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Moderating Effect of ICT on Supply Chain Information Flow Risk and Performance of Manufacturing Firms in Kenya

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Abstract: **The manufacturing firms in Kenya contribute greatly to the economic development of the country. Developments in ICT are creating possibilities for moderating risks along the supply chain by creating platforms for effective decision support tools. However, the performance of the manufacturing firms has been decreasing in the past few years due to information flow risks that affect their supply chain, thereby undermining the sectors ability to contribute to the Gross Domestic Product (GDP) and attainment of Kenya's vision 2030. This study sought to investigate the moderating effect of ICT on information flow risks and performance among manufacturing firms in Kenya. Cross-sectional survey design was adopted as the research design for this study using both qualitative and quantitative approaches. The target population was 94 firms in Kiambu County, Kenya who were both members and potential members of the Kenya Association of Manufacturers (KAM). The study used stratified random sampling to pick a sample size of 76 manufacturing firms which represented 12 industrial sectors in manufacturing firms. Data was collected using questionnaires. Descriptive statistics was used aided by Statistical Packages for Social Sciences version 21 to compute percentages of respondents' answers. Inferential statistics using linear regression and correlation analysis was applied to assist examining relationship between the research variables. It was established that ICT used moderated the relationship between Information flow risks. Therefore, the study recommends that manufacturing firms should leverage on ICT use to enhance performance of their firms.**

Keywords: **information flow risks, firm performance.**

1. INTRODUCTION

Managers, consultants and academicians are increasingly recognizing the importance of the supply chain performance to the success of a business. Efficiency along the supply chain requires detailed knowledge on every minute mechanics that involve each step along the journey of a product and also understanding how these detailed mechanics support the whole process effectively (Peterson, 2016). According to Hendricks and Singhal (2005), companies are now relying on their supply chain networks to provide value. Most industries are now viewing the supply chain from a strategic angle due to its ability to generate revenue, reduce costs, improve the productivity of assets as well as increase customer satisfaction levels.

Globally, supply chain risk is not a unique phenomenon, according to Juttner et al, (2002), Foot and mouth disease in the UK in 2002 had a more diverse effect on the agricultural industry than was the case during the last outbreak which had taken place 25 years back. This was due to increase in global sourcing and consolidation of the industry. This also affected Volvo which is a luxury car manufacturer which had to stop deliveries due to lack of quality leather. In February, 1999, Toyotta was forced to close down 18 plants for about two weeks due to a fire that led to a loss of $ 195 million and

a decline in sales of $325million (70, 000 vehicles) (Converium, 2001). The global recession according to a study carried out by Accenture (2010) made companies more aware of the need for supply chain risk management. 50% of all the companies that responded gave more attention to procurement risk in 2009 than was the case in the previous years. The global competitive environment, sharing of information freely, developing long-term supply relationships, planning for the future as well as joint problem solving directly contributes to effective supply chain management and firm performance (Christopher, 2005).

Statement of the problem:

A report by the African Economic Outlook, (2015) indicates that the manufacturing sector in Kenya is the third leading contributor in terms of the Gross Domestic Product (GDP) after agriculture and horticultural industry. According to the Kenya association of Manufacturers' (KAM, 2013), the manufacturing sector in Kenya growth declined to 4.4% in 2011 as compared to a growth of 5.8% in 2010 and it has been experiencing mixed performance over the last five years, that is, 5.8% in 2010, 4.4% in 2011, 3.1% in 2012, 5.6% in 2013, 3.4% in 2014 (KAM, 2013; Waiguru, 2015; East African Community Fact and Figures, 2010). The sector recorded a growth 3.4% in 2014 compared to a 5.6 per cent growth in 2013 (Waiguru, 2015). The decline in growth was highly attributed to an increase in inflation (5.7% in 2013 compared to 6.9% in 2014) and high fuel cost in 2014 compared to 2013. The sectors contribution to the total wage employment has worsened from 13.8% in 2008 to 12.9% in 2012 (Kenya economic Report 2013).

Objectives of the Study:

General Objective:

The main objective of this study was to examine the moderating effect of ICT on supply chain information flow risks and firm performance among the manufacturing firms in Kenya

Specific Objective:

The specific objectives of this study are:

1. To determine the moderating effect of ICT on information flow risk and firm performance among the manufacturing firms in Kenya.

Research Questions:

1. What is the moderating effect of ICT on information flow risk and firm performance among the manufacturing firms in Kenya?

Research Hypothesis:

1. H_{01}: ICT use does not moderate the relationship between information flow risk and firm performance among the manufacturing firms in Kenya.

2. LITERATURE REVIEW

This chapter will discuss the literature review of the study. The main aim of the literature review is to explore the available and existing information which has been covered by the various researchers. The literature will be reviewed from, journals, the internet, reference books, working papers, reports and periodicals.

The literature will review the following areas: the conceptual framework, review of variables research gaps and a summary of the chapter

3. THEORETICAL REVIEW

Normal Accident Theory (NAT):

The Normal accident Theory (NAT) was propagated by Charles Perrow whose objective was to explain the reasons that lead to the failure of social-technical systems based on the nuclear power plant near-disaster analysis of the US (Perrow, 1984). The theory suggested that the probability of systems accident occurrence and the severity of the systems accidents are determined by two characteristics of the system.

Interactive complexity of the system is the first characteristic, a supply chain is a system which is social-technical, that is, it is a complex system since there are many elements that interact in a non-simple way as explained by Simon (1962), this makes it more difficult to control and manage. The complexity according to NAT becomes more dangerous when the components in the system interact in a non linear. This is because non linear interactions lead to event consequences that are unpredictable. When many small failures interact, they produce unfamiliar and unexpected events.

Tight coupling of the elements in the system is the second characteristic; the system is a tightly coupled system and as Galbraith (1973) and Perrow (1984) puts it, the system contains interrelated components that have processes that are time dependent, have possible substitutions and minimal slack or buffer. While systems that have tight coupling are able to have high efficiency and performance levels, supply chains that are loosely coupled are also able to absorb changes in the environment, failures or unexpected behaviors in the system. A system that is tightly coupled, a change in one component may trigger a strong and fact change in the other components in a domino kind of an effect. Therefore disruptions along the supply chain can rapidly spread through the system.

Based on these characteristics therefore, a system that has high levels of interactive complexity and high levels of tight coupling is vulnerable to accidents. This is because the combination of the two characteristics makes the prediction and the protection of the ways in which the system would fail impossible. The accidents in the system are therefore inevitable; one concludes therefore that in such systems, accidents are normal.

According to the NAT supply chains whose degree of interactive complexity is complex, and have tight coupling, the frequency of supply chain disruption is higher. Hopkins, (1999) and Wolf, (2001) as cited by Sammarco (2003) argue that it is difficult to subject the level of tight coupling to empirical test.

Vachon and Klassen, (2002) view information processing and technology as the two dimensions of supply chain complexity. Supply chain has three drivers according to Choi and Krause (2006); the quantity of suppliers, the diversity among the suppliers and the interrelationships among the suppliers. Daft (2006) on the other hand view complexity from the dimensions of vertical complexity, spatial and horizontal complexity. In the supply chain context, the vertical complexity can refer to the number of tiers in the upstream supply chain.

Spatial complexity can be seen as the geographical dispersion of the various supply base, while the horizontal complexity as Choi, Dooley and Rungtusanatham, (2001); Choi and Hong, (2002) and Vachon and Klassen, (2002) point out, refers to the number of suppliers that an organization has. In summary therefore, the three dimensions increase the supply chain complexity, reduce transparency, increases uncertainty and this in turns leads to increased exposure to disruptions along the supply chain (Choi & Krause, 2006).

In the Kenyan manufacturing sector, this theory is very relevant. This is because the interactive complexity and tight coupling (inventory buffering) leads to disruptions along the supply chains which also is the case in safety accidents. According to Perrow (1999), an accident refers to a failure in a subsystem or the system as a whole that causes damage to more than one unit and in the process causes a disruption (missed shipment, drought, depreciation of the Kenyan shilling against the dollar) on the ongoing or even the future output of the supply chain (system). The manufacturing Sector in Kenya however, with the right information are able to detect when the disruptions are occurring or when they are about to occur. Manufacturing firms in Kenya have also experienced tight coupling (higher inventory levels) that has affected customer satisfaction.

Empirical review:

Information Flow risk:

As explained by Musa (2012), information flow helps in updating all the supply chain elements and therefore provides resources for supply chain decision making. Information that may flow along the supply chain may for example include the status of orders, delivery of the orders, and status of the inventory just to mention a few (Musa, 2012; Hahn et al., 2000).

As Hahn et al (2000) puts it, efficient coordination along the supply chain as well as effective communication is vital for all the participants. Chopra and Sodhi (2004) and point out that increase in visibility on demand information reduces supply chain risk. A study by Lee et al (1997) also describe that sharing of information reduces the causes of the bullwhip effect. Lee and Whang, (2000) further add that information keeps coordination in a supply chain tight. Faisal et al (2000)

also assert that cooperation among the various participants in a supply chain leads to competitive advantage. Since each supply chain focuses on compatible objectives, duplication of efforts and redundancy of activities along the chain can be eliminated. In addition, partners in a supply chain share information openly and this provides them with a platform to jointly meet the needs of the end customer and consequently performance (lewis, 2003).

According to Musa (2012), value adding activities in a supply chain are often triggered by the flow of information which may include; information on demand, the status of the inventory, product and process design changes, status of the available capacity as well as order fulfillment. The flow of information also brings together the flow of the materials and finances within an organization. For example, when a material is delivered, the recipient is informed using the delivery order and the amount of payment that is due is also communicated by using the invoice. The information contained in the invoice triggers the recipient to make payment appropriate to the sender. Therefore funds flow in the opposite direction of the materials flow (Lewis, 2003).

According to Choy et al (2004), when information is not effectively and efficiently communicated externally with the customers and internally with the suppliers, high transaction costs are involved. Supply chain value is enhanced when costs of sourcing are reduced as well as increasing the service levels. The bullwhip effect is usually a product of poor information flow and management along the supply chain and often leads to increased inventory levels (Sweeney, 2006). Good information flow according to Christopher (2005) is normally is a substitute for high levels of inventory.

According to Clements and Munoz (2007), minor disruptions along the supply chain lead to significant impacts on the performance of a firm. Decrease in the supply chain performance can be attributed to sources related to decisions that are made by individuals (Hendricks & Singhal, 2003). Each decision made lead to a disruption in the flow of materials or information along the supply chain. This can lead to undesirable stock levels, tying up of an organization resources and ultimately contributing to opportunity costs (Clements & Munoz, 2007).

Additionally, the information should be accurate, comprehensive and should be provided in a timely manner. The efficiency, accuracy, comprehensiveness and reliability of information flow are associated directly with the entities handling this information. This as explained by Tyrinopoulos (2004) leads to faster flow of information as well as effectiveness in decision making. Information along the supply chain is vital for the coordination of the daily activities relating to production, inventory, location and transportation as well as planning and forecasting for the purpose of anticipating and meeting future demand (Maurer, 2011). Information as explained by Hugos (2006), gathered at various points of the supply chain has to be transferred or has to efficiently flow between the members of the organization and the various functions of a firm in order to provide the information to the relevant parties (Maurer, 2011).

Jain (2004) argues that information is one of the most important assets of an organization. Therefore, strategic management of information is not an option for an organization that seeks to gain a competitive advantage and win in the market place. Information is particularly important if the correct information is available for decision making, problem solving and investigation at the right time. According to Jain (2004), undistorted information should be available to an organization and therefore the importance of using information technology to manage the said information.

Failure of supply chain wide data exchange among the supply chain partners may lead to increasing errors in forecasting and diminishing quality of data (Maurer, 2011). This in turns leads to the bullwhip effect. Bullwhip effect according to Derrick (2003); Trikman and Groznik (2006) refers to the ripples in the demand forecasts that travel through the supply chain and which is as a result of discrepancies between the demand forecasts of the individual company and the real demand. Derrick (2003) believes that company share information, however, this information is limited in nature and scope therefore leading to the bullwhip effect. Simchi-Leviet et al. (2009) on the other hand maintains that the bullwhip effect results due to lack of information on demand at each stage of the supply chain. According to them (Simchi-Leviet et al., 2009), when a company takes long in responding to the demands of the customer by failing to pass the correct information to the next tier on time on the forecast order, variability in the forecast orders increase in that tier. Bullwhip effect therefore arises due to lack of real time information sharing and efficient flow of information along the supply chain (Maurer, 2011).

Inter-organizational information systems such as EDI enables an organization to share information which is accurate, assists in integrating the information (Lee & Lim, 2005) and enables the integrity, product quality and responsiveness as well as reducing the distortion of information. EDI therefore enables an organization to increase response time, increases

value to an organization and allows it to provide services that are unique. EDI also adds the capabilities of delivering products and services to the customers. Supply chain players are also adopting the Radio Frequency Identification (RFID) in their ICT logistics system. Radio Frequency Identification (RFID) is an information system that allows the reduction of time required in the distribution of a product.

According to Mercado (2008), RFID is a data capturing system and an automatic identification which combines three components; a tag which is formed by a chip and which is connected to an antenna; a reader that is responsible for the emission of the radio signal and the middleware which is connected to the hardware and other application devices. RFID provides data communication in real time through the radio waves to several objects or data at the same time and at a distance without touch. This helps in the improvement of the traceability and visibility of the products between the partners in the supply chain. RFID has also the advantage of increasing efficiency, processing speed, reduction of losses associated with inventory as well improved accuracy of information (Mercado, 2008; Son et al., 2005). RFID can also decrease the costs of handling, storage and distribution as well as help in the reduction of out of stock products (Leung et al., 2007).

Vendor Managed Category Management (VMCM) is an innovative system that helps in the reduction of problems that are associated with replenishment, especially managing out-of-stock (Lee & Lim, 2005). VMCM is a combination of VMI, Efficient Customer Response (ECR) and outsourcing in the manufacturing industry. Implementation of VMI system in the supply chain helps in the reduction of inventory shortages and rationing gaming. The system helps in the signaling of demand and also anticipates the number of product sales as well as management of inventory (Gavirneni, 2006).

Results of a study conducted by Zibra (2010) however found out that when firms fail to leverage on modern technology such as Short Message Service (SMS) to communicate with supply chain partners.

Information accuracy:

Accurate information should be error free, that is, the information shared according to Kaipia, (2009) should be based on objective data and should be complete to enable effective sharing by firms. According to Butcher, Lalwani and Mangan (2008), accurately matching supply and demand information is important in ensuring that products are delivered at the right time, in the right place, at the right price, from the right source and in the right quality and quantity to meet the specification of the end customer. Butchers, Lalwani and Mangan, (2008) further assert that the demand side information helps the suppliers in knowing what products are required, quantities and the right specifications by the customer. Bidgoli (2010) asserts that information bureaucracy, where many levels are involved before the information reaches the intended destination increases uncertainty along the supply chain, further increasing lead times which impacts on costs.

Information inaccuracy can be prevented by the adoption of information sharing and transparency which can be achieved through the appreciation of the advancements in the internet technology. Taking the wrong actions and policies regarding inventory data can trigger information inaccuracy according to Raman et al. (2001) and Lee (2004) assert that top supply chains have triple A characteristics which include: Agility to changes, Adaptable top evolvement and Aligned to the interests of all the firms in the supply network.

According to Chopra and Sodhi (2004), failure to accurately match demand and supply has led to loss of sales for many companies. For example, lack of accurate information on an increase in demand leads to under stocking and consequently loss of sales and profits for a business. Information flow according to Bradley (2001) should be faster and should be able to allow for compressing cycle times in order to avoid loss in sales. Geary et al. (2002) argue that implementation of flawless materials and information system among the supply chain participants should be used to prevent uncertainty and improve the performance of a firm.

Inaccurate information on inventory levels may lead to dissatisfied customers since organizations may sell stocks that do not actually exist since they may be mislead that they have more inventory than they actually have (Partida, 2012). On the other hand, accurate information on the levels of inventory may lead to improved performance in the logistical processes. An increase in information accuracy on the inventory levels is associated with an increase in the suppliers' orders that are delivered on time, faster dock to stock cycle times as well as increased sales orders that are delivered on time.

Supply side information on the other hand helps the customers to know when the products will be delivered by the suppliers, the quantities that the products will arrive in and the specifications of the products (Butcher, Lalwani & Mangan, 2008). Today, with the proliferation of the global supply chain networks, customers on the demand side require

increased volumes and varieties of items in shortened time frames. This creates the need for high speed and accurate information on the market (Butcher, Lalwani & Mangan, 2008).

Information types:

Type refers to the different variety of information that can be shared along the supply chain. These may include information on demand forecast, the sales data, the levels of inventory, the order status, planning of products, and logistics of the company as well as production schedules (Helo & Szekely, 2005). When information on the inventory levels and sales data is shared, it helps in the reduction of the bullwhip effect (Sweeney, 2006). Companies which share information on the performance metrics such as the required product quality and the lead times can help in the identification and reduction of bottlenecks within the entire supply chain and therefore improve the performance of the company (lee & Whang, 2000). Sharing information on capacity with the downstream partners can also help the supply chain partners to coordinate their production on demand and therefore prevent any shortages from occurring in the organization (Lee & Whang, 2000).

Information on demand levels can helps to provide forecasts, acts as a source of promotional campaigns and also informs the future business of an organization (Gavirneni et al, 2006). Information on inventory includes the levels of stocks held by an organization which affect the orders placed with partners along the supply chain (Lee et al., 2004). Information on production provides information concerning the lead times, resources, production capacity, production routing and duration which helps in the implementation of production plans (benz & Hoflinger, 2011). Production resources and capacity assist the organization in optimizing the flow of the materials hence efficiency (Lee & Whang, 2000). Logistics information include information on delivery schedules, the track loads and tracing of orders which in turn increases visibility along the supply chain and increase the processes of distribution (Helo & Szekely, 2005). The performance metrics are the Key Performance Indicators (KPI) that support the decisions made by an organization in order to improve the processes. The KPI can assess for example the rate of inventory turnover, the performance of the suppliers and the transport costs incurred by an organization thereby helping in keeping the supply chain risks on check (Gunasekaran & Kobu, 2007).

Information connectivity:

Information connectivity refers to the way the information along the supply chain is shared among the chain partners (Goswami, Engel & Krcmar, 2013). Information connectivity can occur both internally and externally. When information is shared among the different functions of an organization but within the boundaries of a firm, this is referred to as internal connectivity. External connectivity on the other hand occurs when information is exchanged outside the boundaries of a firm, for example with the customers, suppliers and third party service providers outsourced by an organization (Closs et al., 1997). Connectivity allows process coordination both within the firm as well as outside the firm. Various supply chain concepts such as Vendor Management Inventory (VMI), Collaborative Planning Forecasting and Replenishment which enhance collaboration and coordination within an organization can be supported through connectivity (Nambisan, 2000)

4. RESEARCH METHODOLOGY

The study applied Cross-sectional survey design was adopted as the research design for this study using both qualitative and quantitative approaches. The target population was 94 firms in Kiambu County who were both members and potential members of the Kenya Association of Manufacturers (KAM). The study used stratified random sampling to pick a sample size of 76 manufacturing firms which represented 12 industrial sectors in manufacturing firms. Data was collected using questionnaires. Descriptive statistics was used aided by Statistical Packages for Social Sciences version 21 to compute percentages of respondents' answers.

Results of the Study:

Descriptive analysis of Information flow risk:

The study sought to determine the moderating effect of ICT on information flow risk and firm performance. The following indicators were used to measure this objective: information accuracy, information types and information connectivity. The respondents were asked to indicate the extent to which they agreed with the flow of information along

the supply chain for performance in the manufacturing firms. This was on a likert scale strongly agree, agree, neutral, disagree or strongly disagree.

Majority of the respondents (44.9%) strongly disagreed that their firms frequently shared information with their supply chain partners, such as information on the status of the orders, delivery of orders and inventory status, 40.6% of the respondents disagreed, 11.6% were neutral while 2.9% agreed that information is shared among the supply chain partners (Mean = 1.72, SD =0.784). Majority (47.8%) also disagreed with the presence of appropriate technology that helps in information sharing among the supply chain partners, 34.8% strongly disagreed, 10.1% were neutral while the minority 5.8% agreed there was presence of appropriate technology in the firms that helped in sharing information along the supply chain (Mean = 1.91, SD =0.903). On the other hand, majority of the respondents (36.9%) disagreed that information is not shared at every stage of the supply chain, 24.6% of the respondents were neutral, 20% of the respondents agreed that information is not shared at every stage of the supply chain the minority (9.2%) strongly disagreed and also (9.2%) strongly agreed (Mean = 2.83, SD =1.140). In addition, a large number of the respondents (39.7%) disagreed with the fact that their firms rarely share information with their supply chain partners. 27.9% also strongly disagreed, 13.2% were neutral, 13.2% agreed while a small number 5.9% strongly agreed (Mean = 2.29, SD =1.185).

The highest mean was 2.29 with the lowest being 1.72. This showed that the respondents took a negative position about the presence of information flow risk in their supply chains (below 3.0). All the items had a mean below 3.0. This showed that the general position was that information flow risk was not present among the manufacturing firms in Kenya as shown in table 1..

Table 1 Information flow Risk

	SD%	D%	N%	A%	SA%	M	SD
a) We frequently share information with our supply chain partners (status of orders, delivery of orders, status of inventory e.t.c)	44.9	40.6	11.6	2.9		1.72	.784
b) We have appropriate technology that helps in information sharing	34.8	47.8	10.1	5.8	1.4	1.91	.903
c) Information is not shared in every stage of the supply chain	9.2	36.9	24.6	20.0	9.2	2.83	1.140
We rarely share information with our supply chain partners	27.9	39.7	13.2	13.2	5.9	2.29	1.185

Key: SD (Strongly Disagree), D (Disagree), N (Neutral), A (Agree), SA (Strongly Agree), SD (Strongly Disagree)

In general, the study found out that manufacturing firm in Kenya share information with their supply chain partners. This is in tandem with Musa (2012) who explains that information flow updates all the elements in the supply chain and therefore critical in supply chain decision making. These findings also concur with the study carried out by Hahn et al (2000) that information sharing can enhance efficient coordination along the supply chain and effective communication is important for the supply chain participants. These findings also agree with Lee and Whang (2000) and Faisal et al (2000) who further add that information keeps coordination along the supply chain tight and increases the competitive advantage of an enterprise.

However, the study found out that manufacturing firms in Kenya do not frequently share information such as order status, order deliveries and inventory status with their supply chain partners. Also, manufacturing firms in Kenya lack appropriate technology to enable them share information along the supply chain. A study by Musa (2012) suggests that value along the supply chain is triggered by the flow of information which may include; information on demand, status of the inventory, process and design changes, status of the available capacity as well as order fulfillment. Jain (2004) also asserts that information technology avails undistorted information along the supply chain which further reduces the bullwhip effect. Therefore, manufacturing firms in Kenya should frequently share information with their supply chain partners and have the appropriate technology for supply chain information sharing which will reduce the risk of information flow and further improve the performance of their firms.

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a) Information accuracy:

The majority of the respondents (48.5%) disagreed that they shared objective information along the supply chain that was free of error. 23.5% of the respondents strongly disagreed, 13.2% of the respondents were neutral, 13.2% agreed while the minority (5.9%) strongly agreed (Mean = 2.21, SD =1.001). A large number of respondents (33.8%) disagreed that their firms have many levels through which the documents are passed before the actual implementation is done (bureaucracy), 30.9% of the respondents agreed with bureaucracy in their firms, 20.6% of the firms strongly disagreed, 8.8% were neutral while a small number (5.9%) strongly agreed with presence of bureaucracy in their firms (Mean = 2.68, SD =1.275). Majority of the respondents (35.3%) strongly disagreed that their firms had adopted information technology to enable accurate information sharing along the supply chain, 35.3% of the respondents disagreed, 10.3% were neutral, 13.2% agreed while the minority (5.9%) strongly agreed (Mean = 2.19, SD =1.225). A large number of the respondents (41.2%) disagreed that they were not aware of the exact quantities and timings of the deliveries from suppliers, 33.8% strongly disagreed, 13.2% strongly agreed, while the minority 5.9% strongly agreed and 5.9% were neutral (Mean = 2.16, SD =1.205). A large number of respondents (33.8%) disagreed that they had minimum technology for information sharing, 23.5% strongly disagreed, 23.5% agreed, 13.2% were neutral while a small number 5.9% strongly agreed (Mean = 2.54, SD =1.251). the highest mean for information accuracy was 2.68 while the lowest mean was 2.21. This showed that the majority of the respondents took a positive position that information that was flowing along the supply chain was accurate (mean less than 3.0) shown in table 2.

Table 2: Measurement of Information accuracy

	S D%	D%	N%	A%	S A%	M	SD.
d) We share objective information along the supply chain free of error	23.5	48.5	13.2	13.2	1.5	2.21	1.001
e) We have very many levels through which documents are passed through before the actual implementation bureaucracy)	20.6	33.8	8.8	30.9	5.9	2.68	1.275
f) We have adopted information technology to enable accurate information sharing along the supply chain	35.3	35.3	10.3	13.2	5.9	2.19	1.225
g) We are not aware of the exact quantities and timings of the deliveries from suppliers	33.8	41.2	5.9	13.2	5.9	2.16	1.205
h) We have minimum technology for information sharing	23.5	33.8	13.2	23.5	5.9	2.54	1.251

From the findings, it was clear that manufacturing firms in Kenya avoided many levels when passing documents (bureaucracy) prior to their implementation. This ensures that information is not distorted as it passes along the supply chain. This agrees with Bidgoli (2010) who asserts that bureaucracy along the supply chain increases uncertainty, further increasing lead times which have cost implications to the firm. The firms are also aware of the exact timings of the exact timing and deliveries from the suppliers. This findings concur with Chopra and Sodhi (2004) that lack of accurate information on timings and deliveries of supplies can lead to under stocking which can lead to loss of sales and consequently profits of the business. The firms have adequate technology for information sharing which is in tandem with the findings of Hernandez, Galindo & Colin(2015) that proper technology increases the accuracy of data shared along the supply chain.

There is need however for the manufacturing firms to share more objective, error free information along the supply chain. Information shared along the supply chain should be free of error and objective to enable effective sharing by firms (Kaipia, 2009). This helps in accurately matching supply and demand and ensuring that products are delivered at the right time, at the right place, from the right source, in the right quality and quantity to meet specifications of the customers (Butchers, Lalwani and Mangan, 2008). The firms also need to adopt information technology to enable information sharing along the supply chain. This is in line with Raman et al (2001) and Lee (2004) who explain that lack of information technology adoption can lead to information inaccuracy which can lead to adoption on wrong policies regarding inventory data and lack of agility to changes in the business environment.

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b) Information types:

Majority of the respondents (37.3%) disagreed that they share information such as sales data, product planning and logistical schedules, 25.4% agreed, 19.4% were neutral, 11.9% strongly disagreed while the minority (6%) strongly agreed (Mean = 2.76, SD =1.143). A large number of the respondents (32.3%) disagreed that minimum information on inventory levels and lead times is availed to supply chain partners, 21.5% of the respondents were neutral (Mean = 2.86, SD =1.273). Majority of the respondents (57.6%) disagreed that they shared information on production capacity, 16.7% strongly disagreed, 12.1% were neutral, 10.6% of the respondents agreed that they shared information on production capacity while the minority (3%) strongly agreed that they shared information on production capacity (Mean = 2.26, SD =0.966). The highest mean was 2.86 while the lowest was 2.26 indicating that the respondents agreed that the correct type of information was flowing along their supply chains as shown in table 3.

Table 3: Measurement of Information Types

	SD %	D %	N %	A %	SA %	M	SD
i) We share information such as sales data, product planning, logistical schedules etc.	11.9	37.3	19.4	25.4	6.0	2.76	1.143
j) Minimal information on inventory levels and lead times is availed to supply chain partners	13.8	32.3	21.5	18.5	13.8	2.86	1.273
k) We share information on production capacity	16.7	57.6	12.1	10.6	3.0	2.26	.966

This study found out that majority of the manufacturing firms in Kenya shared information on inventory levels and lead times among their supply chain partners to enable them manage their inventories and satisfy their customers. These findings are in harmony with Sweeney (2006) that when information on inventory levels is shared, it helps in reducing the bullwhip effect. The study also agrees with Lee and Whang (2000) that sharing information on lead times also helps in reducing bottlenecks along the supply chain and therefore improve the performance of the company. However contrary to the findings of Benz and Hoflinger (2011), it was clear that manufacturing firms in Kenya do not share information on production capacity. This can increase risks along the supply chain due to lack of coordination of both production and demand and therefore results to inventory shortages and hinder implementation of production plans within the organizations.

c) Information Connectivity:

A large number of respondents (36.9%) agreed that they shared information only within the company, 32.3% disagreed, 12.3% strongly disagreed while a small number (6.2%) strongly agreed (Mean = 2.92, SD =1.203). Majority of the respondents (37.5%) disagreed that supply chain information is only communicated with the suppliers, customers and 3rd party service providers, 21.9% agreed, 15.6% strongly agreed, while the minority 12.5% agreed, 12.5% were also neutral (Mean = 2.91, SD =1.318). Majority of the respondents (43.5%) agreed that all the company personal information is available in the website, 23,2% strongly agreed, 14.5% disagreed while the minority (5.8%) strongly disagreed (Mean = 3.64, SD =1.163). A large number of respondents (44.1%) agreed that the firm does not have centralized information sharing system and that all the departments share information freely, 19.1% strongly agreed, 16.2% disagreed, 13.2% were neutral while a small number (7.4%) strongly disagreed (Mean = 3.51, SD =1.191) as shown in table 4.

Table 4: Measurement of Information connectivity

	SD %	D %	N %	A %	SA %	M	SD.
l) We share supply chain information only within the company	12.3	32.3	12.3	36.9	6.2	2.92	1.203
m) Supply chain information is only communicated with the suppliers, customers and 3rd party service provider	12.5	37.5	12.5	21.9	15.6	2.91	1.318
n) All the company personal information is available in the website	5.8	14.5	13.0	43.5	23.2	3.64	1.163
o) We do not have a centralized information sharing system and all the departments share information freely	7.4	16.2	13.2	44.1	19.1	3.51	1.191

Based on the findings, the firms share information with the suppliers, customers and 3rd party providers. This is in agreement with the findings of a study by Nambisan (2000) that when information is exchanged with customers, suppliers and 3rd parties who are outside the geographical boundaries of a firm, it allows coordination of processes such as Vendor Management Inventory (VMI). However, much of the information was only shared within the company and companies also lacked centralized information sharing system since information was shared freely. This can be risky for the firms since it hinders collaboration and coordination which is supported through connectivity therefore affecting the firms' performance (Closs et al, 1997; Nambisan, 2000).

d) ICT use on Information flow risk:

The study sought to establish how the manufacturing firms in Kenya use ICT to enable the flow of information along the supply chain. Majority of the firms (75.0%) indicated that they use ICT to gather sales data, 62.5% use ICT to analyze demand forecast data, 65.3% to post inventory level data, 61.1% to gather order status data, 63.9% to analyze production schedule information, 61.1% to store plans of the order, 58.3% to gather logistical data and minority 34.7% for Corporate Social Responsibility (CSR) as depicted in table 5.

Table 5: ICT use on Information flow risk

	Frequency	%
Gather sales data		
No	16	25
Yes	54	75
Analyze demand forecast		
No	25	37.5
Yes	45	62.5
Post inventory data		
No	23	34.7
Yes	47	65.3
Gather order status		
No	26	38.9
Yes	44	61.1
Analyze production schedule		
No	24	36.1
Yes	26	63.9
Store plans of the order		
No	26	38.9
Yes	44	61.1
Gather logistical data		
No	27	41.7
Yes	42	58.3
Corporate Social Responsibility (CSR)		
No	43	65.3
Yes	25	34.7

This study findings are in agreement with Elbashir, Collier and Davern, (2008) ; Shang et al, (2008) who argue that supply chain risk management requires a large data base of information (sales data, demand forecast, inventory levels) which helps in decision making on the strategies to mitigate the risks. These findings also agree with the findings of a research carried out by Cadez, (2008); Stoel and Muhanna, (2009) that information increases the performance of the firm as they are able to formulate responses that are effective.

The study observed that majority of the manufacturing firms in Kenya (75%) use ICT to gather sales data, 62.5% to analyze demand forecast data, 65.3% to post inventory level data, 61.1% to gather order status data, 63.9% to analyze production schedule information, 61.1% to store plans of the order, 58.3% to gather logistical data and minority (34.7%) use ICT for Corporate Social Responsibility (CSR). Other uses of ICT are shown in table 6 below;

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Table 6: Measurement of other uses of ICT

	Frequency	Percentage
Demand Forecast	2	2.8
Timely sharing information	1	1.4
It improves performance	3	4.2

Moderation effect of ICT on information flow risk and firm performance:

A moderator variable influences the relationship between the dependent variable and the independent variable. The magnitude and the direction of the relationship depends on the value of the moderator (Sekaran, 2006). This study identified ICT use as the moderator variable affecting the relationship between information flow risk (independent variable) and firm performance (dependent variable) among the manufacturing firms in Kenya. Using the moderated multiple regression (MMR) analysis in this study, the moderating effect of the variable (interaction term) was analyzed by interpreting the R^2 change in the models obtained from the model summaries and by interpreting the regression coefficients for the interaction term obtained from the coefficient tables. Regression analysis was performed in this study to test the moderating effect of ICT use on the relationship between information flow risk and firm performance among the manufacturing firms in Kenya.

The hypothesis to test for this specific objective was:

H_{01} – ICT use does not moderate the relationship between information flow risk and firm performance among the manufacturing firms in Kenya

To determine if ICT use moderates the relationship between information flow risk and firm performance among the manufacturing firms in Kenya, three models were fitted hierarchically with;

1) Model 1 having X_1 as the predictor.
2) Model 2 having X_1 and the moderation variable as a predictor.
3) Model 3 is model 2 with interaction term between X_1 and the moderating variable.

The 3 models were found to be statistically insignificant, that is, in all cases p was bigger than 0.05 (see table 7).

Table 7: Moderating effect of ICT on information flow risk and firm performance

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		Change Statistics		
					R Square Change	F Change	df1	df2	Sig. F Change
1	.168[a]	0.28	0.013	0.537	0.028	1.889	1[a]	65	0.174
2	.265[b]	0.070	0.041	0.529	0.042	2.895	1[b]	64	0.094
3	.305[c]	0.093	0.050	0.527	0.023	1.595	1[c]	63	0.211

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	0.544	1	0.544	1.889	.174[b]
	Residual	18.729	65	0.288		
	Total	19.273	66			
2	Regression	1.355	2	0.677	2.42	.097[c]
	Residual	17.918	64	0.28		
	Total	19.273	66			
3	Regression	1.797	3	0.599	2.16	.102[d]
	Residual	17.476	63	0.277		
	Total	19.273	66			

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Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	3.468	.066		52.879	.000		
	Information flow risk	-.152	.110	-.168	-1.375	.174	1.000	
2	(Constant)	3.305	.115		28.625	.000		1.000
	Information flow risk	-.081	.116	-.090	-.699	.487	.874	
	ICT use	.248	.146	.219	1.701	.094	.874	1.145
3	(Constant)	3.362	.123		27.233	.000		1.145
	Information flow risk	-.276	.193	-.306	-1.432	.157	.315	
	ICT use	.208	.148	.184	1.399	.167	.834	3.172
	Information flow risk*ICT use	.305	.241	.256	1.263	.211	.352	1.200

However, looking at the reduction in p values (from 0.174 to 0.094 to 0.211), that is, the significant F change, one would suspect some form of moderation, maybe with a larger sample size. ICT use as a moderator on the relationship between information flow risk and firm performance is further depicted by the scatter plot. As shown in the Figure 1 the crossover point for the two regression lines occurs on the right side of predictor and therefore the moderator narrowly influenced the relationship between information flow risk and firm performance. The green regression line is horizontal. This means that information flow risk does not influence performance. However, without ICT use, performance is worse.

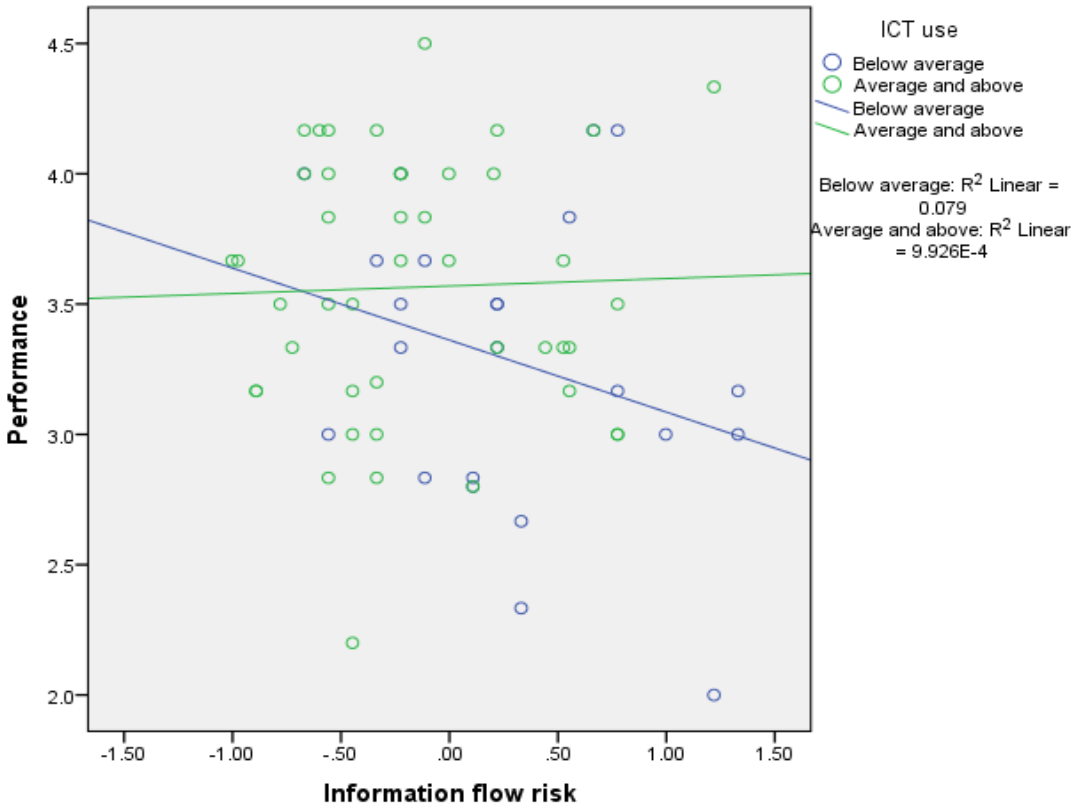

Figure 1: Slope of moderated information flow risk

The scatter plot suggests some form of moderation though not statistically significant (p-value is less than 0.05). The findings from the scatterplot roughly suggested some form of moderation effect of ICT use on the relationship between information flow risk and firm performance. ICT use affects slightly positive the performance of manufacturing firms in Kenya. This means that for manufacturing firms below average (blue line) in ICT use, the higher the information flow risk

and therefore worse in terms of performance. Manufacturing firms in Kenya that have challenges in ICT use (lack training and ICT infrastructure) are affected by information flow risk and this inhibits their performance. Manufacturing firms in Kenya who are above average in terms of ICT use (green line), their performance is not affected. This means that even if information flow risk increases, the performance remains the same (it is not affected).

This is in agreement with the study by Lee and Lim (2005) that ICT enables firms to share information, integrate information thereby improving responsiveness and reducing information distortion. This is especially the case when firms have the necessary infrastructure and a well trained workforce to leverage on the ICT in managing information flow risk.

An open ended question was asked on how information flow affects the performance of the firm. The respondents indicated information flow helps in setting the production schedules of a firm.

5. DISCUSSION

It is clear from the qualitative results that information flow risk does not affect the performance of the manufacturing firms in Kenya. This results disagree with the findings of Choy *et al* (2004) and Musa (2012). This is supported by the descriptive results where the majority of the manufacturing firms (44.9%) failed to share information on sales orders, inventory status and order deliveries. Lack of such information according to Clement and Munoz, (2007); Hendricks and Singhal, (2003) would disrupt the supply chains and therefore significantly impact the performance of the firm in terms of stock levels of tying of organizations resources. This means that important supply chain information that would have had a bearing on the firm performance was not shared among the supply chain partners. The respondents also indicated that information flow also helps in setting the production schedules of a firm which increases customer satisfaction.

On moderation, results from the scatter plot showed that ICT moderated the relationship between information flow risk and the performance of the manufacturing firms in Kenya. In fact, manufacturing firms which failed to leverage in ICT recorded a poor performance compared to those that did. This is in agreement with the findings of Lee and Lim (2005) that information sharing reduces distortion therefore availing the right supply chain information for decision making which improves the firm performance.

6. SUMMARY, CONCLUSION AND RECOMMENDATIONS

Moderating effect of ICT on information flow risk and firm performance among the manufacturing firms in Kenya:

Information flow risks is define as a disruption in supply chain information therefore affecting the firm performance. Information flow risk in this study was measured using information accuracy, information types and information connectivity. The study established that that manufacturing firm in Kenya share information with their supply chain partners. However, the study found out that manufacturing firms in Kenya do not frequently share information such as order status, order deliveries and inventory status with their supply chain partners. Also, manufacturing firms in Kenya lack appropriate technology to enable them share information along the supply chain.

Manufacturing firms in Kenya avoided many levels when passing documents (bureaucracy) prior to their implementation. This ensures that information is not distorted as it passes along the supply chain. The firms are also aware of the exact timings of the exact timing and deliveries from the suppliers. The firms also have adequate technology for information sharing. The manufacturing firms however do not share more objective, error free information along the supply chain. Also, the manufacturing firms in Kenya shared information on inventory levels and lead times among their supply chain partners to enable them manage their inventories and satisfy their customers. However, manufacturing firms in Kenya do not share information on production capacity. Likewise, manufacturing firms also shared information with the suppliers, customers and 3rd party providers. However, much of the information was only shared within the company and companies also lacked centralized information sharing system since information was shared freely.

Manufacturing firms in Kenya use ICT to gather sales data, to analyze demand forecast data, to post inventory level data, to gather order status data, to analyze production schedule information, to store plans of the order, to gather logistical data. However, few firms used ICT for Corporate Social Responsibility (CSR). Information flow helped manufacturing firms in setting the production schedules.

Moreover, there was no significant relationship between information flow risk and firm performance. This means that information flow risk does not influence the performance of manufacturing firms in Kenya.

ICT moderation on the relationship between information flow risk and firm performance was not statistically significant. However, further test using the scatter graph implied that ICT use moderates the relationship between information flow risk and performance of the manufacturing firms in Kenya. Meaning that manufacturing firms in Kiambu County which had leveraged on the use of ICT recorded a high performance while those that had not recorded a poor firm performance. This findings were in harmony Lee and Lim (2005) who asserted that ICT use improves information flow along the supply chain, improves information integration thereby improving the performance of a firm.

Conclusion:

Moderating effect of ICT use on the relationship between information flow risk and firm performance among the manufacturing firms in Kenya:

The findings confirm that there is statistically no significant relationship between information flow risk and performance among the manufacturing firms in Kenya. This can be explained by the fact that, manufacturing firms in Kenya lack information connectivity as evidenced by the descriptive statistics. This results are in line with Choy et al (2004) who explained that lack of proper information flow between an organization and its customers as well as suppliers may lead to high transactional costs. This transactional costs reduces the profits of a firm.

ICT use as a moderator of the relationship between financial flow risk and performance among the manufacturing firms in Kenya was also not significant. This can be explained by the fact that, although manufacturing firms in Kenya have proper ICT infrastructure and also skills in ICT, they fail to use the same to improve their supply chains. Majority of the manufacturing firms for example failed to leverage on ICT to gather more data on their logistics. Lee and Lim (2005) agrees that leveraging on ICT systems such as Radio Frequency Identification (RFID) reduces the amount of time taken by a firm to distribute a product and therefore improves customer satisfaction.

Recommendations:

Moderating effect of ICT use on the relationship between information flow risk and firm performance among the manufacturing firms in Kenya:

Manufacturing firms should share information such as order status, delivery of orders and status of inventory with their supply chain partners. This is because sharing of the status of the order will help the manufacturing firms to improve inventory accuracy. This is because they will be able to plan their production based on the information on whether the order has been shipped and therefore increase customer satisfaction by providing sufficient lead time dates. The order status also helps to reduce information flow risk along the supply chain as the manufacturing firm swill be able to increase supply chain visibility and initiate proactive measures on the potential areas that may hinder the timely delivery of their orders. In formation on inventory levels that is required when shared appropriately with the supply chain partners will improve information accuracy along the supply chain and prevent the bull whip effect (Sweeney, 2006). Bullwhip is caused by information miss match on the correct inventory levels required by the end customer. This increases the inventory holding costs which consequently affects the performance of a firm.

Information on production capacity should also be shared by the manufacturing firms in Kenya. This is because such information as lead times, production routing and production duration will help the manufacturing firms to estimate their production plans (Benz & Hoflinger, 2011). This will also help the firms to optimize their production flow and therefore improve efficiency and reduce costs (Lee &Whang, 2005).

Manufacturing firms in Kenya should also leverage on ICT use. This is because ICT helps in reducing information flow risk and therefore improves the performance of the manufacturing firms in Kenya as evidenced in the fin dings. Therefore firms must have the appropriate ICT infrastructure such as Electronic Data Interchange (EDI) that will help in increasing response time and also adds in the firms' capability of delivering the products to the customer by providing real time information on customer requirements (Lee & Lim, 2005). Firms should also leverage on ICT platforms such as Vendor Managed Category Management (VMCM) as this will increase the flow of information on the stock levels therefore reducing risks associated with out of stock and also enable timely replenishments of materials in the firm (Gavirneni, 2006).

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