Industrial Engineering Letters
ISSN 2224-6096 (Paper) ISSN 2225-0581 (online)
Vol.5, No.9, 2015
www.iiste.org

Econometric Data Analysis Affecting Performance of Supply Chain Systems in the Petroleum Industries in Kenya

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Abstract
The purpose of this paper was to do econometric data analysis on performance of supply chain systems in the petroleum industries in Kenya. Specifically, the objectives of the study were to establish whether there is any effect from; level of skills, information and communication technology and tendering systems and the moderating factor have an effect on supply chain systems performance. The study was conducted using a survey design. The total population of all oil companies in the 73 was covered by the study. Several studies were carried to validate the final findings. Finally, this statistics concluded that there is need to do econometric data analysis to validate the effect of supply chain systems on performance by doing proper forecasting from the up streams to the down streams towards achieving a competitive edge in the business markets such as the petroleum industry. The econometric analysis focused on the these areas; Information functions in order to inform management, support decision making and to identify problem areas; Steering function in order to set targets and give directions to desired outcomes; Controlling function in order to supervise process execution.
Keywords: level of skill of staffs, Information communication and technology, Tendering systems and Performance

1. INTRODUCTION

The wide range of the petroleum industry's products as well as the varied value of these products coupled with the global nature of the petroleum industry presents both challenges and opportunities within the petroleum supply chain. It is along this supply chain that challenges for creating value for the customer exist as well the opportunities for reaching this goal. This analysis explored the challenges affecting performance of supply chain systems in the petroleum industries in Kenya. Final analysis studies show that most successful oil companies do not only embrace customer satisfaction but they also do proper forecasting (Hou et al,2014).The petroleum industry works as a global supply chain involving exploration, material handling, domestic and international transportation, use of technology, and so on. The industry offers a strong model for implementing supply chain management (SCM) techniques (Giovanni & Vinzi, 2012). Supply chain management involves providing maximum satisfaction to end users (consumers), in other words, delivering the right product to the right person at the right time while still maximizing profits. Today, there are many opportunities for the coordination of activities across the supply chain even in the ever complex oil and gas sector.

1.2.1 Global Perspectives of Supply Chain Management

The goal of supply chain management is to provide maximum customer service at the lowest cost possible. A customer is anyone who uses the output of a process. Therefore, the customer's customer is important to any organization that is focused on customer service. In a supply-chain, a company will link to its suppliers upstream and to its distributors downstream in order to serve its customers. Usually, materials, information, capital, labor, technology, financial assets and other resources flow through the supply-chain. Since the goal of the firm is to maximize profits, the firm must maximize benefits and minimize costs along the supply chain (Luthra et al,2013). The firm must weigh the benefits versus the costs of each decision it makes along its supply-chain. Supply-chain management is therefore an extension of the focus on customer service. Integrating supply management with other factors of operations allows all functions to be involved in the management decisions (Cuthbertson, and Piotrowicz, 2011)).

Over the years, the oil industry has continued to face growing challenges, from stricter government regulation, political risks, competition, emergent new comers and political hostilities, which has affected growth and output. Due to the scramble for resources, many oil companies have been driven to explore and produce in some of the most hostile and harsh environments, which in turn tend to be extremely costly. Also, there have been concerns in the industry about the growing scarcity of natural resources, which underlies fears of not being able to meet production levels and goals. However, in reality, the resources are not the cause of supply restrictions with vast potential still available due to continuous discoveries of oil reservoirs around the world. The main challenge facing the oil industry is not the availability of oil resources, but putting these reserves into production and delivering the final products to consumers at the minimum cost possible. Thus, a solid supply chain management program will enhance this goal (Schrettle et al, 2013).

1.2.2 Petroleum Industries

The petroleum industry includes the global processes of exploration, extraction, refining, transporting (often by oil tankers and pipelines), and marketing petroleum products. The largest volume products of the industry are fuel oil and gasoline (petrol). Petroleum (oil) is also the raw material for many chemical products, including pharmaceuticals, solvents, fertilizers, pesticides, and plastics. The industry is usually divided into three major components: upstream, midstream and downstream. Midstream operations are usually included in the downstream category (Mojtaba et al, 2014)

Africa's oil history stretches over a period of several decades, in some places it is even a century old. Presently, there are about 500 oil companies that participate in African hydrocarbon exploration. According to figures from the US EIA, Africa's proven oil reserves have grown by nearly 120% in the past 30 years or so, from 57 billion barrels in 1980 to 124 billion barrels in 2012. In addition, it is estimated that at least another 100 billion barrels are offshore Africa, only waiting to be discovered. In turn, Africa's proven reserves of natural gas have grown from 210 trillion cubic feet (tcf) in 1980 to 509 tcf in 2012, representing growth of over 140%. Furthermore, recent further discoveries of sizable natural gas reserves in Tanzania and Mozambique point to significant upward potential for these figures (Hou et al, 2014).

In 2010, Africa's oil production represented 12.4% of the world's total crude oil output, while Africa's crude oil exports grabbed a higher share at nearly 20% of the world's total exports of crude – as a result of limited refining capacity and still limited oil consumption on the continent while Africa held 8.8% of the world's proven reserves of oil in the year. Africa's prospects and potential for further oil and gas finds remain exceedingly positive. According to research by the Chatham House (published in November 2012), compared with some 15,000 wells drilled in West Africa, only 500 have been drilled in East Africa to date. While new hydrocarbon finds boost the interest in and potential of East Africa, prospects of pre-salt discoveries across the Gulf of Guinea are significant. In this regard, in 2011, Angola signed a number of ultra-deep water deals with oil majors in subsalt blocks in the Kwanza Basin, whose oil volumes are forecast to be of commercial quantities. If prospects are as favourable as projected, Angola could extend its life as a major oil exporter by an additional 30 years and the country should be able to increase its oil production to eclipse that of Nigeria (Petro China Annual Report. 2015).

Four of Africa's oil producers are also members of the Organisation of the Petroleum Exporting Countries (OPEC), namely Algeria, Angola, Libya and Nigeria.1 Libya already joined OPEC in 1962, followed by Algeria in 1969, Nigeria in 1971, and with Angola Africa's newest member of OPEC, joining the international club of oil producing countries in 2007. Gabon was also previously a member of OPEC, but officially departed from the producer organisation at the June 1996 OPEC meeting. Africa's adherence to OPEC output quotas has varied over the years, with domestic supply problems and the international oil price at times more of a driving force to determine output levels, especially in Nigeria, than OPEC output restrictions (Hou et al, 2014).

In terms of trade in oil, Africa has for years been seen by western and Asian markets as a means to diversify away from too deep a dependence on Middle Eastern oil. Robust demand from especially India and China over the past decade, fuelled by strong economic growth in these countries, has started to change not only Africa's export profile, but also the continent's economic landscape. According to Sharma (2013) although Saudi Arabia is the principal supplier of oil to China, Angola occupies second place, with China receiving nearly 9% of its oil from Luanda, according to Trade Map figures. Other African countries that export to China include Congo (Brazzaville), Libya, Algeria, Equatorial Guinea, Nigeria, South Africa, Egypt, with the Asian powerhouse also an important trade partner of Sudan and South Sudan.

Africa's oil exports to China are expected to increase over the medium- to the long-term with the International Energy Agency projecting that China will become the world's largest net-importer of oil by 2020.When just considering the past few years, whereas in 2007, only 10% of Africa's oil was shipped to China, and 5% to India, by 2011, these figures increased to 14% and 8% respectively. Oil contributes substantially to Africa's total export receipts; in 2011, an estimated 58% of Africa's total export receipts in value terms belonged to the category 'mineral fuels, oils and distillation products'. In some individual countries, hydrocarbon exports account for over 95% of export earnings (Silva, 2013). The total energy consumption in Africa is 41% of Petroleum Industry (U.S.EIA, 2012).

In Ghana, petroleum products account for about 26% of total energy consumption (Ministry of Energy, 2010) and about 70% of Ghana's commercial energy needs (Oil and Gas in Ghana - Overview, 2013). The Ministry of Energy estimates that the market for major petroleum products in Ghana will grow by 5.3% annually through 2015 and projects this figure is likely to increase if economic growth is sustained. The petroleum industry includes the global processes of exploration, extracting, refining, transporting and marketing petroleum products. The industry is usually divided into three major sectors: upstream, midstream and downstream (Muhammad, 2013). The upstream is concerned with exploration and production, the midstream deals with storage, marketing and transportation of commodities like crude oil, natural gas, natural gas liquids (NGLs, mainly ethane, propane and butane) and sulphur. The downstream sector involves oil refineries, petrochemical plants, petroleum products distributors, retail outlets and natural gas distribution companies. Midstream operations are considered a part of the downstream sector. In Ghana, the upstream sector is regulated by the Ghana National Petroleum Corporation (GNPC), whilst the downstream sector, the National Petroleum Authority (NPA). The discovery of oil in commercial quantities in 2007 raised the expectations of stakeholders and consumers alike of the petroleum sector on its significant role and contribution to Ghana's developmental efforts in accelerated economic growth, job creation, poverty reduction and general prosperity to the people of Ghana (Mojtaba et al, 2014).

1.2.3 Performance of Companies

The shortages were blamed on the new three-axle rule in Kenya, reducing the amount of fuel a truck could carry; delayed clearance of trucks at the Malaba border; and repairs on the Mombasa to Eldoret pipeline. Further, oil companies reported that they were still holding stocks procured at the high international prices of July 2008 (British Petroleum (2013, June). Kenya, Madagascar, and Malawi have joint purchases of product imports. In Madagascar, oil companies voluntarily import on a joint cargo basis to minimize marine transport costs. In Malawi, Petroleum Importers Limited a private company comprising all the four oil marketing companies operating in the country handles all imports. In Kenya, the government set up an Open Tender System to import crude oil for KPRL and petroleum products. Under the system, crude oil is purchased every month by a single company for the entire market on the basis of a public tender, transported through one terminal, and shared among all marketing companies in proportion to their share of the market (Y. Hou, Y. Xiong, X. Wang, and X. Liang, 2014).

Petroleum products are similarly purchased through the Open Tender System by National Oil Company. Depending on supply and demand, the oil marketing companies may source the balance of their needs independently. The Open Tender System is intended to have the dual benefit of ensuring competitive prices (which are made public) and transporting the oil in a way that would minimize evasion of the import duty. Each company is required to take the crude oil allocation and pay for the consignment within a specified time frame or risk penalties for late payment. In times of high oil prices, some marketers could not pay on time for imports, and their late payments delayed subsequent crude shipments, lowered refinery throughput, and caused fuel shortages. Kenya imports enough petroleum products to accommodate three separate tenders a month, opening up the possibility of options other than the current Open Tender System where the right to import is granted to only one company (Mirhedayatian, S.M., Azadi, M., & Saen, R.F.(2013).

1.2 Statement of the Problem

Earlier researchers have only focused on western countries and apart of Africa in the area of financial aspect, but not supply chain systems. Iyer (2011), note that despite the vast literature on performance of supply chain in the petroleum industries that has often caused fuel shortages, much less is known about factors affecting proper forecasting. The reasons why there are shortages is not the same as the reasons why we have surplus, a fact that is often overlooked. A recent study by (Maheshwarkar and Sohani, 2013) established that it seems surprising that, to date, no studies have systematically investigated how best to forecast the real level of skills of staffs, information communication and technology and tendering systems in real time to avoid fuel shortages. One reason is perhaps that there has been no readily available real-time database for the relevant economic variables. Also, lack of proper forecasting, monitoring of stock level, information dissemination from up streams to down streams. In addition, in spite of the great interest in understanding these problems faced by often shortages. The existing literature reveals that there are gaps in terms of generalized conclusion due to a tendency to research on these entire paradigms of supply chain, challenges affecting performance of supply chain systems in the petroleum industry and the absolute disregard of the professional performance of supply chain systems in the oil companies. Agami, et al (2012), also observed that a previous empirical finding shows that internal supply chain performance measures have lacked precision and consistency. (Alquist et al. 2013) argues that many researchers have only focused on financial performance measures at the expenses of forecasting accuracy. It is insufficient to merely analyze a company's performance by financial, especially under today's changing volatile supply chain systems/environment (Sople, 2012).

Despite the foregoing, there is a scarcity of research of supply chain systems on performance in the Kenya context. As such it is essential for petroleum companies in Kenya to know why there is poor forecasting resulting to fuel shortages. This study therefore, sought to establish the econometric data analysis validating the effects on performance of supply chain systems in the oil companies in Kenya. However, to come up with the analysis, the researcher sought to find out, the effect of level of skills of staff on performance of supply chain systems; how information communication and technology contributes to supply chain system performance; whether tendering systems has an effect on performance and sought suggestions on performance that can help Kenyan oil companies to maintain their forecasting in an accurate manner and mitigate fuel shortages.

1.3 Specific Objectives

1. To establish the extent to which level of skills of staff affects performance of supply chain systems in the

petroleum companies in Kenya.
2. To determine the effects of information and communication technology on performance of supply chain systems in the petroleum industries in Kenya.
3. To examine the effect of tendering systems on performance of supply chain systems in the petroleum industries in Kenya.
4. To determine the moderating effect of legal and regulatory environment in the oil companies on the, relationship between level of skills, information and communication technology and tendering systems in the oil industries in Kenya.

RESEARCH METHODOLOGY

3.1 Research Design

Silva (2013), define research design as the plan and structure of investigation so conceived as to obtain answers to research questions. It includes an outline of what the investigator will do from writing hypotheses and their operational implications to the final analysis of the data (Gruenspecht, 2011). A research design helps to control the experimental, extraneous and error variables of a particular research problem being investigated.

The aim of the study was to establish the challenges affecting performance of supply chain systems in the oil companies in Kenya and to achieve this, a researcher used descriptive research design, (Meyer,2010) states that descriptive studies are more formalized and typically structured with clearly stated evaluative questions. It serves a variety of research objectives such as descriptive of phenomenon or characteristics associated with a subject population, estimates of proportions of population that have these characteristics and discovery of associations among different variables (Gist, 2013).

3.2 Sample and Sampling Techniques

A census of all the registered 73 oil companies was conducted. This involved all heads of procurement in all the registered oil companies, which finally resulted to our unit of observation. The purpose of sampling is to secure a representative group which enabled the researcher to gain information about a population. The researcher carried censuses to all the 73 registered oil companies as per ERC records. Where, all the respondents were requested to indicate the price of fuel for the period between July 2014 - January 2015. Kothari (2011) observes that a census with population of 100 per cent response rate has an advantage over a sample in that there are no concerns as to whether the people who take part are representative of the population. Total population sampling is a type of purposive sampling technique where you choose to examine the entire population that have a particular set of characteristics such as specific experience, knowledge, skills, exposure to an event. In such cases, the entire population is often chosen because the size of the population that has the particular set of characteristics that you are interest in is very small (Meyer, 2010).

3.3 Validity of the Research Instrument

Validity refers to the extent to which a test measures what was actually intended to be measured. It is based on the adequacy with which the items in an instrument measure the attributes of the study (Lin 2013). The following measures were taken to ensure the research instruments yielded valid data for econometric analysis;
i) Expert opinion: Care was taken in designing research instruments to ensure that it would measure and collect the data it was meant to collect. The designed instrument was to be counter checked by the researcher, supervisors, peers and professionals in the target industries.
ii) Pilot study: Instruments pretest survey was carried out in a similar area of study. After the pretest, pilot data analysis lead to modification where necessary to ensure desired results were obtained.
iii) Triangulation. The principle of triangulation was employed in every way. Data was collected from the areas of study. Three different types of research instruments were used; Questionnaire, Survey and Observation. Efforts were also be made to validate data collection by use of well-trained research assistants who were also conversant with the respondents under study.
iv) Factor analysis: Factor analysis was done on the instruments, and then the data was analyzed statistically. Factor analysis is used to identify "factors" that explain a variety of results on different tests. Bowersox et al (2010) assert that factor analysis has advantages that: both objective and subjective attributes can be used provided the subjective attributes can be converted into scores; factor Analysis can be used to identify hidden dimensions or constructs which may not be apparent from direct analysis; it is easy and inexpensive to do.

3.4 Academic Qualifications

The study also revealed that those who were with masters and above were 10% (7). About 41% (28) possessed degree, while 40% (27) hold diploma and 9% (6) were certificates holders. The findings that majority of the respondents possessed less than 1st Degree 49% indicates that the staff did not meet the requirements of providing quality services (refer Table 3.1). Previously, studies such as (Lin, 2013)) observes that the level of education influences the impartation of academic staff working in the petroleum industry. The role of education as an a gent is indisputable and has always been a central mechanism for transmission of skills and values for the sustenance of shortages and enhance proper forecasting of real lead time (Yang et al, 2013). Therefore, the fuel shortages can be attributed to the level of education of the staff.

Table 3.1 Academic qualification of the respondents

	Frequency	Valid Percent
Post Graduate	7	10
Bachelors	28	41
Diploma	27	40
Secondary	6	9
Total	**68**	**100**

3.5 Reliability and Construct Validity

Reliability refers to the extent to which a measuring instrument contains variable errors, that is, errors that appear inconsistently from observation to observation during any one measurement attempt or that vary each time a given unit is measured by the same instrument. Construct validity is established by relating measuring instruments to a general theoretical framework in order to determine whether the instrument is tied to the concepts and theoretical assumptions they are employing (Schrettle et al, 2013). SPSS version 20 programme was used as the tool of analysis to test the relationship between the dependent variable and the three independent variables. Cronbach's alpha type of reliability co-efficient value of .70 or higher is considered as usually sufficient (Muhammad, 2013). The results in the tables below show Cronbach's alpha of well above 0.7 and most of it above 0.8 implying that the instruments were sufficiently reliable for measurement. As most item total correlations were reasonably high, the construct validity of the instruments was considered reasonable (Taylor, 2014). However a few items had 0.0 correlation (no correlation) and very low standard deviation implying that the sub-variables were not valid and therefore omitted.

Table 3.2 Reliability and Construct Validity Test

Cranach's Alpha	
Skill	0.87933
ICT	0.886676
Tendering	0.862037
Performance	0.708313

Higher alpha coefficient value means there is consistency among the items measuring the concept of interest. As a rule of thumb acceptable alpha should be at least 0.70 or above. Cronbach's alpha is a general form of the Kunder-Richardson (K-R) 20 formula derived from Kothari (2011). The formula was as follows:

$$KR_{20}= \frac{(K)\ (S^2-\sum_s{}^{2})}{(S^2)\ (K-1)}$$

Where; KR_{20} = Reliability coefficient of internal consistency
K= Number of items used to measure the concept
S^2= Variance of all scores
s^2 = Variance of individual items

The Cronbach's alpha for all the variables were above 0.70 and hence the questionnaire was therefore considered reliable. Meyer (2010), states that validity is the extent to which an instrument measures what it is supposed to measure and performs as it is designed to perform. Validation involves collecting and analyzing data to assess the accuracy of an instrument. There are numerous statistical tests and measures to assess the validity of quantitative instruments, which generally involves pilot testing. But basically validity boils down to whether the research is really measuring what it claims to be measuring (Zhu, Q., Sarkis, J., & Lai, K.H. (2013).Validity refers to the extent to which a test measures what was actually intended to be measured. It is based on the adequacy with which the items in an instrument measure the attributes of the study (Lin 2013).

Table 3.3 Multicollinearity Test

Model	Collinearity Statistics	
	Tolerance	**VIF**
(Constant)		
Skill rank	.916	1.092
ICT	.877	1.141
Tendering	.851	1.175

From table 3.3 indicates, the Tolerance is the percentage of information of the dependent variable that cannot be explained by the other independent variables. According to Greene & William (2012), they observed that the reciprocal of tolerance gives the VIF (Variance Inflated Factor). Multicollinearity can also be detected with the help of tolerance and its reciprocal, called variance inflation factor (VIF). If the value of tolerance is less than 0.2 or 0.1 and, simultaneously, the value of VIF 10 and above, then the multicollinearity is problematic. In this instance, the researcher might get a mix of significant and insignificant results that show the presence of multicollinearity. Suppose the researcher, after dividing the sample into two parts, finds that the coefficients of the sample differ drastically. This indicates the presence of multicollinearity. This means that the coefficients are unstable due to the presence of multicollinearity. Suppose the researcher observes drastic change in the model by simply adding or dropping some variable. This also indicates that multicollinearity test is present in the data.

Autocorrelation Test

According to Greene & William (2012), observed that serial correlation, or autocorrelation, is defined as the correlation of a variable with itself over successive observations. It often exists when the order of observations matters, the typical scenario of which is when the same variable is measured on the same participant repeatedly over time. For example, serial correlation is an important issue to consider in any longitudinal designs. According to Hayes, Andrew F.; Cai, Li (2007 Autocorrelation test was made by using Durbin and Watson (1951). Durbin--Watson (DW) is a test for first order autocorrelation that is it tests only for a relationship between an error and its immediately previous value. This study used Durbin Watson (DW) test to check that the residuals of the models were not auto correlated since independence of the residuals is one of the basic hypotheses of regression analysis. Clearly, you should reject the null in favor of AR (4) based on the B-G LM test results.

If the test is rejected, there is evidence for AR (1) or first-order serial correlation (auto-regressive process of order; after your regression, issue the command dw state to obtain the durbin- watson statistic. By checking the DW table for critical values, you can test for the above hypothesis. Note; If d=2, no serial correlation. If d<2, there is positive serial correlation and if d>2, there is negative serial correlation. If there is no serial correlation $\hat{\rho} = 0$ then $d \approx 2$ .If there is positive serial correlation $\hat{\rho} > 0$ then. If there is negative serial correlation, i.e. $\hat{\rho} < 0$ then d'< 2.If there is negative serial correlation i.e. p < 0 then d' > 2. b). DW test is not valid if there are lagged values of the dependent variable on the right hand side of the equation (in this case use Breusch-Godfrey LM test or Durbin's h-Test). The results in the table 4.57 show that there was no DW statistics that were close to the prescribed value of 2.0 for residual independence; this implied that the data had no autocorrelation. This result is similar to that of (Greene & William, 2012).

Table 3.4 Autocorrelation Test

	Durbin Watson
ICT	2.004
Skills	1.971
Tendering	1. 965

Predictors: (Constant), Level of skills of staff, ICT, Cost of crude oil and tendering systems
Dependent Performance

Hayes, Andrew.; Cai, Li (2007) observed that Autocorrelation test was made by using Durbin and Watson (1951). Durbin--Watson (DW) is a test for first order autocorrelation that is it tests only for a relationship between an error and its immediately previous value. This study used Durbin Watson (DW) test to check that the residuals of the models were not auto correlated since independence of the residuals is one of the basic hypotheses of regression analysis. The results in the table 4.57 show that there was no DW statistics that were close to the prescribed value of 2.0 for residual independence; this implied that the data had no autocorrelation. This result is similar to that of (Nasarullah and Raja, 2014).

Autocorrelation describes sample or population observations or elements that are related to each other across time, space, or other dimensions. Correlated observations are common but problematic, largely because they violate a basic statistical assumption about many samples: independence across elements. Conventional tests of statistical significance assume simple random sampling, in which not only each element has an equal chance of selection but also each combination of elements has an equal chance of selection; autocorrelation violates this assumption. This entry describes common sources of autocorrelation, the problems it can cause, and selected diagnostics and solutions (Maheshwarkar and Sohani, 2013.Autocorrelation Effects on Basic Regression Models: With more complex statistical techniques, such as regression, the effects of Θ multiply beyond providing a less stable estimate of the population mean. If autocorrelation occurs for scores on the dependent variable in ordinary least square (OLS) regression, then the regression residuals will also be autocorrelated, creating a systematic bias in estimates of the residuals and statistics derived from them.

Heteroscedasticity
Lin (2013), observed that in statistics, a collection of random variables is heteroscedastic.

Table 3.5 Heteroscedasticity Test

Ho	Variables	Chi2 (4)	Prob > Chi2
Constant Variance	Skills, ICT, Cost and Tendering	1.867	.760

------- Breusch-Pagan and Koenker test statistics and sig-values –

	LM	Sig
BP	1.867	.760
Koenker	3.267	.514

Null hypothesis: Heteroscedasticity not present (homoskedasticity) if sig-value is less than 0.05, reject the null hypothesis. Greene & William (2012) observes that one of the key assumptions of regression is that the variance of the errors is constant across observations. Typically, residuals are plotted to assess this assumption. Standard estimation methods are inefficient when the errors are heteroscedastic or have non-constant variance.

Table 3.6 Tests of Normality on Supply Chain Systems

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Unstandardized Residual	.097	58	.200*	.967	58	.118

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Note: Breusch-Pagan test is a large sample test and assumes the residuals to be normally distributed. Heteroscedasticity is not present since Breusch pagan test =1.867 with a non-significant p_ value of 0.760 >0.05 at 5 % level of significance. According to Hayes et al (2007) and Taylor (2014), they observed that if there are sub-populations that have different variabilities from others. Here "variability" could be quantified by the variance or any other measure of statistical dispersion. Thus heteroscedasticity is the absence of homoscedasticity.The existence of heteroscedasticity is a major concern in the application of regression analysis, including the analysis of variance, as it can invalidate statistical tests of significance that assume that the modelling errors are uncorrelated and uniform, hence that their variances do not vary with the effects being modeled. For instance, while the ordinary least squares estimator is still unbiased in the presence of heteroscedasticity, it is inefficient because the true variance and covariance are underestimated. Similarly, in testing for differences between sub-populations using a location test, some standard tests assume that variances within groups are equal.

Table 3.6 indicates, the test for normality, the Shapiro-Wilk test shows that the Standardized residuals are significantly normally distributed with a significance 0.118 which is greater than 0.05. The findings proof that the independent variable, supply chain systems has a strong effect on performance of supply chain systems in the oil industries. Korkmaz (2014) also established that the null-hypothesis of this test is that the population is normally distributed. Thus if the *p*-value is less than the chosen alpha level, then the null hypothesis is rejected and there is evidence that the data tested are not from a normally distributed population. In other words, the data are not normal. On the contrary, if the *p*-value is greater than the chosen alpha level, then the null hypothesis that the data came from a normally distributed population cannot be rejected. For example an alpha level of 0.05, a data set with a *p*-value of 0.02 rejects the null hypothesis that the data are from a normally distributed population. However, since the test is biased by sample size, the test may be statistically significant from a normal distribution in any large samples.

Normality Test
A normal distribution is not skewed and is defined to have a coefficient of kurtosis. Jarque-Bera formalizes this by testing the residuals for normality and testing whether the coefficient of skewedness and kurtosis are zero and three respectively (Barrow,2013).The study used Jarque-Berra's statistic to determine whether the sample data have the skewedness and kurtosis matching a normal distribution. It is a test based on residuals of the least squares regression model. For normal distribution JB statistics is expected to be zero (Testa, 2014). In this study JB statistics values were: Capital requirement (skewedness 0.196, kurtosis 0.623), bank liquidity (skewedness 0.196, kurtosis 0.623), Credit risk transfer (skewedness 0.196, kurtosis 0.623) and financial stewardship (skewedness 0.196, kurtosis 0.623). This result was consistent with Ongore and Kusa (2013) in their study even though their JB statistics result was 0.09 with skewedness of 0.14 and kurtosis of 3.38. Thus, the JB is very close to zero and that the variables are very close to normal distribution. This implies that the research variables are normally distributed.

Table 3.7 Regression Model Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Unstandardized Residual	.102	30	.200*	.979	30	.812

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Table 3.7 indicates, the regression model test of normality above, the statistic of Shapiro-Wilk is 0.979 with a significance of 0.812. If the Sig. value of the Shapiro-Wilk Test is greater than 0.05 then the data is normal, if it is below 0.05 then the data is not normally distribute (Lund Research Ltd, 2012). This shows that the data is normally distributed, since it's greater than 0.05.

Table 3.8 Regression Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.773[a]	.597	.572	.00641	2.037

a. Predictors: (Constant), cost, ICT, skills, tendering

b. Dependent Variable: perform

From table 3.8 indicates, the coefficient of determination explains the extent to which changes in the dependent variable can be explained by the change in the independent variables or the percentage of variation in the dependent variable (performance) that is explained by all the four independent variables. According to Table 3.8 above, R Square for this model is 0.597. This means that 59.7 % of the variation dependent variable (performance) can be explained by the four independent variables.

Table 3.9 ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.793	4	1.198	59.244	0.00[b]
	Residual	1.234	61	.020		
	Total	**6.027**	**65**			

a. Dependent Variable: performance-(2 tailed test)
b. Predictors: (Constant), cost of crude oil , ICT, level of skills of staff, tendering systems

Based on Anova Table 3.8 shown above, the F value is 59.244 with a p-value = 0.000 < 0.05 significance level. Thus, the overall regression model for these four predictors has significantly explained the variation in performance. For example if we choose alpha to be 0.05, coefficients having p-value of 0.05 or less would be statistically significant. With a 2 tailed test and alpha of 0.05, we accept the null hypothesis that the coefficient for shortages is equal to 0.

Coefficients[a]

Model		unstandardized Coefficients		Standardized Coefficients		
		B	**Std. Error**	**Beta**	**t**	**Sig.**
1	(Constant)	1.203	.151		7.984	.000
	ICT	.290	.144	.114	2.011	.049
	Skills	.608	.270	.292	2.249	.028
	Tendering	-.011	.047	-.004	-.240	.811

ICT ,and level of skills are the significant predictors of performance, with t values greater than 1.96.

Table 3.9 indicates, the coefficient of the analysis, where the respondents indicated that skills is the predictor variables that contribute the highest to the variation of the performance; every unit increase in skill, it will increase a total of 0.608 unit of performance provided other independent variables remain constant. The second highest predictor is cost (β = .318), it has a positive relationship with performance; every unit increase in cost, it will increase a total of 0.318 unit of performance provided that other independent variables remain constant. Then followed by ICT (β = 0.290), It has a positive relationship with performance; every one unit increase in ICT, performance will increase by 0.290 holding other variables constant. While Tendering Systems is not a significant predictor in the model with a regression coefficient of -0.011 (t-value=-0.240, p-value=0.811>0.05)

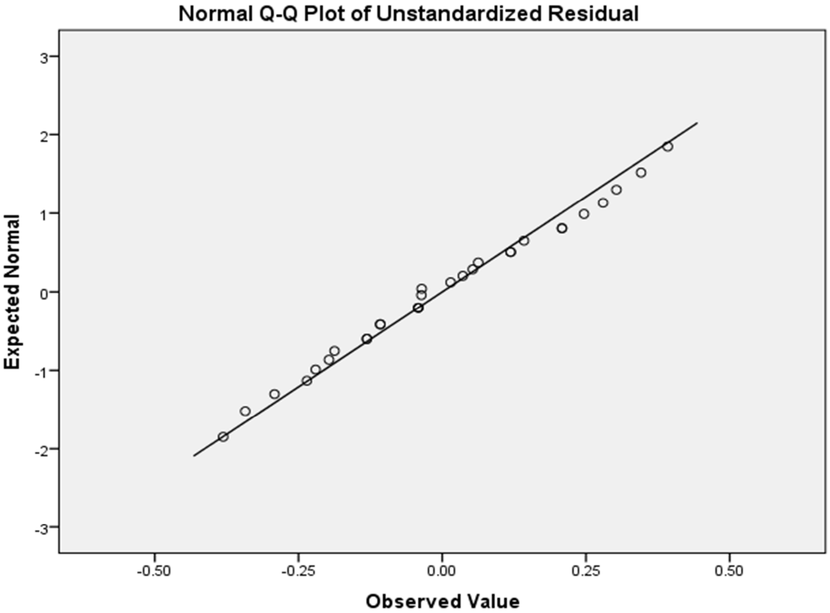

Figure 4.3 Scatter Plot of Normal Q-Q of Unstandardized Residual

Checking the Normal Probability Plot points lie in a reasonably straight diagonal line from bottom left to top right. This would suggest no major deviations from normality.

Table 3.10 Results of Overall Normality Diagnostic Test

Variables	Descriptive Statistical	Statistical Values	Std. Error	Comment
Level of skills	Skewedness	.327	.52715	Normally distributed
of Staff	Kurtosis	.644		Normally distributed
ICT	Skewedness	.325	.51532	Normally distributed
	Kurtosis	.639		Normally distributed
Tendering Systems	Skewedness	.322	. 67542	Normally distributed
	Kurtosis	.634		Normally distributed

3.10. Linear Regression

Linear regression is an approach to modeling the relationship between a scalar variable *y* and one or more variables denoted *x*. In linear regression, data are modeled using linear functions, and unknown model parameters are estimated from the data (Maheshwarkar and Sohani, 2013). Such models are called linear models. Most commonly, linear regression refers to a model in which the conditional mean of Y given the value of *x* is an affine function of *x* (Billy Gray et al, 2013).

SPSS version 19 was used as a tool of analysis. For each variable a scatter plot was generated to show the kind of relationship that existed between each independent variable and the dependent variable holding the intervening variable constant. Any linear relationship generated called for linear regression to test the direction and magnitude of the relationship.

Table 3.11 Correlations on Level of Skills of Staff

		performance	skills
	Pearson Correlation	1	.347**
Performance	Sig. (2-tailed)		.008
	N	58	58
	Pearson Correlation	.347**	1
Skills	Sig. (2-tailed)	.008	
	N	58	58

**. Correlation is significant at the 0.01 level (2-tailed).

3.11 Study Variables

Hypotheses 1

H_o: Level of Skills of staff does not significantly affect performance of supply chain systems in the petroleum industries in Kenya.

Table 3.12.1 Regression Model Summary on Level of Skill of Staff

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.347[a]	.121	.105	.83378

a. Predictors: (Constant), skills

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.341	1	5.341	7.682	.000[b]
	Residual	38.930	56	.695		
	Total	44.271	57			

a. Dependent Variable: performance
b. Predictors: (Constant), skills

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.155	.070		-2.186	.000
	Skills	.298	.108	.347	2.772	.000

a. Dependent Variable: performance= -0.155+ 0.298 xskills

The linear regression analysis shows a relationship, R = 0.347 and R2 = .121 which means that 12.1% of the corresponding change in information and communication technology after the f the shortages can be explained by a unit change in performance. A further test on the beta coefficient of the resulting model, the constant α = -0.155 is not significantly different from 0, and since the p value p = 0.000 is greater than p= 0.050 with a p=0.000 which is less than p=0.05. This explains α that if were held constant then performance will be -0.155 (low) and therefore the gradient (β) and the performance would be very low Regression indicates the strength of the relationship between the independent variables and the dependent variable (performance). The R square value in this case is 0.121 which clearly suggests that there is a strong relationship between the independent variables and the dependent variable. This indicates that the independent variables share a variation of 12.1 % of performance. This implies that if all the oil companies can enhance information and communication technology, skills, cost and tendering systems challenges affecting performance of supply chain systems in the petroleum industries in Kenya will minimize fuel shortages. R squared (R^2) - co-efficient of determination in linear regression relationship, tells how well the regression line fits the data. It is an important indicator of the predictive accuracy of the equation. Goodness of fit refers to how well the model fits the data (Sidola et al, 2012).

1. Testing hypothesis: The model performance = β (level of skills of staff) holds as suggested by the test above. This confirms that there is a positive linear relationship between Level of skills of staff and performance of supply chain systems. The Anova test in Table 3.12 shows that the significance of the F-statistic is less than zero. This implies that the null hypothesis $\beta 1=0$ is rejected and the alternative hypothesis $\beta 1 \neq 0$ is taken to hold implying that the model $Y= \beta 0 + \beta 1X1 + e$, is significantly fit.

The model Performance of supply chain System = α + β (skills) holds for as suggested by the test above. This confirms that there is a positive linear relationship between level of skills of staff and performance of supply chain systems in the oil industries.

Hypothesis 2

H_o: Information and communication technology does not significantly affect performance of supply chain systems in the petroleum industries in Kenya.

Correlation

Table 3.13 Correlations on ICT

		Performance	ICT
Performance	Pearson Correlation	1	.643**
	Sig. (2-tailed)		.000
	N	58	58
ICT	Pearson Correlation	.643**	1
	Sig. (2-tailed)	.000	
	N	58	58

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3.14 1 Regression Model Summary on ICT

	R	R Square	Adjusted Square	RStd. Error of the Estimate
1	.643[a]	.414	.403	.68080

a. Predictors: (Constant), ICT

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.316	1	18.316	39.518	.000[b]
	Residual	25.955	56	.463		
	Total	44.271	57			

a. Dependent Variable: performance
b. Predictors: (Constant), ICT

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.168	.083		-2.027	.004
	ICT	.534	.085	.643	6.286	.000

a. Dependent Variable: performance =-0.168+ 0.534 xICT

The linear regression analysis shows a relationship, R = 0.643 and R2 = .414 which means that 41.1% of the corresponding change in information and communication technology after the f the founder can be explained by a unit change in performance . A further test on the beta coefficient of the resulting model, the constant α = -0.168 is not significantly different from 0, and since the p value p = 0.004 is greater than p= 0.05, the constant is not significant. However, the coefficient β = 0.534 is significantly different from 0, model analysis of regression is shown the table 4.49 above. Regression indicates the strength of the relationship between the independent variables and the dependent variable (performance). The R square value in this case is 0.414 which clearly suggests that there is a strong relationship between the independent variables and the dependent variable. This indicates that the independent variables share a variation of 41.4 % of performance. This implies that if all the oil companies can enhance informanc and communication technnology, skills, cost and tendering systems challenges affecting performance of supply chain systems in the petroleum industries in Kenya will minimize fuel shortages.

A visual examination of the histogram suggests that there is a strong positive linear relationship between affect performance of supply chain systems in the petroleum industries and Information and communication technology. Therefore the level of influence of ICT on the performance of supply chain systems in the petroleum industries can statistically be determined by performing a linear regression analysis.

2. Testing Hypothesis: This explains α that if were held constant then performance will be -0.168 (low) and therefore the gradient (β) and the performance would be very low. The Anova test in Table 3.13 shows that the significance of the F-statistic is less than zero. This implies that the null hypothesis $\beta 1=0$ is rejected and the alternative hypothesis $\beta 1 \neq 0$ is taken to hold implying that the model $Y= \beta 0 + \beta 1 X1 + e$, is significantly fit.

The model performance = α + β (ICT) holds for as suggested by the test above. This confirms that there is a positive linear relationship between cost and on performance of supply chain systems in the oil industries. The model performance = β (ICT) holds as suggested by the test above. This confirms that there is a positive linear relationship between Information and communication technology and performance of supply chain systems.

Hypothesis 3

H_o: Tendering Systems does not significantly affect performance of supply chain systems in the petroleum industries in Kenya.

Table 3.14 Correlations on Tendering Systems

		Performance	Tendering
Performance	Pearson Correlation	1	-.371**
	Sig. (2-tailed)		.004
	N	58	58
Tendering	Pearson Correlation	-.371**	1
	Sig. (2-tailed)	.004	
	N	58	58

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3.15 Regression Model Summary on Tendering Systems

Model	R	R Square	Adjusted Square	RStd. Error of the Estimate
1	.371[a]	.138	.122	.82565

a. Predictors: (Constant), tendering

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.096	1	6.096	8.942	.004[b]
	Residual	38.175	56	.682		
	Total	44.271	57			

a. Dependent Variable: performance
b. Predictors: (Constant), tendering

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.165	.080		-2.057	.044
	Tendering	.332	.111	-.371	-2.990	.004

a. Dependent Variable: performance= -0.165 + -332x tender

The linear regression analysis shows a relationship, R = -0.371 and R2 = .138 which means that 13.8% of the corresponding change in tendering systems after the f the founder can be explained by a unit change in performance . A further test on the beta coefficient of the resulting model, the constant α = -0.165 is not significantly different from 0, and since the p value p = 0.044 is greater than p= 0.05, the constant is not significant. However, the coefficient $\beta = 0.332$ is significantly different from 0, model analysis of regression is shown the table 4.49 above. Regression indicates the strength of the relationship between the independent variables and the dependent variable (performance). The R square value in this case is 0.138 which clearly suggests that there is a strong relationship between the independent variables and the dependent variable. This indicates that the independent variables share a variation of 13.8 % of performance. This implies that if all the oil companies can enhance tendering systems, skills, ICT and tendering challenges affecting performance of supply chain systems in the petroleum industries in Kenya will minimize fuel shortages.

Test Hypothesis: This explains α that if were held constant then performance will be -0.165 (low) and therefore the gradient (β) and the performance would be very low. The A nova test in Table 3.15 shows that the significance of the F-statistic is less than zero. This implies that the null hypothesis $\beta 1=0$ is rejected and the alternative hypothesis $\beta 1 \neq 0$ is taken to hold implying that the model $Y= \beta 0 + \beta 1X1 + e$, is significantly fit.

The model performance = $\alpha + \beta$ (tender) holds for as suggested by the test above. This confirms that there is a positive linear relationship between Tender and on performance of supply chain systems in the oil industries. The model performance = β (tender) holds as suggested by the test above. This confirms that there is a positive linear relationship between tendering systems and performance of supply chain systems

Table 3.16 Model Correlations of all Independent Variables

		performance	ICT		Skills	tendering
performance	Pearson Correlation	1	.643**	.	.347**	-.371**
	Sig. (2-tailed)		.000		.008	.004
	N	58	58		58	58
ICT	Pearson Correlation	.643**	1	.	-.116	-.391**
	Sig. (2-tailed)	.000			.386	.007
	N	58	58		58	58
Level of Skills of Staff	Pearson Correlation	.347**	-.116		1	.138
	Sig. (2-tailed)	.008	.386	.		.303
	N	58	58		58	58
Tendering Systems	Pearson Correlation	-.371**	-.391**		.138	1
	Sig. (2-tailed)	.004	.007		.303	
	N	58	58		58	58

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 3.17 Overall Regression Analysis Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.812[a]	.660	.634	.53286	2.030

a. Predictors: (Constant), tendering, skills,ICT
b. Dependent Variable: performance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	29.222	4	7.305	25.728	.000[b]
	Residual	15.049	53	.284		
	Total	44.271	57			

a. Dependent Variable: performance
a. Predictors: (Constant), tendering, level of skills, ICT

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-.161	.070		-2.294	.026
ICT	.740	.110	.892	6.699	.000
Skills	.349	.070	.406	5.022	.000
Tendering	.297	.118	.332	2.522	.015

Normality Test

A further test for normality was found necessary. Shapiro-Wilk test was found to be the most appropriate. The Shapiro–Wilk test, tests the null hypothesis that a sample $x1... xn$ came from a normally distributed population where $P < 0.05$ for W rejects this supposition of normality. It was published in 1965 by Samuel Shapiro and Martin Wilk (Luthra et al,2013).

The Test statics is:

$$W = \frac{\left(\sum_{i=1}^{n} a_i x_{(i)}\right)^2}{\sum_{i=1}^{n}(x_i - \overline{x})^2}$$

Where:

$x(i)$ (with parentheses enclosing the subscript index i) is the ith order statistic, i.e., the $i$thsmallest

number in the sample;
x = (*x*1 + ... + *xn*) / *n* is the sample mean;
Most authors agree that this is the most reliable test for non-normality for small to medium sized samples (Luthra et al, 2013; Shapiro and Wilk, 1965;).

Table 3.18 Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Unstandardized Residual	.097	58	.200*	.967	58	.118

*. This is a lower bound of the true significance. a. Lilliefors Significance Correction

Table 3.19 Skewness and Kurtosis

Descriptive Statistics

	N	Skewness		Kurtosis	
	Statistic	**Statistic**	**Std. Error**	**Statistic**	**Std. Error**
Unstandardized Residual	58	-.072	.314	-.704	.618
Valid N (listwise)	58				

The further test for normality, the Shapiro-Wilk test shows that the Standardized residuals are significantly normally distributed with a standard error of .618 which is greater than 0.05

Hypothesis 5
H_o: Moderating effect does not significantly affect performance of supply chain systems in the petroleum industries in Kenya.

Table 3.20 Moderated Regressions **Model Summary[b]**

odel	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.848[a]	.719	.692	.49346

a. Predictors: (Constant), legal_and_regulatory, ICT, tendering
b. Dependent Variable: Performance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	31.802	5	6.360	26.121	.000[b]
1	Residual	12.418	51	.243		
	Total	44.220	56			

a. Dependent Variable: performance
b. Predictors: (Constant), legal_and_regulatory, cost, skills, ICT, tendering

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	**Std. Error**	**Beta**		
(Constant)	-.136	.066		-.2.054	.044
ICT	.711	.105	.856	6.774	.000
Skills	.333	.065	.388	5.150	.000
Tendering	.233	.115	.260	2.026	.048
Legal and Regulatory	-.296	.101	-.229	-2.929	.005

a. Dependent Variable: performance = -0.136 + 0.333x skills + 0.711 xICT +0.233xtender + -0.296x legal
Note: The R Square when moderated it gives $^{0.719}$ (71.9%) and overall regression gives $^{0.660}$ (66%) showing an increase of 0.051 (5.1%).

Summary
Data was collected using questionnaire with assistance of research assistant in different industries coverage areas and locations in Kenya. This yielded a commendable response rate of nearly 100%.The collected data was analyses using quantitative techniques, such as descriptive statistics (response rate, measure of central tendency,

measure of dispersion, frequencies and percentages), correlation analysis and multiple regression analysis using SPSS. Reliability and internal consistency of the measurement items were tested using Cronbach's alpha and all the variables attained value above 0.70 implying that the measures was reliable. The qualitative data collected from the exit interview and written responses with the senior procurement officers was analyzed based on themes and the findings were integrated with the quantitative findings.

The analysis of the qualitative interviews with the respondents of the case companies brought the following interesting results: SCPM was mainly used as an internal approach as there are barriers for external measurement as well as the internal measurement process was not considered to be adequate enough for being used externally; The frequently used measures were rather short-term oriented and financial and the linkage between the overall strategy and the supply chain strategy was rather neglected; The choice on the SCPI was rather unstructured and not top-down and the degree of variation on the usage of SCPIs was very high and Suppliers and customers report on certain measures in an informal way as well as the companies inform their counterparts also rarely.

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