. The firm uses the periodic review/order-up-to/base-stock policy for replenishment					
5. The firm fixes the review period to raise the inventory position up to a target level					
6. The firm has implemented a centralized inventory management policy to monitor the inventory level in its supply chain					
7. The firm has a fixed stock policy and reviews inventory position to raise up the target level					
8. the Implementation of the centralized management depends on accessibility of information on inventory levels at other trading partners in the supply chain					

9. To what extent do you agree with the following statements on price control strategies? Use a scale of 1-5, where 1- Very small extent, 2- Small extent, 3- moderate extent, 4- Great extent, 5- very great extent.

Price Control Strategy	**1**	**2**	**3**	**4**	**5**
1. Removal of price controls do not result in major changes in the overall economy					

2. The implementation of pricing strategies by the supplier may lead to reversed bullwhip effect when customers react to changes in the price					
3. The anticipations of price change strategy by the ERC sometimes result in supply shocks					
4. Every supply chain element seeks to maximize on the price differentials made by the ERC					
5. The government has set the maximum prices which the oil marketers are to charge.					
6. Self-sustaining industrial sector requires, establishment of strategic linkages within the domestic economy.					
7. Under imperfect market conditions, agreements by the market players can set supply quotas that are preservative of desired price levels.					
8. Kenya Association of Manufacturers have not improved the manufacturing performance.					
9. Central pricing authority can result in supply shocks as every supply chain element seeks to maximize on the price differentials.					

10. To what extent do you agree with the following statements on order management strategies by the firm? Use a scale of 1-5, where 1- Very small extent, 2- Small extent, 3- moderate extent, 4- Great extent, 5- very great extent.

Order management strategies	**1**	**2**	**3**	**4**	**5**
1. The firm deals with a diverse set of customer touch points and fulfilment nodes					
2. The firm uses innovation to continuously enhance the foundation of their direct procurement and supply chain approach					
3. The firm has created obstructions between production and fulfilment in order to reverse-engineer the supply chain in order to align with fleeting demand					
4. The firm has simplified the migration to and integration of the commerce platform while enabling more complex order fulfilment and inventory optimization					
5. The firm has adopted technology, communication and cost-efficient strategies for its supply chain					
6. Many clients in a firm are best served to first implement next-gen OMS capability before their next-gen commerce platform.					

7. In the period of responsive commerce, order management tools are strategic					

11. To what extent do you agree with the following statements on Material Planning Strategies by the firm? Use a scale of 1-5, where 1- Very small extent, 2- Small extent, 3- moderate extent, 4- Great extent, 5- very great extent.

Material Planning Strategy	**1**	**2**	**3**	**4**	**5**
1. The firm converts the overall plans into time phase production for each product/sub-assemblies and gives information for developing the capacity plans					
2. The firm keeps lowest possible inventory level by releasing the orders to the production and suppliers only if there is a need for it					
3. The firm plans purchasing, production activities and delivery activities					
4. The firm generates planned order quantities and the time of planned order released for different models in order to satisfy the final customer					
5. Producing the parts/component before the time they are needed might lose some aspects					

which are necessary for a customer					
6. Producing parts/components afterwards the customer order, take larger manufacturing lead time					
7. Producing parts/components afterwards is more effective when there is a certainty in the change of customer product design.					
8. Information about inventory level, production lead time, order receipts in a firm generates planned order quantities and the time of planned order released for different models in order to satisfy the final customer					

12. To what extent do you agree with the following statements on **Market Readiness Strategy** by the firm? Use a scale of 1-5, where 1- Very small extent, 2- Small extent, 3- moderate extent, 4- Great extent, 5- very great extent.

Market Readiness Strategy	**1**	**2**	**3**	**4**	**5**
1. The firm has incorporated market literacy and market readiness training into its programming with very poor populations					
2. The firm has used significant capacity building and organization in order to improve weak market relationships					

3. Extensive exposure visits and training on negotiation skills and marketing helps the firm to engage with other market actors					
4. The firm tests the willingness of the customers to pay at various price points					
5. The firm provides a platform for sharing experience for the various players in the supply chain					
6. To improve weak market relationships in a firm, significant capacity building and organization is required					
7. Extensive exposure visits and training on negotiation skills and marketing help the firm committees to engage with other market actors in a way that increased benefits for all market actors					

SECTION C: SUPPLY CHAIN PERFORMANCE

13. Kindly supply the following information on measures of supply chain performance.

Supply chain performance	**2010**	**2011**	**2012**	**2013**	**2014**
Cost of the material (KsH)					
Revenue from goods sold (KsH)					
Activity-based costs of material handling (KsH)					
Activity-based costs of manufacturing (KsH)					
Activity-based costs of assembling (KsH)					
Inventory holding costs (KsH)					
Transportation costs (KsH)					

Oil Marketing Companies In Kenya

1 Metro Petroleum Limited

2 Tecaflex Limited

3 Mbaraki Bulk Terminal Limited

4 Ranway Traders Limited

5 Quantum Petroleum Limited

6 Samhar Petroleum Products Limited

7 Orix Oil Kenya Limited

8 Keroka Petroleum Limited

9 East African Gasoil Limited

10 Regnol Oil (K) Limited

11 Kenol Limited

12 Kobil Petroleum Limited

13 Olympic Petroleum Limited

14 P.J. Petroleum Equipment Limited

15 Intoil Limited

16 Muloil Limited

17 Libya Oil Kenya Limited

18 Hass Petroleum Kenya Limited

19 Bakri Int. Energy Company Limited

20 Topaz Petroleum Limited

21 Galana Oil Kenya Limited

22 Riva Petroleum Dealers Limited

23 National Oil Corporation of Kenya

24 Oil City Services Limited

25 Jaguar Petroleum Limited

26 Global Petroleum Products Kenya Limited

27 Total Kenya Limited

28 Gulf Energy Limited

29 Ainushamsi Energy Limited

30 Jade Petroleum Limited

31 Alba Petroleum Limited

32 Petro Oil Kenya Limited

33 Kenya Shell Limited

34 Royal Energy (K) Limited

35 Tosha Petroleum (Kenya) Limited

36 MGS International (K) Limited

37 Addax Kenya Limited

38 Banoda Oil Limited

39 Gapco Kenya Limited

40 Fossil Fuels Limited

41 Oilcom Kenya Limited

42 Engen Kenya Limited

43 Trojan International Limited

44 Hashi Energy Limited

45 Kamkis Trading Company Limited

46 Premium Petroleum Company Limited

47 Al leyl Petroleum Limited

48 Fast Energy Limited

49 Essar Petroleum (East Africa) Limited

50 One Petroleum Limited

51 Dalbit Petroleum Limited

52 Millenium Dealers Limited

53 Mafuta Products Limited

54 Kenya Petroleum Refineries (New – Licensed to allow conversion to merchant refinery)

55 Cape Supplies Ltd (New)

Source: Energy Regulation Commission (2014)