REVERSED BULLWHIP EFFECT ON THE SUPPLY CHAIN PERFORMANCE OF OIL MARKETERS IN KENYA: A CASE OF NAIROBI CITY COUNTY

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ABSTRACT
Reverse bullwhip effect is multifaceted and can occur between the producers and wholesalers, wholesalers and retailers and between retailers and end user customers. With regards to the supply chain elements, influence is reciprocal and behavior is erratic during periods of supply disruption which compound the problem into a chaotic chain. Today the reversed bullwhip effect seems to be the major problem facing firms. 47% of industries studied in the US exhibited bullwhip effect while the remaining 53% the reverse bullwhip effect. The purpose of the study was to investigate the effect of reversed bullwhip effect on the supply chain performance of oil marketers in Kenya. The target population in this study was 100 oil marketers in Nairobi City County. Therefore all the 100 oil marketers in Nairobi City County formed the unit of analysis. The unit of observation was 100 supply chain managers from the oil marketing companies. Descriptive statistics such as, mean and frequencies and inferential statistics (regression and correlation analysis) were used to perform data analysis. A multiple linear regression analysis model was used to test the hypotheses and link the variables. The study findings showed that storage capacity, internal processes, information flow and equipment availability had a positive and significant effect on supply chain performance. The study recommended that since storage capacity, equipment availability and internal processes positively affect their supply chain performance, they should invest more to improve the storage capacities so as to have space for buffer stocks, they should also invest more in acquiring more equipment such as tankers so as to manage the distribution lead times and also invest more in improving their internal processes including allocating more funds for outsourcing services so as to manage huge demands.

Key words: Storage capacity, Equipment availability, Internal processes, Information flow, Supply Chain Performance
Background of the study

Bullwhip effect which is an observed phenomenon in forecast driven distribution channels is a critical issue in supply chain (Costantino, Di Gravio, Shaban & Tronci, 2013). Since the supply chains patterns do not match the demand patterns, inventory accumulates at various stages for customers demand are rarely perfect stable, business must forecast demand in order to properly position inventory and other resources (Trapero, Kourentzes & Fildes, 2012).

Variability coupled with time delays in manufacturing, shipping goods down the supply chain create the bullwhip effect. Forecasts are based on statistics and they are rarely perfectly accurate. Because forecasts error are given company often carry an inventory buffer called safety stocks (DiGravio, Shaban, & Tronci, 2015). Moving up the supply chain from end consumer to raw materials supplier, each supply chain participant has greater observed variation in demand and thus greater need for safety stocks, in periods of rising demand downstream participants will increase their orders, in period of falling demand orders will fall or stop in order to reduce inventory. The effect is that variations are amplified as one moves upstream in the supply chain (further from the customer) As a consequence, the systematic profitability of a supply chain is seriously affected. Correspondingly, the functional coordination of a supply chain may no longer exist due to such inappropriate interactions of supply-demand information flows between chain members. There are many studies on the bullwhip effect. An effort to quantify the bullwhip effect has been undertaken by a few researchers (Trapero et al., .2012)

Reverse bullwhip effect refers to the variability of supply downstream the supply chain thereby depicting inadequate supply in the face of adequate demand. Reverse bullwhip effect is multifaceted and can occur between the producers and wholesalers, wholesalers and retailers and between retailers and end user customers. With regards to the supply chain elements, influence is reciprocal and behavior is erratic during periods of supply disruption which compound the problem into a chaotic chain (Ferrantino et al., .2014).However with regards to the supply chain facilities, variability’s are localized but the impacts are system wide. As firms successfully streamline their operations, the next opportunity for improvement is better coordination with suppliers and customers in order to receive or get their products to end users within the place, time and form of need. Mehta (2009) notes that this depends on complex tasks that require several companies working together as a supply chain or network to eliminate all supply chain inefficiencies. In attempting to effectively coordinate the supply activities, firms are faced with intermittent supplies, mutating consumer tastes and preferences, advancements in technology and a threatening competition.

According to Thirikawala (2011), as supply chains become more global, supply uncertainty becomes a more striking issue. Vilko & Hallikas (2011) observe that while pipelines are one of the safest modes of transporting bulk energy and have failure rates much lower than railroads or highway transportation, failures do occur and sometimes with catastrophic consequences.Bhattacharyya et al., (2009), apply a control theoretical approach to bullwhip effect quantification. The bullwhip effect relates to the order placed to maintain the inventory levels. Both the inventory variance and bullwhip directly affect the economics of scenario (Mehta, 2009). The higher the variance of inventory levels, the more stock will be needed to maintain customer service at the target level (Canbolat, Gupta, Matera & Chelst, 2008).
Statement of the Problem

An ideal supply chain management should eliminate variabilities in stocks at end sale points and supply points (Steward, Wu & Hartley, 2010). Companies are trying to reduce these variabilities by employing different operations strategies to match demand forecasts with production. Success has been varied as this variability continues with shifting manifestations, at one point the variability is upstream and at the other point, the variability is downstream in the supply chain. This poses multiple challenges on the supply chain strategy. Variability of demand upstream has been described as bullwhip effect (Fransoo & Wouters, 2009), while variability of supply downstream is what has been described as reversed bullwhip effect (Lee et al., 2009).

Initially the problem that companies faced was the bullwhip effect which is variation in demand and goods produced for stocking in large warehouses, in the modern day, the reversed bullwhip effect seems to be the major problem facing firms. Cachon et al. (2007) confirmed that only 47% of industries studied in the US exhibited bullwhip effect while the remaining 53% the reverse bullwhip effect. In Kenya, PIEA (2016) report indicated that there has been an increase in demand of oil which exceeds the supply capacity. This led to the amendment of the Income Tax Act to include petroleum storage and distribution facilities as structures qualifying for investment deductions thereby encouraging investment in them.

The PIEA (2016) report further indicated that the problem of fuel adulteration in Kenya remains a challenge where complains on the quality of products received is questionable. It is argued that the global fall in oil price has led to looming unscheduled supply outages among the exploration and production companies and Oil Marketing Companies (OMCs). The OMCs have continued to revise their strategic and operational plans in order to cope with the situation (PIEA, 2016). In the oil industry in Kenya, shortage of fuel has seen inflation rising and destabilizing the economy.

The reverse bullwhip effect is a problem that needs attention since the nature of current competition has seen the emergence of a new business model where the focus of competition has shifted from between organizations within a supply chain to between the supply chains themselves (Barua, 2010). The concept of reverse bullwhip has also not been given much focus. Since scholars like Barua (2010) argue that the reverse bullwhip effect is a problem that needs attention, and with few studies focusing on the topic, the current study sought to fill this conceptual knowledge gap by assessing the effect of reversed bullwhip effect on the supply chain performance of oil marketers in Nairobi City County, Kenya.

Research Objectives

i. To establish the effect of storage capacity on supply chain performance of oil marketers in Nairobi City County.
ii. To examine the effect of equipment availability on supply chain performance of oil marketers in Nairobi City County
iii. To determine the effect of information flow on supply chain performance of oil marketers in Nairobi City County.
iv. To find out the effect of internal processes on supply chain performance of oil marketers in Nairobi City County
LITERATURE REVIEW

Supply Chain Operations Reference (SCOR)

According to Council, Supply Chain Operations Reference (2010), the Supply Chain Operations Reference (SCOR) model provides a unique framework that links performance metrics, processes, best practices, and people into a unified structure (Council, S. C. Supply Chain Operations Reference, 2010). The SCOR model helps refine strategy, define structure (including human capital), manage processes, and measure performance (Srai & Gregory, 2008). Economic cycles, whether markets are growing or contracting, always force organizations to take an intense look at their supply chains, question their assumptions, root out inefficiencies, and plan for growth (Espallardo et al., 2010). Such analysis and restructuring are an ongoing requirement for effective supply chain management (SCOR, 2010). SCOR metrics provide the basis for an organization to measure how successful it is in achieving its desired objectives SCC (2012). SCOR metrics are designed to be used in conjunction with supply chain performance attributes, making it easier to compare different supply chains and different supply chain strategies (Mikael, 2014).

Economic Order Quantity (EOQ)

Economic order quantity (EOQ) developed by Ford Harris in 1913 is an inventory management model that aims at minimizing total inventory holding costs and ordering costs. The Economic Order Quantity model of inventory management is used to mark the optimum size of delivery and to choose the cheapest deliverer which guarantees minimization of total costs of investments in inventories (Chambers & Lacey, 2011). A larger order quantity reduces ordering frequency and hence ordering cost, but requires holding a larger average inventory, which increases holding costs. On the other hand, a smaller order-quantity reduces average inventory, but requires more frequent ordering and higher ordering costs. The implication of EOQ is that it minimizes storage and holding costs. The model suggests buying a larger quantity in fewer orders to take advantage of bulk buying and minimize ordering costs. It smooths out the restocking process and results in better customer service as inventory is available when needed. The model requires continuous monitoring of inventory levels. Its effectiveness is limited by assumption of one product business and the model does not allow combination of several products in the same order (Pandey, 2006).

System Theory of Logistics

The theory was proposed by Professor Rainer Stank of the Michigan State University. He believed that organization is the integration of logistical related activities that are working together to achieve lowest total costs and optimum service level as opposed to managing discrete functions individually for the lowest costs (Harrington, 2002). Logistics scholars endorsed the relationship of logistics management to the firm logistics capabilities that is determined by the dynamics logistics capabilities (Rushton et al., 2006). Abrahamson & Mat (2011) argued that extending the Resourced Based View (RBV) to the dynamics capabilities, the firm performance is linked to the dynamic logistics capabilities that is also defined by the operational capabilities. According to (Barnley & Clark, 2007 and Abrahamson & Mat, 2011), capabilities must meet the essential condition of rare, valuable, inimitability and organizational in order to offer sustainable competitive advantage. Abrahamson& Mat (2011) found out that logistics must be created from the firm’s unique set of operational and dynamic capabilities, and the two must be combined and be used to attain the firm superior performance.
Kaizen Management Theory

Kaizen is a Japanese word meaning continuous improvement. It's made up of two characters in Japanese: kai, which means 'change,' and zen, which means 'good.' It's used to describe a company culture where everyone, from the CEO to the front desk clerk, regularly evaluates his or her work and thinks of ways to improve it (Fu & Zhu, 2010). The concept is that small steps on a regular basis will lead to large improvements over time. Kaizen is a slow but ongoing process of improvement, not a 'blitz' or quickly implemented set of changes. The improvements are suggested by the person doing the work, not an outside evaluation team (Russell & Taylor-Iii, 2008). If a worker has a problem to address or is considering whether a change will make sense, he should pull in several team members for a quick discussion and brainstorming session, and then decide what to do from there (Ferrier, 2013). Kaizen management has been applied in supply chains of oil marketing companies since it is important that supplies management is trained and be behind the effort. Kaizen will result in many more suggestions for improvements and changes and will take away from a rigid focus on moving items quickly through the existing production process. Supplies management must be ready to accept some time away from current work to focus on changes with longer-range impact (Ciancimino, et al. 2012).

Empirical Literature Review

Otieno et al. (2012) conducted a study on factors causing reversed bullwhip effect on the supply chains of Kenyan firms. The findings suggested that capacity constraint was the major factor contributing to supply chain inefficiency. The conclusion was that the supply chain was inefficient because of capacity challenges and government intervention. According to Kimani (2013), study on supply chain management challenges in Kenya petroleum industry findings that Kenya’s petroleum industry faces supply chain challenges such as lack of strategic stocks, relatively high petroleum prices compared to other East African countries, frequent fuel shortages, sub-standard products and diversion of products destined for export back into the country. The study explored challenges facing implementation of effective supply chain management practices in petroleum industry in Kenya, a case of National Oil Corporation. On lead time variability, Niosi & Zhengu (2010) found that supply fluctuation was due to capacity adjustment lead time, production lead time, order processing delay and order wait time. Clifford, Williams, Randall and Thomas (2010) observe 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.

Rodman (2004) explored the use of SCM techniques to overcome barriers encountered by logistics management during humanitarian relief operations. Using grounded theory methodology, he analyzed barriers based on academic, organizational and contemporary literature. Rodman also identified possible solutions to the barriers identified from available SCM literature. Rodman (2004) works married supply chain principles from different disciplines including private, non-profit and military sectors with an aim of benefiting humanitarian operations. The challenges identified by Rodman as facing humanitarian operations included uncertainty, degraded infrastructure, communications, human resources and earmarking of funds. The results of the study put forth a framework of SCM solutions for overcoming logistics difficulties during relief operations and explain why managers should consider their use.
Conceptual Framework

Storage capacity
- Downstream capacity
- Upstream capacity
- Dispensation capacity

Equipment availability
- Distribution facilities
- Storage facilities
- Production facilities

Supply chain performance
- Better Quality
- Reduced Lead time
- Reduced Cost

Information flow
- Speed
- Reliability
- Consistency

Internal processes
- Policies
- Procedures
- Work schedules

Independent Variables
Dependent variable

Figure 1: Conceptual Frame work

RESEARCH METHODOLOGY
The study adopted a descriptive survey design. The study employed a descriptive survey design and was based on a survey of oil marketers in Nairobi City County. Descriptive survey design was because it focused on complex analysis to bring out the correlation of variables. It was a survey because all the 100 oil marketers were surveyed (Olusola et al, 2013). The population of the study comprised the oil marketers companies in Nairobi City County. According to the Petroleum Institute of East Africa report 2015, the number of oil marketers licensed by PIEA was 100. A
questionnaire was used to collect primary data. Descriptive analysis was employed; which include; mean standard deviations and frequencies/percentages. Inferential statistics such as correlation and regression analysis was also used. A multiple linear regression model was used to test the significance of the influence of the independent variables on the dependent variable. The multiple regression model used is as laid below.

\[ Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon \]

Where: \( Y \) = Supply chain performance, \( X_1 \) = Storage Capacity, \( X_2 \) = Equipment availability, \( X_3 \) = Internal processes, \( X_4 \) = Information flow, \( \varepsilon \) is error term, \( \beta_0 \) represents the constant, \( \beta_{1,2,3,4} \) are regression coefficients

RESEARCH FINDINGS AND DISCUSSIONS

Response rate

The number of questionnaires that were administered was 100. A total of 87 questionnaires were properly filled and returned. This represented an overall successful response rate of 87% as shown on Figure 2. Finchman (2008) argues that a response return rate of more than 60% is enough for the study to continue. This response rate was, therefore considered representative of the respondents to provide information for analysis and deemed acceptable for making statistical inferences. A response rate of 87% was hence very good for the study. The high response rate was achieved because the method of drop and pick was effective. The respondents who were busy were given more time to respond to the questionnaire before they were picked. Furthermore, the researcher conducted a follow up through emails. Those who were not able to respond to the hard copy questionnaire did so on email.

![Figure 2 Response Rate](chart.png)

Demographics Analysis

Respondent’s Gender

The study sought to establish the respondent’s gender. Results on Figure 3 shows that majority of the respondents, 63%, were male while 37% were female. The results indicate that majority of the supply chain managers among the Oil Marketing companies are male. The findings indicate that the Oil marketing companies have complied with the constitutional requirements of employing a third of the work force to be female (Kenyan Constitution, 2010).
The respondents were asked to indicate their level of education. Figure 4 shows that 62% of the respondents indicated to have University level of education, 12% had post graduate level of education and 26% had college level of education. The findings imply that supply chain managers in the Oil and marketing companies have intellectual capacity. This shows that they could interpret the questions in the questionnaires well and respond accordingly. This enhances the reliability of the data collected. Bashir & Durrani (2014) relates high educational level to high understanding and easy comprehending of ideas and information.

The respondents were asked to indicate the number of years they had worked in their current position of supply chain manager. Figure 5 shows that those who had worked as supply chain managers for a period between 3 and 5 years were 48 out of 87, those who had worked for a period over 5 years was 26 out of 87 while those who had worked as supply chain managers for less than two years were 26 in total. The results indicate that majority of the supply chain managers had a work experience of over three years. This contributed greatly to their institutional understanding and was hence appropriate for the study because they had understanding of the oil sector operations. This is in line with Ondari (2015) who links high work experience to more information about the industry as well as more awareness and knowledge.
Figure 5 Duration in the current position

Respondents Age

The respondents were asked to indicate their age bracket. The findings shows that 43% of the respondents were between 41-50 years of age, 35% were between 31-40 years and 14% were 51 years and above. Only 8% were below 30 years of age. The findings mean that majority of supply chain managers in the oil marketing companies are aged over 31 years and this correspondent to the high work experience indicated in Figure 6. This confirms argument by Bowen & Staudinger (2012) that promotions to senior positions is directly linked to age.

Figure 6 Respondents Age

Storage Capacity

The study sought to find out the extent to which the respondents agreed or disagreed with the statements regarding storage capacity. A Likert scale ranging from 1 = Strongly Disagree, 2 = Disagree, 3 = Moderately Agree, 4 = Agree and 5 = Strongly Agree was used. The summary mean responses are as shown in Table 4.2. The results indicated that majority of the respondents agreed that they experience shortage of storage equipment (Mean = 4.59), the major causes of oil shortages in is breakdown of tankers (Mean = 4.68) and also indicated that their company is faced with full utilization of the storage capacity (Mean = 3.47). Furthermore, the findings showed that the respondents moderately agreed that upstream capacity is always a major challenge in their firm (Mean = 3.32) and that downstream capacity is always a major challenge in their firm (Mean = 3.47). On average, the results showed that majority of the respondents agreed with statements on storage capacity (Mean = 3.91). The findings are consistent with the findings of a study by Kimani (2013) on supply chain management challenges in Kenya petroleum industry and indicated that among the main supply chain challenges were lack of strategic stocks due to limited storage
capacity, frequent fuel shortages, sub-standard products and diversion of products destined for export back into the country.

**Table 1 Storage Capacity**

<table>
<thead>
<tr>
<th>Statements</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our company experience shortage of storage equipment</td>
<td>4.59</td>
<td>0.81</td>
</tr>
<tr>
<td>The major causes of oil shortages in the our company is breakdown of tankers</td>
<td>4.68</td>
<td>0.51</td>
</tr>
<tr>
<td>Our company is faced with full utilization of the storage capacity</td>
<td>3.47</td>
<td>1.07</td>
</tr>
<tr>
<td>Upstream capacity is always a major challenge in our firm</td>
<td>3.32</td>
<td>1.15</td>
</tr>
<tr>
<td>Downstream capacity is always a major challenge in our firm</td>
<td>3.47</td>
<td>1.07</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>3.91</strong></td>
<td><strong>0.92</strong></td>
</tr>
</tbody>
</table>

The study further asked the respondents to indicate the quantity of inventory (In percentage) which could be accommodated by the available storage capacity for the last three years. Trend analysis was established as indicated in Figure 7. The findings implied that the quantity of inventory accommodated has been increasing from between 20-50% in 2014 and 2015 to over 50% in 2016. This is an indication of investment in expanding the storage capacity. It is also an indication of realization of a challenge in storage capacity. These findings agree with (Hung, 2010) who observed that the reversed bullwhip effect is caused by factors such capacity issues and that facilities with mass production are responsive to supply variability while customization platforms are prone to longer production lead times.

![Figure 7 Quantity of Inventory accommodated](image)

**Figure 7 Quantity of Inventory accommodated**

**Equipment availability**

The study sought to find out the level of respondents satisfaction on statements regarding equipment availability. A five point Likert scale ranging from 1-Not Satisfied, 2-Slightly satisfied, 3-Neutral, 4-Satisfied and 5-Very Satisfied used. The summary mean responses are as shown in Table 2. The findings showed majority of the respondents were satisfied with the presence of relevant distribution infrastructure (Mean = 3.97) and relevance of supply chain production infrastructure to the County Government (Mean = 4.10). The findings also showed that majority of the respondents were neutral on their level of satisfaction regarding the condition of supply chain storage infrastructure (Mean = 3.44), complexity of supply chain infrastructure (Mean = 3.33) and the use of supply chain infrastructure (Mean = 3.48). On average, majority of the
respondents agreed on the statements on equipment availability (Mean = 3.66). The findings are consistent with the argument by Nyamu (2012) who indicated that a company's existing supply chain infrastructure is an important determinant of supply chain performance and that it’s the primary cause of daily disruptions and short-term challenges. The findings agree with Shah, Li & Ierapetritou (2011) who indicated that those companies that experience the smoothest and most profitable operations are the ones that routinely re-evaluate both operations and infrastructure of their supply chains.

Table 2 Equipment availability

<table>
<thead>
<tr>
<th>Statements</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of relevant distribution infrastructure</td>
<td>3.97</td>
<td>1.32</td>
</tr>
<tr>
<td>Condition of supply chain storage infrastructure</td>
<td>3.44</td>
<td>1.51</td>
</tr>
<tr>
<td>Relevance of supply chain production infrastructure to the County Government</td>
<td>4.10</td>
<td>1.33</td>
</tr>
<tr>
<td>Complexity of supply chain infrastructure</td>
<td>3.33</td>
<td>1.38</td>
</tr>
<tr>
<td>Use of supply chain infrastructure</td>
<td>3.48</td>
<td>1.14</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>3.66</strong></td>
<td><strong>1.33</strong></td>
</tr>
</tbody>
</table>

The study further asked the respondents to indicate the approximate budget set aside for procuring Equipment for the last three years. Trend analysis was established as indicated in Figure 8. The results indicate that the budget set aside for procuring of equipment has been gradually increasing from between 500,000 and 1 Million in the year 2014 and 2015 to over one million in the year 2016. This indicates that the companies recognize the need to invest more in equipment as they consider equipment availability as an important determinant of supply chain performance. The ones which reevaluate as a matter of procedure tend to become supply chain and profitability leaders. The results also agree with Nyamu (2012) that recurring evaluation of infrastructure should be considered a necessity since adverse events may happen due to constrained infrastructure.

![Figure 8 Approximate budget set aside for procuring Equipment](image)

**Figure 8 Approximate budget set aside for procuring Equipment**

**Internal processes**

The study sought to find out the level to which the respondents agreed or disagreed with the statements regarding internal processes. A Likert scale ranging from 1 = Strongly Disagree, 2 =
Disagree, 3 = Moderately Agree, 4 = Agree and 5 = Strongly Agree was used. The summary mean responses are as shown in Table 3. The findings indicated that the respondents agreed that there is well stipulated policies in their company regarding distribution of oil (Mean = 3.99), the company has an elaborate supply chain work schedule (Mean = 4.43) and that the company has a flexible price list of the oil products (Mean = 3.71). The results also showed that majority of the respondents agreed that the company has competent staff who monitor on demand and supply of the oil products (Mean = 3.94). On average, majority of the respondents agreed on statements on internal processes (Mean = 4.02). The results are consistent with Awino (2009) who indicated that some of the critical internal processes factors included operating policies, linkages within supply chain firms, improved performance, information technology systems, strategic alliance, performance measures, goal orientation, customer relationships, guidelines and procedures, supplier selection and supplier evaluation (Awino, 2009).

Table 3 Internal Processes

<table>
<thead>
<tr>
<th>Statements</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is well stipulated policies in our company regarding to distribution of oil</td>
<td>3.99</td>
<td>1.22</td>
</tr>
<tr>
<td>Our company has an elaborate supply chain work schedule</td>
<td>4.43</td>
<td>0.95</td>
</tr>
<tr>
<td>Our company has a flexible price list of the oil products</td>
<td>3.71</td>
<td>1.06</td>
</tr>
<tr>
<td>Our company has a competent staff who monitor on demand and supply of the oil products</td>
<td>3.94</td>
<td>1.21</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>4.02</strong></td>
<td><strong>1.11</strong></td>
</tr>
</tbody>
</table>

The study further asked the respondents to indicate the approximate budget set aside for updating internal processes. Trend analysis was established as indicated in Figure 9. The results indicated that there is realization of the benefit of investing in internal processes as indicated by an increasing expenditure of less than 500,000 in the year 2014 to between 500,000 and 1 million in the year 2015 and 2016. This indicates that oil marketing companies have realized the importance of internal processes to supply chain performance and are continually increasing the budgetary allocations to internal processes in order to turn around the supply chain situation. The findings agree with the findings of a study by Sean (2013) which stated that supply chain challenges such as supply disruptions can be minimized by reducing the risk on the supply chain through investing more in internal processes such as outsourcing the delivery function to a third party who recruits and manages their own drivers and fleet of vehicles.
Figure 9 Approximate budget set aside for updating internal processes

Information Flow

The study sought to find out the level to which the respondents agreed or disagreed with the statements regarding information flow. A Likert scale ranging from 1 = Strongly Disagree, 2 = Disagree, 3 = Moderately Agree, 4 = Agree and 5 = Strongly Agree was used. The summary mean responses are as shown in Table 4. The findings indicate that the respondents agreed that the company has a reliable communication system (Mean = 4.44), the company respond to the customers’ orders within the reason time (Mean = 4.36) and that the company ensures that there is a consistent flow of information (Mean = 4.17). The findings also showed that the respondents agreed that managing the information flow is the most critical of oil supplies activities (Mean = 4.15). On average majority of the respondents agreed on the statements on information flow (Mean = 4.28). The findings agree with arguments by Ketikidis, Koh, Dimitriadis, Gunasekaran and Kehajova (2008); Lalwani et al (2011); Sodhi, et al, (2011), that managing the information flows is the most critical of supply chain management activities and that internal IT systems such as ERP, distribution resource planning, capacity planning systems as well as other tools such as RFID, barcodes, and EDI platforms that are used in supply chain transactions to enhance processing and communication are important in supply chain management.

Table 4 Information Flow

<table>
<thead>
<tr>
<th>Statements</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our company has a reliable communication system</td>
<td>4.44</td>
<td>0.84</td>
</tr>
<tr>
<td>Our company respond to the customers’ orders within the reason time</td>
<td>4.36</td>
<td>1.10</td>
</tr>
<tr>
<td>Our company ensures that there is a consistent flow of information</td>
<td>4.17</td>
<td>1.10</td>
</tr>
<tr>
<td>Managing the information flows is the most critical of oil supplies activities</td>
<td>4.15</td>
<td>1.05</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>4.28</strong></td>
<td><strong>1.02</strong></td>
</tr>
</tbody>
</table>

The study further asked the respondents to indicate the approximate budget set aside for maintaining information systems for the last 3 years. Trend analysis was established as indicated in Figure 10. The results indicate increasing trends on the budget set aside for maintaining information systems. Even though the amount has been gradually increasing, it has remained in the tune of less than 500,000 since the year 2014 to 2016. The findings indicate that investment in the maintenance of information system has not been given a priority by the oil marketing companies in Kenya even though allocations have been gradually increasing. The findings are thus not consistent with the findings of a study by Linzalone (2008) who indicated that communication is a significant determinant of supply chain performance and that there is a need to improve the communication structure to enhance easy flow of information.
Supply Chain Performance

The study sought to find out the number of days by which lead time has decreased with for the last three years. Trend analysis was established as indicated in Figure 4.10. The results indicate that there has decreasing trends in the lead time in terms of the number of days taken between ordering and supply of oil products from the producers as well as to the consumers. It decreased from between 30 and 100 days in the year 2014 and 2015, to less than 30 days in 2016.

Figure 11 Change in Lead time

The study also sought to establish the percentage decrease in operation cost for the last three years. Trend analysis was established from the respondent’s responses as indicated in Figure 4.11. The results indicate decreasing trends in the rate of decrease of operation costs. The huge percentage decrease has remained to be less than 25% from the year 2014 to the year 2016 even though the magnitude varies.
Figure 12 Percentage change in cost of operation

The respondents were also asked to indicate the extent to which they agreed or disagreed with the statements regarding supply chain performance on a scale of 1 to 5. The mean responses are as indicated in Table 5. The results indicate that the respondents indicated that the quality of products has improved over the years (Mean = 4.59), there has been a decrease in lead time over the years (Mean = 4.72) and that there has been a decrease in procurement costs over the years (Mean = 4.79). On average the respondents agreed on statements on supply chain performance (Mean = 4.70).

Table 5 Supply chain performance

<table>
<thead>
<tr>
<th>Statements</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>The quality of products has improved over the years</td>
<td>4.59</td>
<td>0.81</td>
</tr>
<tr>
<td>There has been a decrease in lead time over the years</td>
<td>4.72</td>
<td>0.49</td>
</tr>
<tr>
<td>There has been a decrease in procurement costs over the years</td>
<td>4.79</td>
<td>0.41</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>4.70</strong></td>
<td>0.57</td>
</tr>
</tbody>
</table>

Correlation analysis

The findings showed that storage capacity has a positive and significant correlation with supply chain performance ($r = 0.425$, sig $< .05$). This shows that improving the storage capacity leads to an improvement in supply chain performance. The findings are consistent with the findings of a study by Zhu, Dou & Sarkis (2010) who argued that factors such as the most efficient use of resources as well as enhancing storage and distribution capacity improves supply chain performance significantly. The findings also showed that equipment availability has a positive and significant correlation with supply chain performance ($r = 0.385$, sig $< .05$). This shows that increasing the equipment leads to an improvement in supply chain performance. The findings are consistent with the findings of a study by Niosi & Zhegu (2010) who found that supply fluctuation was due to equipment available, capacity adjustment lead time and production lead time caused by ineffective equipment. The results also indicated that internal processes has a positive and significant correlation with supply chain performance ($r = 0.302$, sig $< .05$).
This shows that improving the internal processes leads to an improvement in supply chain performance. The results agree with the findings of a study by Awino (2009) conducted on an empirical investigation of supply chain management best practices and indicated significant effect of internal processes such as strategic fit of an organization’s core competencies, strategy and core capability on supply chain performance. The correlation findings lastly showed that information flow has a positive and significant correlation with supply chain performance ($r = 0.300$, sig < .05). This shows that improving the information flow between the company and its suppliers leads to an improvement in supply chain performance.

**Table 6 Correlation analysis**

<table>
<thead>
<tr>
<th>Correlations</th>
<th>Storage capacity</th>
<th>Equipment availability</th>
<th>Internal processes</th>
<th>Information flow</th>
<th>Supply Chain performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage capacity</td>
<td>Pearson Correlation 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment availability</td>
<td>Pearson Correlation 0.004</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.97</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal processes</td>
<td>Pearson Correlation 0.082</td>
<td>-0.126</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.448</td>
<td>0.243</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information flow</td>
<td>Pearson Correlation -0.185</td>
<td>-0.287**</td>
<td>-0.204</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.086</td>
<td>0.007</td>
<td>0.058</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply Chain performance</td>
<td>Pearson Correlation .425**</td>
<td>.385**</td>
<td>.302**</td>
<td>.300**</td>
<td>1</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.004</td>
<td>0.005</td>
<td></td>
</tr>
</tbody>
</table>

**Correlation is significant at the .01 level (2-tailed).**

**Regression analysis**

The study used a regression analysis to test the effect of the four independent variables that is storage capacity, Equipment availability, internal processes and information flow on supply chain performance.

**Table 7 Model Summary**

<table>
<thead>
<tr>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>.656</td>
<td>0.631</td>
<td>0.403</td>
<td>0.208742</td>
</tr>
</tbody>
</table>

The regression results show that storage capacity, Equipment availability, internal processes and information flow jointly have a positive correlation with supply chain performance ($R = 0.656$).
This implies that an improvement in the four variables jointly, has a positive effect on supply chain performance. The findings also presented the coefficient of determination (R-square). Generally, a higher value of R-Square means that you can better predict one term from another. 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 (supply chain performance) that is explained by all the four independent variables that is storage capacity, Equipment availability, internal processes and information flow.

From the findings 63.1% of the supply chain performance of oil marketing companies is attributed to combination of the four factors (storage capacity, Equipment availability, internal processes and information flow) investigated in this survey at 5% level of significance. This implies that the remaining 36.9% of supply chain performance of oil marketing companies is attributed to other factors not investigated in this survey; therefore, further research should be conducted to investigate them. The study also conducted an Analysis of Variance to establish the model fitness. The results are presented in Table 8.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>2.703</td>
<td>4</td>
<td>0.676</td>
<td>15.508</td>
<td>0.000</td>
</tr>
<tr>
<td>Residual</td>
<td>3.573</td>
<td>82</td>
<td>0.044</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>6.276</td>
<td>86</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The ANOVA Table shows that the test for the joint significant which is given by the F statistic is 15.508 and as observed in table 4.9, it is statistically significant (0.000 which is Less than .05) at 5 percent level of significance. This implies that storage capacity, Equipment availability, internal processes and information flow significantly predict supply chain performance of oil marketing companies. The ANOVA statistics at 5% level of significance shows that the value of F calculated (F computed) is 15.508 and the value of F critical (F tabulated) at 4 degrees of freedom and 82 degrees of freedom at 5% level of significance is 2.483. Since F calculated (F computed) is greater than the F critical (F tabulated) (15.508 > 2.483), this shows that the overall model was significant at 5% significance level. This therefore reveals that the regression model developed is statistically significant and the variation in the results is insignificant that cannot result to a much difference in case of a change in the study units (population) and therefore the model can be relied upon to explain the effect of reverse bullwhip on supply chain performance of oil marketing companies. The findings agree with Otieno et al. (2012) that capacity adjustment strategies, equipment upgrade, additional man and machine hours, reliable source of power and a non-disruptive government intervention significantly affect supply chain performance. The model coefficients were lastly established as indicated in Table 4.10.

<table>
<thead>
<tr>
<th>Predictor variables</th>
<th>B</th>
<th>Std. Error</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>3.474</td>
<td>0.275</td>
<td>12.627</td>
<td>0.000**</td>
</tr>
<tr>
<td>Storage capacity</td>
<td>0.162</td>
<td>0.035</td>
<td>4.575</td>
<td>0.000**</td>
</tr>
<tr>
<td>Equipment availability</td>
<td>0.202</td>
<td>0.022</td>
<td>4.607</td>
<td>0.000**</td>
</tr>
<tr>
<td>Internal processes</td>
<td>0.391</td>
<td>0.025</td>
<td>3.592</td>
<td>0.001**</td>
</tr>
<tr>
<td>Information flow</td>
<td>0.215</td>
<td>0.030</td>
<td>2.510</td>
<td>0.012**</td>
</tr>
</tbody>
</table>
Optimal Model

Supply chain performance = 3.474 + 0.391 (Internal processes) + 0.215 (Internal processes) + 0.202 (Equipment availability) + 0.162 (Storage Capacity)

The data findings analyzed shows that taking all other independent variables at zero, a unit increase in storage capacity will lead to a 0.162 unit increase in supply chain performance; a unit increase in equipment availability will lead to a 0.202 unit increase in supply chain performance; a unit increase in internal processes will lead to a 0.391 unit increase in supply chain performance and a unit increase in information flow will lead to a 0.215 unit increase in supply chain performance. These factors have a significant effect on supply chain performance since their significance level was significant (less than 0.05).

The results imply that storage capacity positively and significantly affects supply chain performance. An increase in storage capacity through investment in expansion of the storage capacity in terms of warehouses leads to a significant improvement in supply chain performance. The findings of the study are consistent with the findings of a study by Otieno et al. (2012) conducted a study on factors causing reversed bullwhip effect on the supply chains of Kenyan firms and suggested that capacity constraint was the major factor significantly contributing to supply chain inefficiency and that a improvement in storage capacity improves supply chain efficiency. The results further implied that equipment availability positively and significantly affects supply chain performance. The findings imply investing more to increase the equipment leads to an improvement in supply chain performance significantly. The results agree with an argument by Shah et al. (2011). Internal processes also positively and significantly affect supply chain performance. This shows that investing more in internal processes improves supply chain performance significantly. The findings are consistent with the argument by Shah et al (2011) who argued that investing more in internal processes for instance improving quantity threshold has a double impact on supply chain and can encourage or discourage reverse bullwhip effect. Information flow also positively and significantly affects supply chain performance.

Conclusions

The results led to the conclusion that the effect of internal processes on supply chain performance is positive and significant implying that investing more in internal processes improves supply chain performance significantly. This implies that an improvement in policies regarding distribution of oil among most of the oil marketing companies, having an elaborate supply chain work schedule, a flexible price list of the oil products and competent staff who monitor on demand and supply of the oil products leads to an improvement in supply chain performance. The study further concluded that information flow has a positive but not significant effect on supply chain performance. This implies that when the oil marketing companies have a reliable communication system, respond to the customers’ orders within the reason time and ensure that there is a consistent flow of information, it leads to better supply chain performance.
Recommendations of the study

To the oil marketing companies, the study recommended that since storage capacity, equipment availability and internal processes positively affect their supply chain performance, they should invest more to improve the storage capacities so as to have space for buffer stocks, they should also invest more in acquiring more equipment such as tankers so as to manage the distribution lead times and also invest more in improving their internal processes including allocating more funds for outsourcing services so as to manage huge demands. To policy makers such as ERC and PIEA, the study recommends that they should make strict requirements in terms of the threshold regarding the equipment the oil marketing companies should have, as well as fully functional storage capacities like warehouses and information flow structures so as to be able to have fully vetted and capable oil marketing companies to handle the reverse bullwhip effect. To the oil suppliers, the study recommends that they should consider storage facilities, equipment, internal processes and information flow as important determinants of supply chain performance and hence invest more in them to be able to handle the demand variation in response to changing customer orders or demand.

REFERENCES


