INFLUENCE OF DISTRIBUTION CONTROL SYSTEMS ON PERFORMANCE OF MANUFACTURING FIRMS IN KENYA

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ABSTRACT
This study sought to establish influence of distribution control systems on performance of manufacturing firms in Kenya. Increasing competitive pressures are forcing companies to increase their rates of innovation. Without proper management, increasing product turnover will increase design and manufacturing costs. This study employed a descriptive survey research design to accomplish its goals since it has enough provision for the protection of bias and maximized reliability. The target population comprised of managers in manufacturing firms that are members of the Kenya Association of Manufacturers (KAM). KAM therefore provided the sampling frame for this study. As at 2017, KAM had a membership of 903 manufacturing firms. A sample of 90 respondents was drawn from this population. Primary data was collected using a semi-structured questionnaire which was self-administered. Data obtained was processed and analysed using descriptive and inferential statistics. The results of the data analysis were presented in charts and tables. The study revealed that distribution control systems account for 18.4% of change in performance in manufacturing firms in Kenya. Distribution control systems as an element of multi-echelon distribution system had a significance impact on performance of manufacturing firms in Kenya. The study concluded that distribution control systems significantly influence performance in manufacturing firms in Kenya. This study recommends that manufacturing firms in Kenya should employ aspects of distribution control systems as it is one of the most important elements of multi-echelon distribution system. These include technology, collaborative models and avoiding stock-outs.

Keywords: manufacturing, performance, distribution control systems, multi-echelon, firm, technology.
INTRODUCTION

Background
Supply chain management is divided into two levels: strategic and operational. The strategic level primarily is about the cost-effective location of facilities (plants and distribution centers), the flow of products throughout the entire supply chain system, and the assignment in each echelon (Da Cunha et al., 2007; Xu et al., 2009). The operational level is about the safety stock of each product in each facility, the replenishment size, frequency, transportation, and lead time, and the customer service level. Determining an effective supply chain is an important component for improved performance. In addition, the decisions regarding in which facilities the product should be made and how to serve customers are very critical (Dubois, 2003).

Most of the manufacturing firms comprises of networks of distribution facilities that procure raw material, converts them into finished goods and distribute the finished goods to customers. The term ‘multi-echelon’ manufacturing and distribution networks are synonymous with such networks. The distribution locations in the supply chain are called “echelons”. Usually the complexity of a supply chain is related to the number of echelons inside it. Supply chain networks having multiple layers of distribution locations are referred to as multi-echelon supply chains (Moinzadeh, 2002).

Every firm desires to keep customer service and operations efficiency high, while keeping the cost of distribution low. Most firms are still using very basic methods for achieving this goal, such as utilizing a Days-of-Coverage ratio or a statistical safety-stock calculation for end-items. Multi-echelon distribution systems (MDS) bring major advances to answering the old question of where to distribute in the supply chain. Many firms have adapted this technology but it is still a big mystery to many others (Xu et al., 2009).

Distribution system optimization is the balancing of investments in stock-keeping units and service goals, while taking into account the volatilities of demand and supply (Tsiakis, Shah & Pantelides, 2001). One of the major challenges a company faces is matching its supply to consumers’ demand. How efficiently a company addresses this challenge directly impacts the company’s profitability. Working capital being of utmost importance for any company, it is important for companies to keep low levels of stock and sell them quickly. Supply chain systems
today have multiple layers of suppliers and distributors. With each layer adding some safety stock considering service requirements, a significant amount of working capital is involved. Multi-echelon distribution systems approach involves taking a holistic approach toward the entire supply chain and considering the impact safety stock in each layer have at any given level in the supply chain. It answers where in the supply chain distribution locations should be placed and optimizing and updating buffer stock at all levels. By effectively modeling the entire supply chain from raw materials to manufacturing and finished goods, multi-echelon distribution creates what-if scenarios and explores alternate suppliers, transport links, lead times as well as locations. Levels of safety stocks and postponement strategies having lower cost implications are also verified in the process (Tsiakis, Shah & Pantelides, 2001).

Billington et al. (2004) have showed that savings realised by using the multi-echelon systems approach for Hewlett-Packard’s Digital Camera and Inkjet Supplies business exceeded $130 million. Farasyn et al. (2011) have reported that the multi-echelon systems based models produced 7% of average inventory reduction at Procter & Gamble’s business units. Wieland et al. (2012) have described a multi-echelon systems project at Intel and indicated that after its implementation, inventory levels were reduced more than 11% providing average service levels exceeding 90%.

Manufacturing is an important sector in Kenya’s economy since it makes a substantial contribution to the country’s economic development (Snyder, 2006). With solid growth continuing in the manufacturing industry, Kenya is poised to be among the fastest-growing economies in East Africa, according to the World Bank Group’s economic analysis for the country (World Bank, 2016). However, as a share of GDP, Kenya’s manufacturing firms has been stagnant in recent years. Low overall productivity and large productivity differences in firms across subsectors point to lack of competition. Manufacturing firms in Kenya are characterized by elongated or overextended chains of retailers (Snyder, 2006) which, in turn, mean long chains of transactions between chain members and consumers. Unavailability of integrated distribution management has affected productivity at manufacturing firms leading to reduced profits.
Although a number of studies have been done on the concept and context of management practices in Kenya, there is limited information within the context of manufacturing industry. Okanda, Namusonge and Waiganjo (2016) investigated the influence of supply planning practice on the performance of the unit of vaccines and immunizations in the Ministry of health, Kenya and found out that supply planning practices such as optimum distribution procurement, determination of health requirements of health facilities at every node, aggregate determination requirements and joint coordination with suppliers if adopted by the unit of vaccines and immunizations will increase the performance positively. Arani et al. (2016) investigated the influence of strategic sourcing on resilience in manufacturing firms in Kenya. Okello and Were (2014) explored the influence of management practices on performance of the selected NSE listed food manufacturing companies in Nairobi Kenya and the study revealed that product development process, distribution management, lead time, technology and innovation have a significant influence on the performance of food manufacturing companies in Kenya. Amemba et al. (2013) did a study on elements of green supply chain management and established green supply chain management leads to enhanced production efficiency and reduced wastage culminating in improved performance of the organisation. These studies however, have not examined performance of organisations in the context of multi-echelon systems.

**Statement of the Problem**

Manufacturing firms use safety stock to protect against increased supply risk, longer lead times or faster service requirements (Tang & Musa, 2011). It, therefore, requires effective demand forecasting. In Kenya today, manufacturing firms experience increased stock-outs due to challenges in managing safety stocks.

For many manufacturing firms, distribution costs account for over 50% of total production costs. However, an effective distribution system can achieve a saving of approximately 6% of total costs (Baiman & Rajan, 2002). Ideally, a multi-echelon distribution system should ensure that stock-outs are avoided without high distribution costs (Fawcett & Magnan, 2002). This has remained elusive for manufacturing firms in Kenya perhaps due to the choice of technology for distribution systems (Hardgrave, Langford & Waller, 2008; Asmus, Cauley & Maroney, 2006).
Customers want to receive ordered products as soon as possible (Christopher, 2011). Short delivery time is therefore of great importance to customers. A long lead time makes it harder for a firm to follow demand fluctuations in volume and product configuration (Ouyang, Wu & Ho, 2007; De Treville, Shapiro & Hameri, 2004). This has limited the availability of products in distribution systems of manufacturing firms in Kenya and therefore a cause for stock-outs and discontent for customers.

Previous studies have attempted to highlight problems in distribution systems and their performance. KAM (2013) attributed customer dissatisfaction New KCC downstream chain to a poor distribution system that reduced firm profits by 48%. Mathuva (2013) found that a good distribution system can improve the organisational effectiveness. However, KAM (2013) and Mathuva (2013) did not consider the effect of multi-echelon distribution systems. It is amid these research gaps that this study sought to establish role of multi-echelon distribution systems on performance of manufacturing firms in Kenya.

**Objective of the Study**

To determine the influence of Distribution Control Systems on performance of manufacturing firms in Kenya

**Research Hypothesis**

H$_{0}$. Distribution Control Systems has no significant influence on performance of manufacturing firms in Kenya

H$_{1}$. Distribution Control Systems has a significant influence on performance of manufacturing firms in Kenya

**LITERATURE REVIEW**

**Channel Coordination Theory**

The channel coordination theory was developed by Kumar in 1992 and further reviewed by Malone and Crowston in 1994 (Arshinder, Kanda & Deshmukh, 2011). According to this theory, coordination is the act of managing dependencies between entities and the joint effort of entities working together towards mutually defined goals (Malone & Crowston, 1994). It is perceived as a prerequisite to integrate operations of supply chain entities to achieve common goals. Channel
coordination models involves multi-echelon distribution systems, multiple decision makers, asymmetric information, as well as paradigms of manufacturing, such as mass customization, short product life-cycles, outsourcing and delayed differentiation (Kumar, 1992).

Various models have been examined presenting different forms of coordination such as price changes, quantity discounts (Sharafali et al., 2000), and partial deliveries and establishing their joint policies in context of manufacturing firms (Sarmah et al., 2007), information sharing and decision-making coordination (Sahin & Robinson, 2002). The emerging area of channel coordination is outsourcing practices in case of insufficient production capacity of suppliers (Sinha & Sarmah, 2007). The other pragmatic initiatives such as Collaborative Planning, Forecasting and Replenishment (CPFR) (Larsen et al., 2003) and Supply Chain Operations Reference (SCOR) (Huan et al., 2004) have found relevance from practitioner’s perspective.

Even though the tenets of channel coordination theory improve the performance of the supply chain, it may not always be beneficial to coordinate the supply chain members. The high adoption costs of joining inter-organisational distribution systems and information sharing under different operational conditions of organisations may hurt some supply chain members (Zhao & Wang, 2002). It is essential, therefore, to investigate the conditions under which channel coordination is beneficial, so that it should not result in higher supply chain costs and imprecise information.

The channel coordination theory is applicable to this study in explaining how firms can determine and maintain optimum investment in distribution to achieve the required operational performance. This theory recognizes the essence to manage dependencies in a distribution system if at all different entities are to engage in efforts with an aim of achieving mutual goals; elimination or low levels of stock outs at minimum distribution cost. The theory has cautioned on the costs involved against blindly joining inter-organisational distribution systems and sharing information under different operational conditions as this may hurt firms (Arshinder et al., 2011). Further investigation has been recommended on the conditions that channel coordination is beneficial to every firm.
Distribution Control Systems

Distribution control systems (DCSs) have evolved significantly (Amiri, 2006; Mathuva, 2013). From large systems tailored to the needs of continuous industries, such as refineries, DCSs can now respond to the requirements of small batch-oriented processes and can address a variety of automation projects. The philosophy of distributed control is to break down a large application into smaller subsystems and bring the level of control down to the unit level when appropriate to decrease overall system response time. This makes it possible to exchange information between the different control units and allows for integrated decision making at the product line or plant level. The control of a process occurs at many different levels of logical and conceptual sophistication. There are many ways to categorize the control functions into different hierarchical levels.

At the bottom of the system hierarchy, the input or output devices, sensors, and actuators directly interact with the process (Amiri, 2006). Regulatory control of process variables such as pressures and temperatures using proportional, integral and derivative (PID) control and logical operations such as time and event based control actions are carried out at this level. Individual controllers operate at the unit control level to control equipment such as blenders. To improve control at this level, several options are currently available to the users. For example, smart transmitters with some amount of data processing provide for closer monitoring of the process variables, automatic calibration, linearization; autotuners provide for automatic tuning of the PID controller constants as the process conditions change. In the near future, predictive controllers will be available as alternatives to PID controllers. Predictive controllers will make the job of controller tuning very easy and intuitive. For example, instead of having to specify gains for the PID portions of the loop controller - quantities with no intuitive interpretation - the users would specify the settling time for the process or the desired rate of change of the controlled variable; the control actions necessary to achieve this will be computed by the predictive controllers. With these controllers, optimization at the local level will also be possible (O'Dennell, Maguire, McIvor & Humphreys, 2006; Hardgrave, Langford & Waller, 2008).

The next level of hierarchy is the tactical level and it improves control by integrating the control of independent process parameters (Hardgrave, Langford & Waller, 2008). For example, if the product quality is out of specification, then set-point profiles may have to be modified on-line.
To perform on-line modification of set points, a model of the process is required. The model can be a set of heuristic rules, a mathematical description of the process, or a combination of the two. DCS and other automation systems provide a user programming facility for such intelligent control of the process. For batch processes, vendors are currently offering preconfigured software modules. Users define the batch automation program by configuring and linking modules rather than by programming. This feature is important because a process engineer can configure or modify the software without the support of a computer specialist. At the next higher level, communication networks for remote and local information exchange enable integration and coordination of the different subsystems. The distribution control system supports gateways to corporate computing systems, allowing management a real-time window into plant operation (O'Dennell, Maguire, McIvor & Humphreys, 2006).

Inventories of raw materials, work-in-progress components and finished goods are kept as a buffer against the possibility of running out of needed items (Salawati, Tinggi, & Kadri, 2012). However, large buffer inventories consume valuable resources and generate hidden costs (Salawati, Tinggi & Kadri, 2012). Too much inventory consumes physical space, creates a financial burden, and increases the possibility of damage, spoilage and loss (Nyabwanga & Ojera, 2012). On the other hand, too little inventory often disrupts business operations (Amiri, 2006). Distribution control systems enable a business to determine and maintain an optimum level of investment in distribution in order to achieve required operational performance. Sila, Ebrahimpour and Birkholz (2006) observed that the aim of distribution control is to meet customer demand. Further, Fawcett & Magnan (2002) argued that to meet customer demand, firms have to ensure that stock-outs are avoided without incurring high distribution costs.

O'Dennell, Maguire, McIvor and Humphreys (2006) pointed out that sophisticated techniques have been applied in distribution control such as genetic algorithms to determine optimal ordering at each echelon. Similarly, Mustaffa and Potter (2009) in their study suggested that application of the vendor managed distribution system leads to higher service levels to customers and improvements in key variables such as decreasing stock-outs and elimination of the bullwhip effect. Amiri (2006) identified the various distribution control systems that have been implemented by various industries such as vendor managed distribution and forecasting and replenishment.
According to Hardgrave, Langford and Waller (2008), firms have to acquire the right technology of distribution control systems for managing their inventories. Vaart and Donk (2008) examined distribution control systems through collaborative models. They further discussed the integration of traditional logistics decisions with distribution management decisions using traditional control models. Distribution control systems would integrate the suppliers, factories and customers. However, according to Mathuvu (2013) the direction of the relationship between distribution control systems and operational performance of business firms have not been clear. Furthermore, studies on the relationship between distribution control systems and performance have produced mixed results (Asmus, Cauley & Maroney, 2006).

Gadde et al. (2010) conducted a case study that focused on analyzing the Greek government procurement systems carried out by the General Secretariat of Procurement. This study identified tangible (quantifiable) and intangible (difficult to quantify) benefits. Tangible benefits included cost of supply reduction, tender costs reduction and lead time savings. Intangible benefits included process improvement and organisational benefits.

Another study was conducted by Doggett (2005) which exploited issues related to implementation and impact of distribution systems in nine public sectors in the United Kingdom (UK). Five impacts were identified in this study, namely: change in total cost of acquisitions, changes in organisational characteristics, changes in governance structure, management and implementation.

Amiri (2006) conducted a study on the impacts of distribution systems in the procurement process by analyzing the project of Hong Kong Textile. He used SWOT analysis to describe impacts in each stage of procurement process. Strengths and weaknesses were used as internal performance measurement in the procurement process, for example, efficiency, and effectiveness. Opportunities and threats were identified as the electronic environments that support distribution systems.

Disney, Holmström, Kaipia and Towill (2001) did a study on the implementation of VMI within a grocery supply chain. They used the Time Benefit analysis tool to identify the particular products most suitable for VMI control from within the suppliers product range. Practical issues concerning the production and distribution process are highlighted. A production and inventory
control system is selected and refined and realised via a spreadsheet application. Necessary data for enabling VMI is collated and presented to the production planner by the existing supply chain ERP system and entered into the spreadsheet-based VMI DSS. The DSS then advises the production scheduler on production and distribution targets for both VMI and non-VMI customers. All the data requirements for VMI are easily available from modern ERP systems. It is also possible to design production planning and distribution control systems that are robust to many real-life uncertainties. They reported that the Time Benefit analysis tool quickly highlights the most profitable products in a company’s portfolio for VMI implementation, requiring only data that is readily available. Findings from the analysis of production and inventory control strategies can be easily incorporated into simple Decision Support Systems that are understandable, reliable and useful to production schedulers in VMI supply chains.

Enns and Suwanruji (2007) presented a direct comparison of two common distribution planning and control systems, based on the logic used to move material through supply chains. Although there has been a lot of conjecture regarding the relative merits of such systems, their study was a step towards understanding the true underlying behaviour and tradeoffs in each system. Results indicated that centralized planning and control, as implemented under Distribution Requirements Planning (DRP), is beneficial under realistic situations of time-varying demand and replenishment time uncertainty.

Monthatipkul and Yenradee (2005) proposed a new inventory control system called the optimal inventory/distribution plan (IDP) control system for a one-warehouse/multi-retailer supply chain. The IDP control system includes three major components, namely, a linear programming model, an adjustment rule, and a rationing rule. Implementing the IDP control system begins with solving the proposed linear programming model and then following the obtained optimal inventory/distribution plan by adopting the adjustment and rationing rules. The efficiency of the IDP control system is compared to that of the traditional installation-stock s,Q system under two uncertain demand patterns. The experimental results show that the IDP control system gives lower total cost with higher fill rates than the traditional installation-stock s,Q system for the two demand patterns.
INTRANS (2010) a project supported by the Research Council of Norway focused on the results related to the integration of control systems in the Supply Chain (SC) domain and the transport domain. By control system in the SC domain meant any system that supports the decision takings in the SC and by control system in the transport domain meant any system that supports the monitoring and management of a transport network, such as a road network. INTRANS (2010) looked upon the integration from an interoperability point of view and describes the three different types of interoperability, contractual, functional and technical interoperability, providing complete interoperability. It took the role model and functions defined in the ARKTRANS – The Multimodal ITS framework architecture as the starting point and combines it with the Supply Chain Operations Reference (SCOR) model. The study described how complete interoperability can be achieved by a common role model for the two domains, a common set of core functions for the two domains and a common information architecture. It also introduced the intelligent goods as a crucial link between the two domains as well as playing an important role in the decision taking in the SC domain and the monitoring and management of transport in the transport domain.

**Conceptual Framework**

A conceptual framework is an analytical tool used to make abstract distinctions and organize ideas to capture something real and do this in a way that is easy to remember and apply (Shields & Rangarajan, 2013). The conceptual framework in this study shows the interaction of variables. The independent variables comprise of technology, collaborative models and level of stock-outs. All these variables are expected to have an influence on performance of manufacturing firms. Organizational policy was expected to have an intervening effect on this interaction. The interaction of these variables is shown in Figure 1.
RESEARCH METHOD
Research Methods and Design

This study used a descriptive survey research design. Creswell (2013) asserts that a descriptive research design is used when data are collected to describe persons, organisations, settings or phenomena. The design also has enough provision for protection of bias and maximized reliability (Kothari, 2004). It was appropriate for this study because it allowed the collection of information for independent and dependent variables using questionnaires (Orodho, 2003).

Population and Sample
The study population was 903 manufacturing firms. A list that contains the number of all 903 manufacturing firms was sourced from the Kenya Association of Manufacturers (KAM, 2017). This study used stratified random sampling. A sampling frame of this study comprised of 903 manufacturing firms who are members of Kenya Association of Manufacturers categorized in fourteen (14) different sub-sectors that characterizes manufacturing industry in Kenya. However, consultancy services sub-sector was excluded from this study as multi-echelon distribution systems do not apply in the services sector.
To obtain the desired sample size for the study with the population of 903, Nassiuma (2000) formula was used as shown; 

\[ n = \frac{N (c v^2)}{C v^2 + (N-1) e^2} \]

Where \( n \) = sample size \\
\( N \) = population (903) \\
\( C v \) = coefficient of variation (take 0.5) \\
\( e \) = tolerance of desired level of confidence (take 0.05 at 95% confidence level) 

\[ n = \frac{903 (0.5^2)}{0.5^2 + (903-1) 0.05^2} = \frac{225.75}{2.505} = 90.11 \] (rounded off to 90 respondents) 

The sample size was 90.

When a population from which a sample is drawn does not constitute a homogenous group, Kothari (2004) recommended that stratified sampling technique should be used. The thirteen (13) different sub-categories of manufacturing firms formed the strata in stratified random sampling. Sampled firms in each of the stratum were proportionate to its population to ensure equal representation and avoid bias as shown in the sampling matrix table.

**Table 1: Sampling Matrix**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Members</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building, Mining &amp; Construction</td>
<td>49</td>
<td>5</td>
</tr>
<tr>
<td>Chemical &amp; Allied Sectors</td>
<td>159</td>
<td>16</td>
</tr>
<tr>
<td>Energy, Electrical &amp; Electronics</td>
<td>45</td>
<td>5</td>
</tr>
<tr>
<td>Food &amp; Beverages</td>
<td>187</td>
<td>19</td>
</tr>
<tr>
<td>Leather &amp; Footwear</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Metal &amp; Allied Sector</td>
<td>104</td>
<td>10</td>
</tr>
<tr>
<td>Motor Vehicle &amp; Accessories</td>
<td>71</td>
<td>7</td>
</tr>
<tr>
<td>Paper &amp; Board</td>
<td>54</td>
<td>5</td>
</tr>
<tr>
<td>Pharmaceutical &amp; Medical Equipment</td>
<td>54</td>
<td>5</td>
</tr>
<tr>
<td>Plastics &amp; Rubber</td>
<td>77</td>
<td>8</td>
</tr>
<tr>
<td>Fresh Produce</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>Textiles &amp; Apparels</td>
<td>44</td>
<td>4</td>
</tr>
<tr>
<td>Timber, Wood &amp; Furniture</td>
<td>39</td>
<td>4</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>903</strong></td>
<td><strong>90</strong></td>
</tr>
</tbody>
</table>


**Data Collection, Processing and Analysis**

This study used the questionnaires in collecting the primary data while secondary data was obtained from journals, textbooks, Internet and Kenya Association of Manufacturers magazines.
A semi-structured questionnaire containing both open-ended and close-ended questions was used to collect primary data for this study. The questionnaires method was preferred as it is economical in terms of time and cost as compared to other methods.

Mugenda and Mugenda (2003) assert that questionnaire is designed to address specific objective, research question or test hypothesis. This study used questionnaire because of its ability to collect large amount of information in a reasonably quick space of time and also make the analysis of data simpler based on the research objective of the study.

The researcher obtained necessary authorization and clearance from relevant authority before commencing the study. The researcher also obtained authorization letter from NACOSTI and an introduction letter from the University. A cover letter was attached to each questionnaire to assure the participants that the information given was anonymous and confidential.

The questionnaires were distributed using drop-and-pick later method to the respondents. This enabled the respondents to have ample time to fill the questionnaires and at the same time ensure high response rate. According to Kothari (2004), a self-administered questionnaire elicits self-report on people’s opinion, attitudes, beliefs and values.

After collecting data from the respondents through the questionnaire, data was then checked for completeness, consistency and reliability. The next step involved coding the responses in the coding sheets by transcribing the data from questionnaire by assigning characters the numerical symbols. This was followed by screening and cleaning of data to make sure there are no errors. After this, data was transferred to SPSS for analysis.

The collected data was analysed using SPSS (Statistical Package for Social Science) version 20 as an aid. Descriptive statistics were used to examine the characteristics of the population. It enabled the researcher to meaningfully describe a distribution of scores using statistics that depends on the type of variables in the study and the scale of measurement. Mugenda and Mugenda (2003) assert that descriptive statistics enable the researcher to describe distribution of scores. Variable aggregation was undertaken in facilitation of further statistical analysis. The researcher applied "Collapsing Response" method in analyzing responses from a Likert scale
measurement. This was done by adding the ‘strongly agree’ responses with the 'agree' responses and also adding the ‘disagree’ responses with ‘strongly disagree’ (Gwavuya, 2011).

Regression analysis was used to examine the presence of a linear relationship between two variables; Distribution Control Systems and performance of manufacturing firms in Kenya. The following regression model was used:

\[ Y = \beta_0 + \beta_1 X_1 + \epsilon \]

Where,

- \( Y \) = Performance of manufacturing firms in Kenya
- \( X_1 \) = Distribution Control Systems

\( \beta_0 \) is the constant or intercept while \( \beta_1 \) is the corresponding coefficients for the respective independent variable while \( \epsilon \) is the error term.

**Table 2: Hypothesis Test**

<table>
<thead>
<tr>
<th>Hypothesis Test</th>
<th>Regression Model</th>
<th>Where:</th>
</tr>
</thead>
<tbody>
<tr>
<td>( H_0: \beta_1 = 0 ) vs ( H_a: \beta_1 \neq 0 )</td>
<td>( Y = \beta_0 + \beta_1 X_1 + \epsilon )</td>
<td>( \beta_0 ) = Constant (Co-efficient of intercept) ( \beta_1 ) = Regression co-efficient of ( X_1 ), ( X_1 ) = Distribution Control Systems, ( \epsilon ) = Error Term</td>
</tr>
</tbody>
</table>

**RESULTS AND DISCUSSION**

**Construct Distribution Control Systems**

Respondents were asked to indicate the extent to which aspects of distribution control systems are employed in their respective companies. They were asked to use a scale of 1-5 where 1=not at all, 2=small extent, 3=moderate, 4=large extent, 5=very large extent. The findings are shown in table 3.
Table 3: Aspects of Distribution Control Systems

<table>
<thead>
<tr>
<th>Aspects of distribution control systems</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>N</th>
<th>%</th>
<th>N</th>
<th>%</th>
<th>N</th>
<th>%</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintainance of an optimum level of investment in distribution</td>
<td>4.20</td>
<td>.401</td>
<td>65</td>
<td>80.2</td>
<td>16</td>
<td>19.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Achieved required operational performance</td>
<td>3.99</td>
<td>.783</td>
<td>25</td>
<td>30.9</td>
<td>32</td>
<td>39.5</td>
<td>24</td>
<td>29.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meeting customer demand</td>
<td>4.80</td>
<td>.401</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>16</td>
<td>19.8</td>
<td>65</td>
<td>80.2</td>
</tr>
<tr>
<td>Stock-outs are avoided</td>
<td>4.70</td>
<td>.459</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>24</td>
<td>29.6</td>
<td>57</td>
<td>70.4</td>
</tr>
<tr>
<td>Distribution costs have been lowered</td>
<td>4.38</td>
<td>.681</td>
<td>32</td>
<td>39.5</td>
<td>40</td>
<td>49.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is optimal ordering in each echelon</td>
<td>4.31</td>
<td>.645</td>
<td>40</td>
<td>49.4</td>
<td>33</td>
<td>40.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vendor managed distribution system is used</td>
<td>4.47</td>
<td>.963</td>
<td>16</td>
<td>19.8</td>
<td>56</td>
<td>69.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forecasting is used</td>
<td>4.59</td>
<td>.494</td>
<td>33</td>
<td>40.7</td>
<td>48</td>
<td>59.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replenishment is used</td>
<td>4.59</td>
<td>.494</td>
<td>33</td>
<td>40.7</td>
<td>48</td>
<td>59.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There is integration of the suppliers, factories and customers</td>
<td>4.49</td>
<td>.503</td>
<td>41</td>
<td>50.6</td>
<td>40</td>
<td>49.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results show that to a large extent many aspects of distribution control systems are employed in manufacturing firms. The findings show that to a large extent maintainance of an optimum level of investment in distribution (M=4.20, SD=.401), meeting customer demand (M=4.80, SD=.401) and avoiding stock-outs (M=4.70, SD=.459) are employed in manufacturing firms. The results also show that distribution costs have been lowered (M=4.38, SD=.681), there is
optimal ordering in each echelon (M=4.31, SD=.645), vendor managed distribution system is used (M=4.47, SD=.963), and forecasting is used (M=4.59, SD=.494). Other distribution control systems aspects used include replenishment (M=4.59, SD=.494) and there is integration of the suppliers, factories and customers (M=4.49, SD=.503). The results also show that to a moderate extent required operational performance was achieved (M=3.99, SD=.783). The results address the cost implications of stock-outs as expressed by Amiri (2006). They also emphasize aim of distribution control systems as it is to attain optimum level in distribution for optimum level of operational performance through integration of integrate suppliers, factories and customers (Mathuva, 2013; Sila, Ebrahimpour & Birkholz, 2006).

Hypothesis Test Results
The hypothesis sought to test influence of distribution control systems on performance of manufacturing firms. Hypothesis 1: H₀₁: Distribution control systems have no significant influence on performance of manufacturing firms in Kenya. A simple linear regression analysis was conducted using the following model;

\[ Y = \beta_0 + \beta_1 X_1 + \epsilon \]

Where:
- \( Y \) = performance of manufacturing firms
- \( \beta_0 \) = Constant (Co-efficient of intercept)
- \( \beta_1 \) = Regression co-efficient of \( X_2 \).
- \( X_1 \) = Distribution control systems,
- \( \epsilon \) = Error Term

\( H_0: \beta_1 = 0 \) Vs \( H_1: \beta_1 \neq 0 \)

Reject \( H_0 \) if \( p < 0.05 \), otherwise fail to reject the \( H_0 \)

Distribution control systems was regressed against performance. The regression analysis results are shown in table 4.
Table 4: Model Summary

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.429*</td>
<td>.184</td>
<td>.173</td>
<td>2.86574</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), Distribution Control Systems

The regression analysis results for distribution control systems against performance show that distribution control systems can explain 18.4% of change in manufacturing firms in Kenya as indicated by the value of $R^2$ (0.184).

ANOVA test was done to determine whether model used for analysis was fit. The ANOVA test results are presented in table 5.

Table 5: ANOVA

<table>
<thead>
<tr>
<th>Model</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>145.983</td>
<td>1</td>
<td>145.983</td>
<td>17.776</td>
<td>.000b</td>
</tr>
<tr>
<td>Residual</td>
<td>648.783</td>
<td>79</td>
<td>8.212</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>794.765</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Dependent Variable: Performance

b. Predictors: (Constant), Distribution Control Systems

The ANOVA test results in table 5 show that the model used was fit for the regression analysis ($F=17.776$, $p=0.000$). The results obtained from the regression analysis can therefore be used as they are valid and did not occur by chance.

Coefficients table shows the contribution of distribution control systems as independent variable to performance, the dependent variable. The results are shown in table 6.

Table 6: Coefficients

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>24.489</td>
<td>4.609</td>
<td></td>
<td>.000</td>
</tr>
<tr>
<td>Distribution Control Systems</td>
<td>.435</td>
<td>.103</td>
<td>.429</td>
<td>.000</td>
</tr>
</tbody>
</table>

a. Dependent Variable: Performance
The results of coefficients table show that the contribution of distribution control systems was 0.435 for every unit change in performance of manufacturing firms in Kenya.

According to regression results, $H_1: \beta_3 \neq 0$ (\(\beta=0.435\)) and $p < 0.05$ (\(p=0.000\)). We therefore reject the null hypothesis that distribution control systems have no significant influence on performance of manufacturing firms in Kenya.

**CONCLUSIONS AND RECOMMENDATIONS**

**Conclusions**
The study sought to establish the influence of distribution control systems as an element of multi-echelon distribution system on performance of manufacturing firms in Kenya. The results revealed that distribution control systems account for 18.4% of change in performance of manufacturing firms in Kenya. It was also found that for every unit change in distribution control systems there is 0.435 units increase in performance of manufacturing firms. The findings of this study are in agreement with observations by Gadde et al. (2010) who identified tangible (quantifiable) and intangible (difficult to quantify) benefits. Tangible benefits included cost of supply reduction, tender costs reduction and lead time savings. Intangible benefits included process improvement and organisational benefits. Doggett (2005) in a similar manner identified five impacts of distribution control systems, namely: change in total cost of acquisitions, changes in organisational characteristics, changes in governance structure, management and implementation. The results are also congruent with an assertion by Amiri (2006) on impacts of distribution systems in the procurement process. He identified strengths and weaknesses as internal performance measurement in the procurement process and opportunities and threats were identified as the electronic environments that support distribution systems. The study concluded that distribution control systems significantly influence performance of manufacturing firms in Kenya. It has tangible (quantifiable) and intangible (difficult to quantify) benefits. Tangible benefits include cost of supply reduction and lead time savings. Intangible benefits include process improvement and organisational benefits.

**Recommendations**
Manufacturing firms in Kenya should employ aspects of distribution control systems as it is one of the most important elements of multi-echelon distribution system. It will enable them not only
to reap tangible (quantifiable) benefits such as cost of supply reduction and lead time savings but also intangible (difficult to quantify) benefits such as process improvement and other organisational benefits. This can be achieved through maintenance of an optimum level of investment in distribution and attaining required operational performance. Meeting customer demand and avoiding stock-outs are avoided as well as lowering distribution costs are critical towards this goal. Manufacturing firms should also ensure that there is optimal ordering in each echelon, vendor managed distribution systems, forecasting and replenishment are used. The integration of the suppliers, factories and customers are also critical in employing distribution control systems.

REFERENCES


