INFLUENCE OF ICT INTEGRATION ON PERFORMANCE OF MANUFACTURING FIRMS IN KENYA

Nehemiah Kiprop Kiplagat  
(Corresponding author) 
Jomo Kenyatta University of Agriculture and Technology 
kiplagatnk@gmail.com

Dr. Ismail Noor  
Jomo Kenyatta University of Agriculture and Technology

Professor Mike Iravo  
Jomo Kenyatta University of Agriculture and Technology

Dr. Kepha Ombui  
Jomo Kenyatta University of Agriculture and Technology


ABSTRACT
This study sought to establish influence of ICT integration on performance of manufacturing firms in Kenya. Increasing competitive pressures are forcing companies to increase their rates of innovation. The increasing rate of innovation shortens each product’s duration in the market, thereby compressing each product’s life cycle. 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 ICT integration explain 33.9% of change in performance of manufacturing firms in Kenya. ICT integration was found to be one of the elements of multi-echelon distribution system that have the most significance on performance of manufacturing firms in Kenya. The study concluded that ICT integration significantly influences performance of manufacturing firms in Kenya. This study recommends that manufacturing firms should ensure they adopt ICT integration in their supply chain. Manufacturing firms in Kenya should important elements of multi-echelon distribution system.

Keywords: manufacturing, performance, ICT, integration, distribution, multi-echelon, system, firm, technology.
INTRODUCTION

Background

Globalization and competition among firms have resulted in firms developing a supply chain that can respond quickly to customers’ need. In the current business environment, a firm has to reduce costs while improving its customer service level to remain competitive, which also helps maintain profit margins. In order to achieve these goals, a firm should appropriately select the location of the factory and the distribution center (Amiri, 2006; Da Cunha et al, 2007). According to Dejonckheere et al. (2004), an optimal, efficient, and effective supply chain platform is provided by distribution systems, which also helps to improve performance. Moreover, Asmus et al. (2006) noted that the distribution systems goal is to maximize the financial ratio, which is relevant to the objective of gaining the maximum return of investment at the minimum cost.

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).

Multi-echelon distribution system boosts the capability of supply chain teams in achieving service goals with minimum levels of safety stock (Lee, 2003). With problems such as stock outs and obsolescence also taken care of, bottom lines of companies are significantly improved irrespective of whether the supply chain is local or global. The biggest driver for multi-echelon distribution systems is the financial losses that companies can avoid using these techniques. The complexities that multi-echelon supply chains present and the need to efficiently allocate resources and increase profitability is further likely to fuel the use of multi-echelon distribution systems. Investments in distribution being one of the largest liquid assets for any organisation, taking advantage of any technique that can lower distribution investments while maintaining and ultimately improving service levels are significantly aiding profitability to the organisation. However, reducing the safety stocks in distribution should in no way affect customer service
levels. Multi-echelon approach addresses this concern by keeping more stock at the outer nodes so that the customer service level is not affected, while reducing overall level of safety stock in the distribution system. However, for this strategy to effectively work, companies should be able to forecast customer demands (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. Manufacturing firms in Kenya are faced with problems of wrong forecasting due to lack of enough distribution management information. Unavailability of integrated distribution management has affected productivity at manufacturing firms leading to reduced profits. To sustain growth and increase the contribution of the manufacturing firms to GDP, firms should boost their level of productivity to help the firms regain its competitiveness by managing the flow of stock.

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 while 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. Gichuru, Iravo and Arani (2015) carried out an empirical investigation on influence of Collaborative Practices on Performance of Food and Beverages Companies. Their study found out that ICT integration practice and resource sharing practice has positive influence on the performance of the company. Similarly, Kimani (2013) explored the influence of information technology, supply chain design, people issues and collaboration issues on the implementation of effective supply chain management and found out that all four independent variables have high effect on implementation of effective SCM in the petroleum sector. 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.

The difficulties in managing safety stocks in a multi-echelon distribution system make it necessary for the use of technology or ICT (Lotfi, Sahran & Zadeh, 2013). There is a problem of bullwhip for manufacturing firms in Kenya as small changes in end item demand amplify order
oscillations as one moves up in the supply chain. This problem shows lack of integration and coordination of actions across different distribution locations.

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 ICT Integration on performance of manufacturing firms in Kenya

**Research Hypothesis**

H₀: ICT Integration has no significant influence on performance of manufacturing firms in Kenya

H₁: ICT Integration has a significant influence on performance of manufacturing firms in Kenya

**LITERATURE REVIEW**

**E-Perspective Theory**

The e-perspective theory was developed by Hammarkvist, Hakansson and Mattsson in 1982 (Anderson, 2002). The theory holds that a network is comprised of three concepts that include actors, resources and activities. The relationship between the different actors is important in order to understand the network. All actors form their own networks but are dependent on each other (Hakansson & Johanson, 1992). The relationship between the different actors is important in order to understand the network. The relationships are characterized by continuity, multiplexity and specificity. Over time mutual knowledge and trust create a framework for future business among the actors in the network. The actors can be linked to each other through technical, social, cognitive, legal, economic and other ties.

Information and Communication Technology (ICT) plays three central roles in e-perspective theory. First, ICT allows firms to increase the volume and complexity of information which
needs to be communicated with their trading partners. Second, ICT allows firms to provide real-time supply chain information, including inventory level, delivery status, production planning and scheduling. This enables firms to manage and control its supply chain activities. Third, ICT facilitates the alignment of forecasting and scheduling of operations between firms and suppliers, allowing better inter-firms coordination. As such, the problems in coordinating supply chain activities which often are hindered by time and spatial distance can be reduced (Paulraj, Chen & Flynn, 2017).

Effective ICT connection improves the integration between supply chain partners in terms of material flows. The internet has been widely adopted by firms with the aim of improving performances both in internal processes and in processes going beyond their boundaries (Barratt and Rosdahl, 2002). Despite the fact that business-to-business (B2B) trade has enjoyed a quieter existence online than business-to-consumer (B2C) (Barratt & Rosdahl, 2002) the benefits are significant as seen from procurement performance in a B2B setting (Min and Galle, 2001).

The use of ICT has facilitated the reduction of coordination costs, which has been extensively documented in the literature (Bakker et al., 2008). For example, electronic market places, facilitated through ICT, reduce the cost of searching for obtaining information about product offerings and prices (Bakker et al., 2008). Also, collaboration facilitated by information sharing can lower transaction costs (in particular coordination costs) as firms can thereby reduce supply chain uncertainty and thus the cost of contracting. If a supplier is unable to accurately predict the price of its product inputs, it will be reluctant to enter into a contract, which locks it into a fixed price for an extended period of time (Arrowsmith, 2002).

Integration of technology and business processes presents a strategic link for creating efficiencies in the development of highly complex products (Narasimhan et al., 2010). Purposeful technological infrastructure should be a functional part of an organisational structure, especially as regards to the distribution of technological competence, information and responsibilities among business departments. Integration of individual technological processes and their inputs and outputs, integration of technology and other business processes, or integration of market demands and technological capacities, all these processes require building up a functional technology infrastructure/network. This technology infrastructure should be designed to run
production as well as other business processes, including data centres that enable ICT to be used as a platform upon which business decisions are made (Gold et al., 2001).

ICT Integration

ICT serves as an essential approach for the survival of enterprises and enabler of integration. With the advancement in information and communication technology, ICT integration has become more conceivable. Furthermore, ICT integration has become more efficient by the global introduction of long-term cooperation and coordination which leads ultimately to the improvement of companies’ competitive advantages. A lack of ICT integration can result in an inefficiency of coordinating actions within the units in the company or organisation (Lotfi, Mukhtar, Sahran & Zadeh, 2013).

Gallego and O’zer (2001) searched optimal policies for with and without demand information-sharing cases in a two-stage, where the retailer batches orders and faces Poisson demands. Cheng and Wu (2005) show how ICT integration can reduce distribution costs in a two-level chain with multiple retailers. Dejonckheere et al. (2004) show that ICT integration is very beneficial, if not indispensable in order-up-to-S policies since the magnitude of the bullwhip can thus be significantly reduced at higher levels in the chain. However, they note that ICT integration cannot completely eliminate the bullwhip.

Supply chain systems are prone to fluctuations and instability. Small changes in the end item demand can create distribution and order oscillations that amplify as one moves up in the supply chain (Stevenson, 2006). This phenomenon of amplification of oscillations through the supply chain is also known as the bullwhip effect (Xu et al., 2001). Demand information could significantly reduce the bullwhip effect. Xu et al. (2001) observed that sharing of the demand forecast and distribution information is effective in reducing order fluctuations and safety stocks. Chen et al. (2000) demonstrate the fact that smoother demand forecasts reduce the bullwhip effect, and longer lead times increase it. They also show that for both moving average and exponential smoothing forecasts, the very inclusion and need for estimation of a linear trend parameter into the forecasting model results in increased bullwhip. Dejonckheere et al. (2004) analysed the effects of constant, linear, and quadratic exponential smoothing algorithms on the bullwhip. They show that the bullwhip emanating from the trend detection algorithms (linear and
quadratic or exponential smoothing) are reduced by lowering the exponential smoothing constant used in these algorithms. Datta et al. (2007) analysed the relationships between demand and order forecasting and the bullwhip effect, and proposes an advanced forecasting model that is known as Generalized Autoregressive Conditional Heteroscedasticity (GARCH) for supply chain management.

Developments in ICT are making it increasingly possible for organisations to learn, communicate and coordinate thereby enhances their success in a competitive environment. Communication and co-ordination provide the means to produce; store, use, and reuse information that an organisation needs to transform its routines and achieve its desired state. The role of ICT in this process includes knowledge acquisition, information distribution, information interpretation and organisational memory. One instance of use of ICT in knowledge acquisition is that of Market Research and Competitive Intelligence Systems. At the level of planning, scenario-planning tools can be used for generating the possible futures. Similarly, use of Groupware tools, Intranets, email, and Bulletin Boards can facilitate the processes of information distribution and information interpretation. The archives of these communications can provide the elements of Organisational Memory (Olamade, Oyebisi & Olabode, 2014).

ICTs are enabling organisations to develop and continually renew their ability to dynamically manage their interfaces with the environment. Today’s successful organisations are strategically deploying ICT to influence the evolution of their environment and enhance performance. At national and organisational levels, development is increasingly viewed as a process of change and learning with technological capabilities and institutional changes driving the process. In this view, technology is much more than an ingredient in development strategies; it is a conditioning element of their viability (Perez, 2001).

At the organisational level, three forces can be identified as exerting pressures on entities leading to change and development. The forces are identified as; changes in the external operating environments, internal changes of strategy and organisation, and production factor forces. The rapidity of change in these forces is an important element of the knowledge economy. The knowledge economy is typified by a virtuous cycle of competition, innovation and productivity growth. Fierce competition spurs innovation in both technology and business processes which
spreads quickly, improving productivity across sectors. As productivity rises, competition intensifies further bringing a fresh wave of innovation (Farrell, 2003).

In today’s waves of innovation, ICTs as drivers of development are assisting organisations to respond to the forces of change in what has been termed dynamic flexibility by which short-term flexibility to cope with fluctuating demand patterns is combined with wider productivity gains from innovation in products and processes. Farrell (2003) identified ICT to have proved a particularly powerful tool in the achievement of dynamic flexibility through four main processes. First, ICT enabled the development of both attractive new products and efficient new business processes through administrative savings, higher quality, and lower costs. Second, ICT facilitated rapid, industry-wide diffusion of innovations. Third, it facilitated interface with the market through the capturing of market information, adjusting production to meet demand and exploiting scope economies through the target selling of complementary products or services. And finally, it exhibited strong scale-economies. Also, organising production and distribution around ICT has enabled the adoption of new processes, procedures, and organisational structures, which in turn, have led to sustainable gains in productivity, quality, and responsiveness (Brynjolfsson & Hitt, 2000; Litan & Rivlin, 2000).

Information technology helps to link the point of production seamlessly with the point of delivery or purchase. It allows planning, tracking and estimating the lead times based on the real time data. Internet and web can enhance effective communication, which helps members of supply chain review past performance, monitor current performance and predict when and how much of certain products need to be produced and to manage workflow system (Liu et al., 2005).

Nyabwanga and Ojera (2012) carried out a web survey, embarked on exploring and categorizing different collaborative functionalities that are offered by electronic marketplaces. They put forward, as a result, five types of horizontal and four types of vertical collaborative mechanisms to enhance integration. Although their research is quite comprehensive and exploratory, they define collaboration in very broad terms- “...in its broadest sense, joining an electronic market place is called collaborative commerce, regardless of whether business participants trade through arms-length market relationships or through long-term relationships” (Nyabwanga & Ojera, 2012).
Fin (2006) investigated the relation between EDI in apparel industry and three performance levels: operational, financial and strategic. This helped in reduction of lead time from several weeks to 3 days. Devaraj et al. (2007) analysed the relationship between supplier integration and customer integration with supply chain performance when supported by e-business technologies. E-business capability supporting supply chain technologies such as customer orders, purchasing and collaboration between suppliers and customer enhances the production information integration intensity, which in turn improves the supply chain performance.

Skipper et al. (2008) proposed a conceptual model to link level of interdependence among supply chain with supply chain performance moderated by different types of IT needed to achieve different levels of coordination. The framework is supported by interdependence theory and coordination theory. The coordination processes between globally dispersed and mobile supply chain members is becoming more and more information intensive. The recent trends in intelligent wireless web services have proved enhancement in the mobile real time supply chain coordination (Saroor et al., 2009).

Li et al. (2009) carried out an empirical study to explore relationship between IT, supply chain integration and supply chain performance of Chinese manufacturing organisations. Supply chain integration mediates the relationship between IT implementation and supply chain performance. Hence, IT can be a good enabler to integrate supply chain.

Jacques et al., (2013) described how searching for information, reading and responding to e-mails, and collaborating with colleagues take up about 60% of typical knowledge worker’s time and how they could become up to 25% more productive through the use of social technologies. ICT is strategic to a firm if it helps to gain a competitive advantage and or reduce a competitive disadvantage. The intensity of ICT application in shaping or sustaining strategy will depend on the competition faced by companies, their strategic response to the competition, and their capability to dynamically integrate ICT and competitive strategies. Based on a sample of manufacturing firms, three questions were formulated to determine if manufacturing companies in Nigeria strategically deploy ICT and the intensity of the deployment. The evidence produced by Olamade et al. (2014) found support for the strategic use of ICT by the companies. The authrs
concluded that companies will be using ICT more strategically if competition is driven by the competitive advantages that are more ICT intensive.

Kollberg and Dreyer (2006) observed that the adoption of information and communications technology is spreading rapidly in supply chain management. As companies seek to improve supply chain efficiency through increased integration, ICT can be considered as a key enabler for supply chain management by supporting information-sharing. Their literature review within supply chain integration and the impact of ICT indicates that there are various integration dimensions and levels, and different effects and influencing factors. Even though there is a considerable amount of research within the field, the complexity of ICT impact on integration implies that previous studies cover only a limited number of dimensions and variables at a time. Kollberg and Dreyer (2006) proposed a research model that can support empirical in-depth studies seeking to explore how ICT influences integration in supply chain control. The model is developed from literature and incorporates areas of control, ICT, integration dimensions, ICT effects, influencing factors and supply chain integration.

According to Georgise, Thoben and Seifert (2014), with the advancement of information and communication technologies, supply chain integration has been considered a strategic tool for firms to improve their competitiveness. The supply chain integration within processes and between organisations has enhanced value creation. However, the fragmented nature of the business in developing country demonstrates a noticeable difficulty in terms of competitiveness and efficiency. Lack of a relevant literature on practical experience in supply chain integration in developing countries is one of the challenges. Georgise, Thoben and Seifert (2014) sought to identify the level of interorganisational and intraorganisational supply chain integration practices. They also analysed the challenges faced in the manufacturing firms in developing countries. Their methodology followed a thorough review of literature and semi structured interviews amongst the Ethiopian manufacturing industries. Their study findings highlighted that prevailing approach to supply chain integration is limited to ad hoc functional based boundaries within the firm. The SC integration enablers are also restricted to the traditional way of communications such as telephone, fax, and letters. They concluded that firms need to focus on those issues that require attention in pursuance of greater SC integration.
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 optimal policies, availability of demand information, and integration and coordination of actions. 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: \( n = \frac{N (Cv^2)}{Cv^2 + (N-1) e^2} \)

Where \( n \) = sample size
\( N \) = population (903)
\( Cv \) = 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 can be used to examine the presence of a linear relationship between two variables; ICT integration and performance of manufacturing firms in Kenya. The following regression model was used:

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

Where,

\( Y \): Performance of manufacturing firms in Kenya

\( X_1 \): ICT Integration

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

Construct ICT Integration
The respondents were asked to indicate the extent to which attributes of ICT integration are exhibited by their company. Respondents were requested to use a scale of 1-5 where 1=not at all, 2=small extent, 3=moderate, 4=large extent, 5=very large extent. These results are presented in table 3.

Table 3: Attributes of ICT Integration

<table>
<thead>
<tr>
<th>Attributes of ICT integration</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>Not at all</th>
<th>Small extent</th>
<th>Moderate</th>
<th>Large extent</th>
<th>Very large extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are optimal information access and communication policies</td>
<td>3.70</td>
<td>.901</td>
<td>0</td>
<td>0.0</td>
<td>8</td>
<td>9.9</td>
<td>24</td>
</tr>
<tr>
<td>There is sufficient availability of demand information</td>
<td>3.69</td>
<td>.465</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>25</td>
</tr>
<tr>
<td>Activities in the supply chain are integrated</td>
<td>4.20</td>
<td>.401</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>There is coordination of actions through ICT</td>
<td>4.69</td>
<td>.645</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>8</td>
</tr>
</tbody>
</table>
The results show that to a large extent activities in the supply chain are integrated (M=4.20, SD=.401) and there is coordination of actions through ICT (M=4.69, SD=.645) in manufacturing firms. The results also show that to a moderate extent there are optimal information access and communication policies (M=3.70, SD=.901) and there is sufficient availability of demand information (M=3.69, SD=.465). The findings are in agreement with Lotfi, Mukhtar, Sahran and Zadeh (2013) who saw information and communication technology playing a significant role in improving coordination of business activities and cooperation among different stakeholders resulting into efficiency in operations.

Respondents were asked to indicate the extent to which ICT Integration has enabled reliability in their company. They were requested 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 results are shown in table 4.

### Table 4: Achievements of ICT Integration in Reliability

<table>
<thead>
<tr>
<th>Achievements of ICT Integration in reliability</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>Not at all</th>
<th>Small extent</th>
<th>Moderate</th>
<th>Large extent</th>
<th>Very large extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timeliness</td>
<td>4.68</td>
<td>.668</td>
<td>0</td>
<td>0.0</td>
<td>9</td>
<td>11.1</td>
<td>64</td>
</tr>
<tr>
<td>Consistency</td>
<td>4.90</td>
<td>.300</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>8</td>
</tr>
<tr>
<td>Accuracy</td>
<td>4.69</td>
<td>.465</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>25</td>
</tr>
</tbody>
</table>

The results show that to a large extent ICT integration has achieved reliability in manufacturing firms. The findings show that ICT integration to a large extent achieved aspects of reliability such as timeliness (M=4.68, SD=.668), consistency (M=4.90, SD=.300) and accuracy (M=4.69, SD=.465). The results reflects observations by Gallego and O’zer, 2001 as well as Cheng and Wu (2005) who indicated that ICT integration create a suitable environment for demand and distribution information sharing and reduce distribution costs.

Respondents were asked to indicate the extent to which ICT Integration has enabled responsiveness in their company. They were requested 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 5.
Table 5: Achievements of ICT Integration in Responsiveness

<table>
<thead>
<tr>
<th>Achievements of ICT Integration in responsiveness</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>Not at all</th>
<th>Small extent</th>
<th>Moderate</th>
<th>Large extent</th>
<th>Very large extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willingness to help</td>
<td>4.10</td>
<td>.539</td>
<td>0.0</td>
<td>0.0</td>
<td>8.0</td>
<td>9.9</td>
<td>57.0</td>
</tr>
<tr>
<td>Prompt attention to requests</td>
<td>4.59</td>
<td>.494</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>33.0</td>
</tr>
<tr>
<td>Problem resolution</td>
<td>4.30</td>
<td>.459</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>57.0</td>
</tr>
<tr>
<td>Complaint handling</td>
<td>4.59</td>
<td>.494</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>33.0</td>
</tr>
</tbody>
</table>

The results show that to a large extent ICT integration has achieved responsiveness in manufacturing firms. The findings show that ICT integration to a large extent achieved aspects of responsiveness such as willingness to help (M=4.10, SD=.539), prompt attention to requests (M=4.59, SD=.494), problem resolution (M=4.30, SD=.459) and complaint handling (M=4.59, SD=.494). The observations are in agreement with Lotfi, Mukhtar, Sahran and Zadeh (2013) that ICT plays a central role in integration of business processes.

Hypothesis Test Results

The hypothesis sought to test influence of ICT Integration on performance of manufacturing firms. Hypothesis 1: H₀₁: ICT Integration has 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 \(X_2\)
- \(X_1\) = ICT Integration,
- \(\epsilon\) = Error Term

\(H₀: \beta_1 = 0\) Vs \(H₁: \beta_1 \neq 0\)

Reject \(H₀\) if \(p < 0.05\), otherwise fail to reject the \(H₀\)
ICT Integration was regressed against performance. Table 6 shows the results of the regression analysis.

**Table 6: 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>.582*</td>
<td>.339</td>
<td>.331</td>
<td>2.57846</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), ICT Integration

Regression analysis results of ICT Integration against performance show that ICT integration can explain 33.9% change in performance in manufacturing firms as indicated by the value of R² (0.339).

ANOVA test was done to establish whether the model used for the analysis was fit. The results are presented in table 7.

**Table 7: 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>269.537</td>
<td>1</td>
<td>269.537</td>
<td>40.541</td>
<td>.000b</td>
</tr>
<tr>
<td>Residual</td>
<td>525.229</td>
<td>79</td>
<td>6.648</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), ICT Integration

ANOVA test results in table 7 shows that the model used in regression of ICT integration against performance was fit for the analysis (F=40.541, p=0.000). The results did not occur by chance hence are valid and suitable for making conclusions.

Coefficients table is used to show independent variable contribution to the change in the dependent variable and its significant. The coefficients in the regression of ICT integration against performance are presented in table 8.
Table 8: 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>1</td>
<td>(Constant)</td>
<td>19.459</td>
<td>3.846</td>
<td>5.060</td>
</tr>
<tr>
<td></td>
<td>ICT Integration</td>
<td>.507</td>
<td>.080</td>
<td>.582</td>
</tr>
</tbody>
</table>

a. Dependent Variable: Performance

The coefficients in the regression of ICT integration against performance show that ICT integration contributed 0.507 for every unit change in performance of manufacturing firms in Kenya.

The regression results show that H1: $\beta_2 \neq 0$ ($\beta=.507$) and $p < 0.05$ ($p=0.000$). We therefore reject the null hypothesis that ICT integration has no significant influence on performance of manufacturing firms in Kenya.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The study sought to determine the influence of ICT integration as an element of multi-echelon distribution system on performance of manufacturing firms in Kenya. ICT integration was found to explain 33.9% of change in performance of manufacturing firms in Kenya. The results also revealed that for every unit increase in ICT integration there is 0.507 unit increase in performance of manufacturing firms. The findings were congruent with observations by Nyabwanga and Ojera (2012) that horizontal and vertical collaborative mechanisms and functionalities of ICT are critical to enhance integration in a supply chain. The findings of this study also agree with those by Devaraj et al. (2007) who established that capability supporting supply chain technologies such as customer orders, purchasing and collaboration between suppliers and customer enhances the production information integration intensity, which in turn improves the supply chain performance. The findings also confirm Li et al. (2009) assertion that supply chain integration mediates the relationship between IT implementation and supply chain performance. Hence, IT can be a good enabler to integrate supply chain.
The study concluded that ICT integration significantly influence performance of manufacturing firms in Kenya. The horizontal and vertical collaborative mechanisms and functionalities of ICT are critical in enhancing integration in a supply chain. The capability supporting supply chain technologies such as customer orders, purchasing and collaboration between suppliers and customer enhances the production information integration intensity, which in turn improves performance. ICT can therefore be a good enabler to integrate supply chain.

**Recommendations**

To achieve timeliness, consistency and accuracy, manufacturing firms should ensure they adopt ICT integration in their supply chain. These can be achieved through having optimal information access and communication policies, sufficient availability of demand information, integration in the supply chain and coordination of actions through ICT. The horizontal and vertical collaborative functionalities of ICT supporting supply chain technologies such as customer orders, purchasing and collaboration between suppliers and customers enhances the production and demand information integration intensity, which in turn improves performance.

**REFERENCES**


