

Influence of Demand Forecasting on Supply Chain Performance of Petroleum Marketing Companies in Nakuru County, Kenya

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Abstract: Inventory management techniques are essential for the organization since organizations success and cost minimization of the expenditures of a firm leads to improvement in the performance of supply chain and employee knowledge. Inventory management techniques are aimed at reducing stock holding costs, being able to supply what is required, when is required and being supplied in the right quality and quantity to avoid waste, while remaining competitive. The main objective of this study was to establish the influence of demand forecasting on procurement performance of Petroleum marketing companies in Nakuru County, Kenya. The study used a descriptive survey research design. 147 supply chain managers and the procurement officers working with the petroleum marketing companies in Nakuru County, Kenya constituted the target population. The study used a structured questionnaire and the findings were presented in tables. The results indicated that there was a positive correlation ($r=.285$) between demand forecasting and supply chain performance. The hypothesis test results showed that demand forecasting had a statistically significant influence on supply chain performance.

Key Words: Demand Forecasting, Supply Chain Performance

I. Introduction

The Petroleum and gas industry is one of the largest and most complex industry in the world today that touches on peoples' everyday lives with services ranging from transportation, electricity, heating, lubricants and a host of chemical and petrochemical products. Globally, a whopping 30 billion barrels of Petroleum is consumed per year [1]. In Europe and Asia, Petroleum accounts for 32% of energy consumption, whilst in the Middle East, 53%. For South and Central America the figure is 44% whereas in North America it is 40%. In the Petroleum industry, the supply-chain network is composed of shipping via vessel, petroleum tankers, and pipelines that may run across multiple countries. This network is used to transport crude from wellhead to refinery for processing, to transport intermediates between multi-site refining facilities, and to transport finished products from product storage tanks to distribution centers and finally to the customers. 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. Hence, to effectively model a supply-chain design problem, the dynamics of the supply chain ought to be considered and data aggregation techniques for the extensive data set should be employed [2].

According to [3] who conducted a study to establish the effect of inventory management techniques on selected manufacturing firm's productivity, inventory control has significant effect on productivity. The study also assessed the effect of demand management and customer satisfaction among selected manufacturing firms. Through the use of descriptive research design established that inventory control has a significant effect on selected manufacturing firms performance. It was therefore recommended that manufacturing firms should come up with policy frameworks to facilitate the inventory management techniques' implementation. It further recommended that organizations should diversify inventory systems to suit specific needs. A related study by [4] focused on inventory management

optimization tool in Coca-Cola Bottling industry in Nigeria. Inventory constitutes the most significant part of current assets of larger majority of Nigerian manufacturing industries. Because of the relative largeness of inventories maintained by most firms, a considerable sum of an organization's fund is being committed to them. It thus becomes absolutely imperative to manage inventories efficiently so as to avoid the costs of changing production rates, overtime, sub-contracting, unnecessary cost of sales and back order penalties during periods of peak demand.

A research conducted by [5] to analyze inventory management systems and supply chain performance in public hospital in Nairobi Kenya. Descriptive study method was employed targeting population in the eight public hospitals in Nairobi. Data was generated using questionnaire, oral interviews, observations, books, journals and the internet. From the data analyzed, it was established that inventory management systems and level of integration impacts on supply chain performance within the public hospital in Nairobi Kenya. It further concluded that inventory management systems are key in influencing supply chain performance. Another study done by [6] titled "inventory management and supply chain performance of petroleum marketing firms in Nairobi" used descriptive design and employed both primary and secondary data collection methods. The study found that the surveyed petroleum firms in Nairobi use inventory management technique and it was an indication that they Improve supply chain performance in their firms. The study recommended that petroleum marketing firms should develop a policy framework to facilitate faster implementation of the best management techniques. According to [7], in Kenya, the petroleum sector boasts of over 30 Petroleum importing and marketing companies comprising of 5 major companies namely Shell, Total, Kenol/Kobil, Petroleum Libya, Chevron, and other emerging petroleum companies which include the Government owned National Petroleum Corporation of Kenya. The supply chain in the petroleum industry is very dynamic, and thus it is very important to measure its performance to know what to control and keep the company on track of its business objectives. Measuring the performance of a supply chain will create a scope for improvement of its performance, which will go a long way in leading a company to gaining competitive advantage.

II. Statement of the Problem

Globally, petroleum markets are changing thus affecting the demand and supply patterns for its products. Local companies have had to adapt to the global techniques in an effort to maximize the performance of their firms financially while at the same time keeping all allies and competitors in check. The most effective and desired way to achieve this is by adopting a practice in the form of inventory management techniques. This is because such techniques will not only ensure a balance between all stakeholders' needs, the organization itself and its suppliers but also melts down the firm as a whole under one effective platform. However, this is not the case as described by the current state of affairs. This gap between the desired state of affairs and the actual practice is what led the researcher to conduct this study. According to the Economic Survey Report in Kenya of 2016, an increase in the demand for petroleum products has resulted to an increase in the number of firms offering this service to 20, meaning that competition has stiffened over the last decade or so [8]. It is equally important to note that all these firms offer the same goods and services in the form of petroleum products. As such, in order to stay competitive, it is prudent for them to engage in sound inventory management techniques so as not only improve their individual supply chain performance, but will also go a long way in creating a favorable and competitively balanced business environment that will result in better provision of goods and services to the end-consumer. One such technique is demand forecasting which aims at reducing stock holding costs, being able to supply what is required, when is required and being supplied in the right quality and quantity to avoid waste, while remaining competitive. Local studies on petroleum firms include [9], whose study specifically emphasized on the supply chain risk factors and performance in petroleum industry in Kenya, [10] also studied the petroleum industry in Kenya and established that leading petroleum companies have some level of power to influence activities in the industry. It is therefore clear that from the studies conducted, extensive research has been conducted as far as the petroleum industry is concerned. However none of the authors has paid attention to demand forecasting and supply chain performance, which was the main interest of this study.

III. Research Objective

The main objective of this study was to establish the influence of demand forecasting on supply chain performance of Petroleum marketing companies in Nakuru County, Kenya

IV. Literature Review

Forecasting is a human activity where researchers ask questions about the way in which an organization's environment, culture, and process interact with the use of quantitative and qualitative techniques for generating a forecast [11].

Indeed, a significant portion of forecasting literature addresses the role of the individual forecaster in identifying and applying appropriate forecasting models and techniques. Nonetheless, where forecasting management theory is concerned, human involvement is typically viewed from a more macro perspective as one of several organization-level factors impacting an organization's forecasting performance. Specifically, such research is characterized by themes of functional integration and supply chain collaboration as means to mitigate the effects of functional biases upon the organization's forecasting process as well as to improve forecasting from the broader perspective of supply chain management. While this line of inquiry has undoubtedly made significant contributions to forecasting management theory and practice, it is also necessary to understand how organizational forecasting management techniques impact forecasting performance at the individual forecaster level. As has been captured in multiple surveys of organizational forecasting techniques and has been repeatedly observed in case studies of business organizations, much of the forecasting process takes place at a disaggregate level where individual forecasters review and adjust statistical forecasts for hundreds, potentially even thousands of stock-keeping units [12]. Typically, statistical forecasts are generated by the organization's forecasting software/system and then, if necessary, adjusted by the forecaster based on information not captured in the statistical model. According to [13], when it comes to supply planning, it is the quality of forecasts at the lower levels of product hierarchies that is most impactful to forecasting performance. Similarly, [14] found this to be true, especially when product demands are negatively correlated.

According to [15], demand forecasting plays a pivotal role in reducing inventory stock outs especially in cases where Just-in-Time or where supplies are done by long lead time suppliers. These demand forecasts help timing of purchases to ensure they correspond to sales fulfillment time and ensures that these inventories sit in the warehouses for a shorter time and reduce the warehousing cost as well. Their study argues that a good demand forecasting process has a direct impact on the planning of inventory levels by harmonizing; Developing production requests to manufacturing; planning for new product launches; planning for promotions and planning for seasonal variations in demand. The harmonizing of these links ensure that safety stock requirement is greatly reduced which in turn lowers associated costs. Other studies suggest that demand planning helps schedule production more effectively. Through effective sales inventory and operations planning, an organization can understand the planning balance between supply and demand. Forecasting literature concerned with the individual forecaster has focused on explaining forecaster performance as a function of various factors. However, limited research exists which directly investigates how forecasting management techniques impact forecaster performance. This is surprising for two reasons. First, management techniques are likely to affect the forecaster's scope of responsibility and the complexity of their assigned tasks. Second, management techniques may potentially help guard against the biases and inconsistencies of human judgment that have so often been found to degrade forecast quality. For these reasons, research addressing the effects of management techniques on the forecaster's contribution to the forecasting process is essential in advancing forecasting management theory.

As the business arena takes a paradigm shift, we are now seeing improvements in supply chain performance where firms are focusing on the overall firm's supply chain performance other than individual company supply chain performance. Competition has necessitated organizations to improve on their service delivery, customer satisfaction, forecasting demand and ensuring that response time is efficient. The original company boundaries have been broken and the level play ground is the same where functional groups now play a central role in advancing supply chain performance [16]. Petroleum marketing companies' performance measures are depicted by their outputs and more so on achievement of their goal which is petrol distribution. This is enhanced by the technologies they adopt to increase productivity and the research they undertake to come up with better varieties. Studies observe that organizational performance can be viewed under four key areas which include: customer service, corporate social responsibility, employee's loyalty and financial performance [17]. Petroleum marketing companies cannot desist from these key areas because it will determine how much their clients are satisfied. Petroleum marketing companies on the other hand can adopt key performance indicators to measure their supply chain performance. Key performance indicators are a yardstick for tracking progress and also it's a tool to achieve a goal. They encompass all areas of business which are demand management, supply conversion and delivery. Measures of performance comprise ongoing monitoring and reporting of activities, particularly progress towards pre-established goals along the supply chain. It involves comparing the expected versus the actual performance achievements along the supply chain and introduction of correction measures to deal with the performance variances [18]. The measure of performance depicts the way an organization can monitor its operations and make plans for managing its inventory levels by ensuring that replenishments are done in good time without any delay. These measures go a long way in cutting operational and logistical costs for the organization thus saving time and energy for the management.

V. Research Methodology

The study used descriptive survey research design. This type of design is appropriate for gathering information, summarizing, presenting and interpreting it for the purpose of clarification. According to [19], descriptive survey research design generated accurate information for large number of people over a wide area using a small sample. The supply chain manager and the procurement officers working with the petroleum marketing companies in Nakuru County, Kenya constituted the target population. Therefore, 147 supply chain managers and procurement officers working with the aforementioned petroleum marketing companies in Nakuru County comprised the accessible population. For this study, the sample was drawn from the petroleum marketing companies' organization structures during the research period. The present study used the stratified random sampling in order to obtain the required sample size. Stratified random sampling is also ideal for the other respondents as it has the characteristic of providing each member of the target population in their strata an equal chance of being included in the study while at the same time keeping the size manageable. Since the target population of this study is sufficiently large to warrant to use of random sampling methods, the overall sample size will first be calculated using statistical formula since no population parameters are available. Therefore, the sample size at 95% confidence level was 108 respondents. In survey studies like the present one, [20] emphasize on the use of questionnaires in data collection. In this respect, structured questionnaires which were self-administered were used to facilitate data collection. The researcher issued the questionnaires to the study respondents and left them to answer in researchers' absence and at respondent's free time. The researcher then returned to collect the questionnaires after two weeks. The data was analyzed using both descriptive and inferential statistical methods.

VI. Research Findings And Discussions

The researcher examined the respondents' profiles in terms of their gender, highest level of education attained and the number of years served with the petroleum marketing companies. The study revealed that 77% of the sampled respondents were male while 23% were female. The findings implied that majority of employees working with the petroleum marketing companies in Nakuru County were male, these petroleum marketing companies were not observant of the two thirds gender rule as enshrined in the Constitution of Kenya of 2010. The distribution of the sampled employees according to their highest level of education show that 50.8% of the supply chain managers and procurement officers of the petroleum marketing companies in Nakuru County had at least diploma/certificate. It was also observed that 9.8% and 16.4% others had master's degree and post-graduate diploma respectively while 23% had degree. The study sought to determine the number of years that the respondents have served the petroleum marketing companies in Nakuru County and found that majority (42.6%) of the supply chain managers and procurement officers had worked with the petroleum marketing companies in Nakuru County for a period of between over 3 years. This is attributed to the fact that most of these petroleum marketing companies have been in existence for almost similar period. The findings also demonstrate a significant (9.8%) of the respondents had worked with the aforesaid petroleum marketing companies in Nakuru County for a period of 2-3 years. Cumulatively, therefore, 47.5% of the respondents had worked with petroleum marketing companies for a period exceeding one year. These findings shows the respondent had been in the organization long enough and this provided responses based on a wider knowledge base.

6.1 Influence of Demand Forecasting on Supply Chain Performance

This section presents the descriptive findings on the influence of demand forecasting on supply chain performance of Petroleum marketing companies in Nakuru County, Kenya as shown in Table 1.

TABLE 1: Descriptive Statistics on Demand Forecasting

Statements	SA (%)	A (%)	N (%)	D (%)	SD (%)	Mean	Std. Dev
When it comes to supply planning, it is the quality of forecasts at the lower levels of product hierarchies that is most impactful to forecasting performance	21.5	51.9	11.4	10.1	5.1	4.13	0.76
Much of our forecasting process takes place at a n disaggregate level where individual forecasters review and adjust statistical forecasts	40.5	35.4	19.0	5.1	0.00	3.61	0.99

Our statistical forecasts are generated by the organization's forecasting software/system and then, if necessary, adjusted by the forecaster based on information not captured	15.2	49.4	12.7	21.5	1.30	3.13	1.45
The management techniques are likely to affect the forecaster's scope of responsibility and the complexity of their assigned tasks.	41.8	39.2	3.8	15.2	0.0	4.16	1.00
Our management techniques potentially help guard against the biases and inconsistencies of human judgment that have so often been found to degrade forecast quality	36.7	51.9	3.8	7.6	0.0	4.16	0.92
Forecasting helps our organizations to predict demand, thus we are able to fulfill the customer orders as and when they arise with short lead time and on time.	41.8	39.2	3.8	15.2	0.0	3.95	1.36

From the findings in Table 1, it was established that when it comes to supply planning, it is the quality of forecasts at the lower levels of product hierarchies that is most impactful to forecasting performance as shown by a mean of 4.13 within a standard deviation of 0.76. According to [21] a significant portion of forecasting literature addresses the role of the individual forecaster in identifying and applying appropriate forecasting models and techniques. Nonetheless, where forecasting management theory is concerned, human involvement is typically viewed from a more macro perspective as one of several organization-level factors impacting an organization's forecasting performance. It was established that much of our forecasting process takes place at an disaggregate level where individual forecasters review and adjust statistical forecasts as shown by a mean of 3.61 and a standard deviation within 0.99. As has been captured in multiple surveys of organizational forecasting techniques and has been repeatedly observed in case studies of business organizations, much of the forecasting process takes place at a disaggregate level where individual forecasters review and adjust statistical forecasts for hundreds, potentially even thousands of stock-keeping units. Further the findings revealed that petroleum marketing companies statistical forecasts are generated by the organization's forecasting software/system and then, if necessary, adjusted by the forecaster based on information not captured as indicated by a mean of 3.13 and a standard deviation within 1.45. According to [22], typically, statistical forecasts are generated by the organization's forecasting software/system and then, if necessary, adjusted by the forecaster based on information not captured in the statistical model. When it comes to supply planning, it is the quality of forecasts at the lower levels of product hierarchies that is most impactful to forecasting performance. It was established that the management techniques are likely to affect the forecaster's scope of responsibility and the complexity of their assigned tasks as shown by a mean of 4.16 and a standard deviation of 1.00. Therefore, management techniques are likely to affect the forecaster's scope of responsibility and the complexity of their assigned tasks.

It was established that the petroleum marketing companies management techniques potentially help guard against the biases and inconsistencies of human judgment that have so often been found to degrade forecast quality as shown by a mean of 4.16 and a standard deviation of 0.92. Management techniques may potentially help guard against the biases and inconsistencies of human judgment that have so often been found to degrade forecast quality. For these reasons, research addressing the effects of management techniques on the forecaster's contribution to the forecasting process is essential in advancing forecasting management theory. Also the respondents reported that forecasting helps their petroleum marketing companies to predict demand, thus we are able to fulfill the customer orders as and when they arise with short lead time and on time as shown by a mean of 3.95 and a standard deviation within 1.36. It can thus be seen that demand forecasting plays a pivotal role in reducing inventory stock outs especially in cases where Just-in-Time or where supplies are done by long Lead time suppliers. These demand forecasts help timing of purchases to ensure they correspond to sales fulfillment time and ensures that these inventories sit in the warehouses for a shorter time and reduce the warehousing cost as well.

6.2 Supply Chain Performance of Petroleum Marketing Companies in Nakuru County, Kenya.

TABLE 2: Descriptive Statistics on Supply Chain Performance

Statements	SA (%)	A (%)	N (%)	D (%)	SD (%)	Mean	Std. Dev
Competition has necessitated us to improve on our service delivery, customer satisfaction, forecasting demand and ensuring that response time is efficient	39.2	48.1	5.1	7.6	0.0	4.51	0.79
Our firm has improved its supply chain flexibility over the last two years	36.7	49.4	5.1	7.6	1.3	4.20	0.87
Our supply chain effectiveness has improved over the last two years as a result of implementation of inventory management techniques	41.8	54.4	3.8	0.0	0.0	4.18	0.92
Our supply chain has reported a positive cost-efficient trend over the last two years.	17.7	38.0	30.4	6.3	7.6	4.02	0.90
Our organization has reported progress towards pre-established goals along the supply chain in the last two years	16.5	48.1	12.7	17.7	5.1	3.93	1.18

This section entails an analysis of the dependent variable (Supply Chain Performance) as shown in Table 2.

As outlined in Table 2, it was established that competition has necessitated Petroleum marketing companies in Nakuru County to improve on their service delivery, customer satisfaction, forecasting demand and ensuring that response time is efficient as shown by 4.51 and a standard deviation of 0.79. According to [23], as the business arena takes a paradigm shift, we are now seeing improvements in supply chain performance where firms are focusing on the overall firm’s supply chain performance other than individual company supply chain performance. Competition has necessitated organizations to improve on their service delivery, customer satisfaction, forecasting demand and ensuring that response time is efficient. The original company boundaries have been broken and the level play ground is the same where functional groups now play a central role in advancing supply chain performance. It was also established that Petroleum marketing companies in Nakuru County have improved their supply chain flexibility over the last two years as shown by a mean of 4.20 and a standard deviation within 0.87. Petroleum marketing companies on the other hand can adopt key performance indicators to measure their supply chain performance. Key performance indicators are a yardstick for tracking progress and also it’s a tool to achieve a goal. Key performance indicators encompass all areas of business which are demand management, supply conversion and delivery.

It was also established that Petroleum marketing companies in Nakuru County have improved supply chain effectiveness has improved over the last two years as a result of implementation of inventory management techniques as shown by a mean of 4.18 and a standard deviation of 0.92. As stated by [24], measures of performance comprise ongoing monitoring and reporting of activities, particularly progress towards pre-established goals along the supply chain. It involves comparing the expected versus the actual performance achievements along the supply chain and introduction of correction measures to deal with the performance variances. It was also established that Petroleum marketing companies in Nakuru County have supply chain has reported a positive cost-efficient trend over the last two years as shown by a mean of 4.02 within a standard deviation of 1.18. The measure of performance depicts the way an organization can monitor its operations and make plans for managing its inventory levels by ensuring that replenishments are done in good time without any delay. These measures go a long way in cutting operational and logistical costs for the organization thus saving time and energy for the management. Further, the findings revealed that Petroleum marketing companies in Nakuru County have reported progress towards pre-established goals along the supply chain in the last two years as shown by a mean of 3.93 and a standard deviation within 1.18. Thus organizations are judged on performance according to their achievements over the years. If an organization has been performing through the years, then its performance is rated favorably.

6.3 Correlation Analysis

The Pearson product-moment correlation coefficient was used to obtain a measure of the strength of association between demand forecasting and supply chain performance as shown in Table 3.

TABLE 3: Demand Forecasting and Supply Chain Performance

		Demand Forecasting
Supply Chain Performance	Pearson Correlation	.285*
	Sig. (2-tailed)	.026
	N	61

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

The correlation analysis results in Table 3 revealed that there was a positive and a significant relationship between demand forecasting and Supply Chain Performance of Petroleum marketing companies in Nakuru County, Kenya as supported by ($r=0.285$, $p=0.026$). This implied that both demand forecasting and supply chain performance move in the same direction. Petroleum marketing companies can thus adopt demand forecasting as a key technique in enhancing their supply chain performance.

6.4 Regression Analysis

The study then carried out a linear regression to establish the influence of demand forecasting on supply chain performance of petroleum marketing companies in Nakuru County, Kenya as shown in Table 4.

TABLE 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.285 ^a	.081	.079	.1826

a. Predictors: (Constant), Demand Forecasting

b. Dependent Variable: Supply Chain Performance

The model summary in Table 4 indicated a linear correlation coefficient R of 0.285 which indicated that the independent variables (Demand Forecasting) had a positive correlation with the dependent variable. The coefficient of determination (R Square) of 0.081 indicated that the independent variable explained 8.1% of the variation in the dependent variable. The regression model was found to be a good fit for data.

In order to establish the influence of the independent variable on the dependent variable, regression analysis coefficients were obtained as shown in Table 5.

TABLE 5: Regression Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	SE	Beta	t	p
Constant	1.655	.368		3.033	.000
Demand Forecasting	.204	.105	.198	1.934	.048

Dependent Variable: Supply Chain Performance

The hypothesis testing was tested by determining the relationship between demand forecasting and supply chain performance using regression analysis findings in Table 5. The test was done at a significant level 0.05. The test results showed that demand forecasting has a statistical positive influence on supply chain performance ($\beta = 0.204$, $\rho = .048 < 0.05$). The result led to the rejection of the null hypothesis, hence a conclusion that there exists a significant influence of demand forecasting on supply chain performance of Petroleum marketing companies in Nakuru County, Kenya. This is consistent with the findings of [25] that demand forecasting has a significant effect supply chain performance.

VII. Conclusion

The study concluded that when it comes to supply planning, it is the quality of forecasts at the lower levels of product hierarchies that is most impactful to forecasting performance. In addition other researchers referred to forecasting as a human activity and advocated that researchers ask questions about the way in which an organization's environment, culture, and process interact with the use of quantitative and qualitative techniques for generating a forecast. Also, it can be concluded from the descriptive results that, much of their forecasting process takes place at a disaggregate level where individual forecasters review and adjust statistical forecasts. As has been captured in multiple surveys of organizational forecasting techniques and has been repeatedly observed in case studies of business organizations, much of the forecasting process takes place at a disaggregate level where individual forecasters review and adjust statistical forecasts for hundreds, potentially even thousands of stock-keeping units. The results revealed that, the management techniques are likely to affect the forecaster's scope of responsibility and the complexity of their assigned tasks. As stated by other scholars management techniques are likely to affect the forecaster's scope of responsibility and the complexity of their assigned tasks. Further, the results revealed that, the petroleum marketing companies management techniques potentially help guard against the biases and inconsistencies of human judgment that have so often been found to degrade forecast quality. Also the respondents reported that forecasting helps their petroleum marketing companies to predict demand, thus we are able to fulfill the customer orders as and when they arise with short lead time and on time. Correlation analysis showed that there was found a positive and a weak association between demand forecasting and supply chain performance of Petroleum marketing companies in Nakuru County, Kenya. Further, it was concluded that there was a statistically significant relationship between demand forecasting and supply chain performance. The study recommends that, when it comes to supply planning, it is the quality of forecasts at the lower levels of product hierarchies that is most impactful to forecasting performance. Also, it can be recommended that, much of the forecasting process should take place at a disaggregate level where individual forecasters review and adjust statistical forecasts.

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