INFLUENCE OF LOGISTICS INFORMATION SYSTEM MANAGEMENT ON PERFORMANCE OF FOOD AND BEVERAGE MANUFACTURING FIRMS IN KENYA

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ABSTRACT

The purpose of this paper is to assess the influence of logistics information systems management on the *performance of food and beverage manufacturing firms in Kenya. Manufacturing companies in Kenya have been experiencing problems in the performance of their production and operations management. In view of the foregoing, it is relevant to investigate how Kenyan organizations could outsource their logistics requirements through logistics information systems management in the most efficient manner with regard to customer service and cost. In Kenya, studies have reported mixed findings with regard to logistics information systems management and its influence on firm performance among food and beverage manufacturing firms, while published literature on logistics information systems management and firm performance lacks in the country. It is against this backdrop that the present study sets out to investigate the influence of logistics information systems management on performance of food and beverage manufacturing firms in Kenya. This research study adopted a descriptive research design approach. Data was collected using self-administered questionnaires. The data collected was analyzed by use of descriptive and inferential statistics. Multiple regression model was used to show the relationship between the dependent variable and the independent variables. The findings from the study revealed that logistics information systems management had a significant influence on the performance of food and beverage processing firms. Policy and governance framework was also found to significantly moderate the relationship between logistics information systems management and performance of food and beverage processing firms. The study concluded that logistics information system management was critical in enhancing the performance of food and beverage processing firms in Kenya. The study recommends that the management of food and beverage processing firms ought to embrace enhanced use of logistics information systems to enhance performance.*

Keywords: *Logistics Information System Management, Fourth Party Logistics, Food and Beverage Manufacturing Firms, Firm Performance*

1.0 INTRODUCTION

1.1 Background to the Study

In the 21st century, manufacturing environment is becoming competitive day by day as the rapid globalization and technology continue to force organizations to constantly seek ongoing improvement in all areas in terms of their knowledge, flexibility and performance (SoonHu, 2010). Logistics is one of the fields that is receiving growing attention as a result of these rapid changes, owing to its ability to enhance efficiency and productivity towards improving customer service and to lower costs (Payan, 2013; Hirakubo & Kublin, 2011; Bourlakis & Bourlakis, 2015). One of the integral aspects of logistics is the logistics information systems. As the Information Technology is becoming a common and must-have pillar in every modern organization, logistics has also to be tied on technology through logistics information systems. Chang et al. (2012) define logistics information system as the flow of data in different directions with variable contents between various data base (department) within a company. Logistics information system has continually enabled supply chains to respond on real time and accurate data thus meeting and understanding the changing customer needs (Bumstead & Cannons, 2012).

Samson (2012) concurred that, the flow of accurate and real time information in logistics was considered very important to the flow of materials. This logistics information system explosion had enabled logistics to become an important weapon in the firm's arsenal to add value to the bottom line (Bowersox, Closs & Cooper, 2010). Information sharing has been a key to success of logistics performance. Abrahamsson (2008) confirmed that logistics information system had become an important element that reflected collaboration within the logistics management and firm performance. Sharing of information on transfer; exchange of information indicating the level and position of inventory; sales data and information on the forecasting; information about the status of orders, production schedules and delivery capacity, and firm performance measures had become essential to all firms (Wardaya, *et al.*, 2013).

On the other hand, manufacturing sector has been integral to the economic growth and development in both the developed and the developing countries. Among the major sub-sectors in the manufacturing sector is the food and beverage processing firms. These are the companies dealing with production, value addition and supply of food products including beverages. According to OECD (2016), the food and beverage processing industries controls over 48% of the global manufacturing industry owing to the ever-increasing demand of food products. In Kenya, the food and beverage processing firms are the majority in the manufacturing industry. This shows that focusing on these companies would be a major milestone towards answering to the concerns in the manufacturing sector. The logistics information systems management and the entire supply chain in these firms has not been adequately documented, particularly in a local context.

1.2 Statement of the Problem

Most food and beverage manufacturing firms in Kenya operate at a technical efficiency of about 59% compared to their counterparts in South Africa at 70% and Malaysia at about 74% (JDA, 2019). According to a report by Deloitte (2019) on food and beverage manufacturing firms in Kenya, fourth party logistics saved various firms over Kshs.82 Billion in the financial year (FY)

2018/2019. According to KAM (2020), on the life span of food and beverage manufacturing firms, the firms were winding up at notable percentage indices, fluctuating between 49% and 58%; poor logistics outsourcing was cited as the main reason. According to KAM (2019), the manufacturing sector has always accounted for over 35% of the country's Gross Domestic Product (GDP), provided employment to about 600,000 people in the formal sector and 2 million persons in the informal sectors of the economy. However, the firms have been experiencing problems in the performance of their production and operations management.

The existing literature has shown mixed results with regard to fourth party logistics and its influence on firm performance. Moreover, most of the available studies have focused on different contexts from this study with scant evidence available on how logistics information systems management affect performance of manufacturing firms in a Kenyan context. This study therefore sought to bridge this gap by assessing the influence of logistics information systems management on performance of food and beverage manufacturing firms in Kenya.

1.3 Study Objectives

i. To determine the influence of logistics information system management on performance of food and beverage manufacturing firms in Kenya.

ii. To determine the moderating influence of policy and governance framework on the relationship between logistics information systems management and performance of food and beverage manufacturing firms in Kenya.

1.4 Research Hypotheses

The study was guided by the following null hypotheses:

i. H_{o1}: Logistics information system management does not significantly influence the performance of food and beverage manufacturing firms in Kenya.

ii. H_{o2}: Policy and governance framework does not significantly moderate the relationship between logistics information systems management and performance of food and beverage manufacturing firms in Kenya.

2.0 LITERATURE REVIEW

2.1 Theoretical Review

This paper was informed by the Principal Agency Theory. The theory was first proposed in the context of logistics and supply chain in the year 1976 in an article "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure" by Jensen and Meckling. It was established as the dominant theoretical framework of the supply chain literature, and position shareholders as the main stakeholder. The adoption of the agency logic increased during the 1980's as companies started replacing the hitherto corporate logic of managerial capitalism with

the perception of managers as agents of the shareholders (Bourlakis & Bourlakis, 2015). This theory is based on the separation of ownership and control of economic activities between the agent and the principal. Various agent and principal problems may arise including conflicting objectives; differences in risk aversion, outcome uncertainty, and behavior based on self-interest, and bounded rationality. This may for example entail an agent having a different concept of database design and inventory systems that do not concur with the principles needs.

The Principal Agency Theory suggests an "inter-firm contracting perspective" on logistics information systems in the context of fourth party logistics, focusing on the design of an efficient contract between the buyer and seller of logistics services, such as logistics information system management (Aldin, Brehmer & Johansson, 2014). The idea is to develop the most efficient combination of outcome and behavioral incentives in the contract between the shipper and the fourth party logistics provider. The extent to which the fourth party logistics provider's performance can be measured and controlled has a great effect on whether the provider is paid by actual inventory management performance (for example; number of orders picked, packed, and shipped to the customers) or according to production management system (for example; salaries, hours, and/or miles).

2.2 Empirical Review of the Literature

The successful integration of information within an organization is a powerful enabler for reduced costs; increased productivity; and improved customer service, Logistics planning and operations has been an early and extensive adopter of information technology advances due to its dependency on information for efficient operations (Wisner, 2010). Systems for order entry, order processing, electronic data interchange (EDI), vehicle routing and scheduling, and inventory replenishment are examples of early applications (Tilokavichai, 2012). Effective information technology (IT) has become absolutely necessary to support logistics processes, (Samson, 2012). By automating many routine logistics activities, IT has enabled managers to focus on strategic issues and core competencies and supported the use of intermediate supply chain activities, such as distribution (Ross, e*t al.,* 2012).

Atos (2012) addressed a heuristics model to solve forward-reserve allocation problems within the order picking system. This was found to have a positive significant effect on logistics management and firm performance. Alavi *et al.* (2012) introduced an efficient optimization-based heuristics model based on the real-time information to support the decision-making process of a freight transportation network which resulted in improvement of logistics management and performance of retail firms. With the perceived benefits of using LIS in the support of logistics daily operations, seven kinds of LIS are widely applied in the logistics industry: load planning system (LPS); terminal management system (TeMS); vendor selection system; warehouse management system (WMS); financial management system; electronic Customer Relationship Management; and transportation management system (TMS) (Bagchi *et al.,* 2012).

According to Zhang, Goh, and Meng (2011), LIS increases supply chain visibility through collaboration among supply chain members via real-time data sharing and enhance time-based

delivery thus increasing firm performance. With sufficient information and with increased visibility and communication between various logistics operations and shareholders, different parties along the supply chain can promptly make appropriate decisions which in turn improve efficiency in logistics management. Thus Zailani *et al.* (2005) established a moderating effect of logistics information system on relationship between logistics management and firm performance. In fact, the recent advanced developed ICT such as RFID, GPRS, wireless mesh network and smart sensors are able to provide real-time tracking information on moving objects such that logistics firms can enhance their logistics management through improved accuracy in delivery and tracking ability
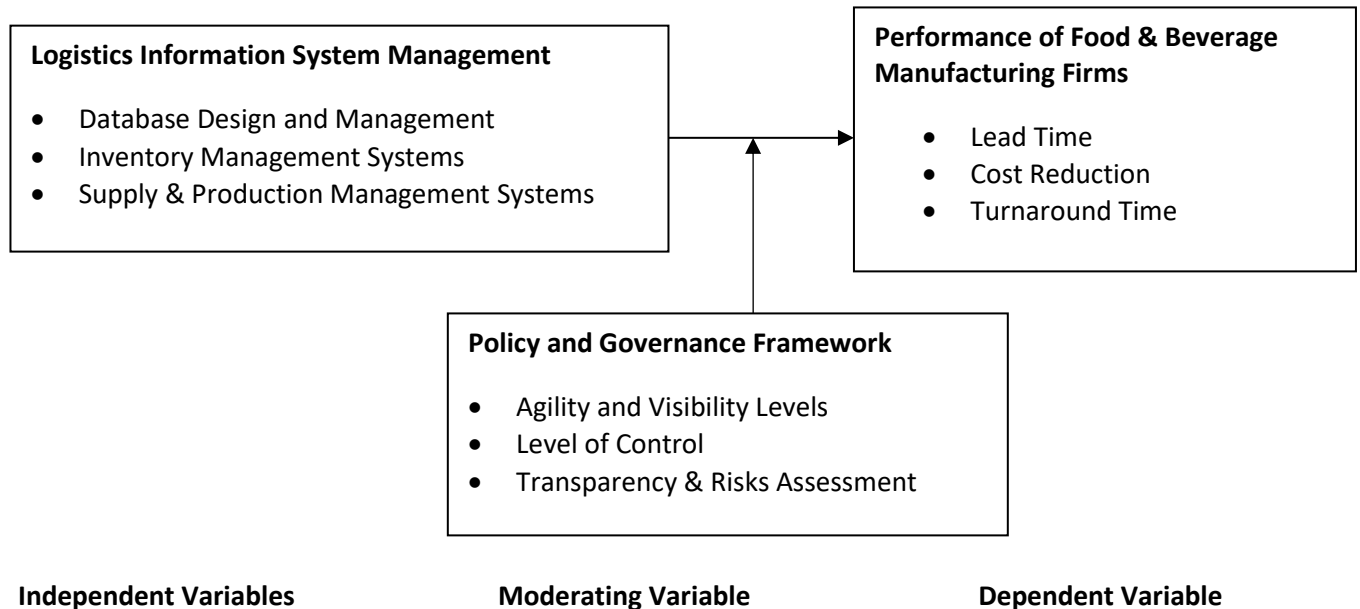
2.3 Conceptual Framework

Logistics Information System Management	**Performance of Food & Beverage Manufacturing Firms**
• Database Design and Management • Inventory Management Systems • Supply & Production Management Systems	• Lead Time • Cost Reduction • Turnaround Time

Policy and Governance Framework

• Agility and Visibility Levels
• Level of Control
• Transparency & Risks Assessment

Independent Variables   **Moderating Variable**   **Dependent Variable**

Figure 1: Conceptual Framework

3.0 RESEARCH METHODOLOGY

3.1 Research Design

This study adopted the descriptive research design using both quantitative and qualitative approaches. Descriptive research design was used to allow researcher to gather, summarize, present and interpret information for the purpose of clarification. It is mainstreamed to fact finding and may result in the formulation of important principles of knowledge and solution to significant problems.

3.2 Target Population

The target population of this study was 197 registered food and beverages manufacturing companies in Kenya as per KAM (2015). Food sector constitutes about 33% of the manufacturing sector in Kenya and the sector adds value to agricultural produce and therefore growth of this sector can have a direct significant impact on the whole Kenya's economy.

3.3 Sampling

The study used stratified random sampling technique where the subjects were selected in such a way that the existing subgroups in the population are more or less reproduced in the sample

Where n is the sample size, N is the population (197) and beta denotes the error, set at 0.05

$$N/ \{1+N (\beta^2)\} = n$$

$$197/ \{1+197(0.05^2)\} = 132$$

Therefore, the study sought to gather information from 132 food and beverage manufacturing firms located in across the country, where the heads of procurement were used. This sample was deemed good representation of the populations since the sample size was greater than 10% of the target population.

3.4 Data Collection

A semi-structured questionnaire was developed to capture the various variables under study, and for the independent variables. The questionnaire contained both closed and open ended questions. The closed ended questions were aimed at giving precise information which minimized information bias and facilitate data analysis, while the open ended questions gave respondents freedom to express themselves.

3.5 Data Analysis and Presentation

Descriptive statistics including frequencies, percentages, mean and standard deviations was used in data analysis. Descriptive statistics was utilized with a view to summarize, reduce data and analyze constructs and items. This form of analysis gave insights into the sample attributes. Descriptive statistics were further offer a basis for inferential statistics using multiple regressions and correlation.

Multiple regression analysis is specifically preferred as it contained a model goodness of fit to show the percent of firm performance being attributed to the conceptualized study variables (Kothari, 2014).

4.0 FINDINGS

4.1 Response Rate

A response rate of 89% was obtained where 117 respondents gave back the questionnaires for analysis out of a total of 132 food and beverage manufacturing firms. This was perceived adequate for analysis.

4.2 Logistics Information System Management

The study sought to establish the influence of logistics information system management on performance of manufacturing firms in Kenya. The key measures of logistics information system management used were: database design and management, inventory management systems, and supply and production management systems. The respondents were asked to indicate their level of agreement or disagreement with specific statements drawn from these sub-constructs. The findings revealed that most of the aspects of logistics information systems management were not effectively upheld in most of the firms, an aspect that could affect the effective performance. The findings are in line with those by Atos (2012) who established that logistics information systems through a well-designed database enhances the prospects of ensuring that the information and other materials regarding database management are appropriately managed for better performance. The findings imply that logistics information systems management is an essential driver to the effectiveness of supply chain in the food and beverage processing firms in Kenya. The findings compare with those by Tilokavichai, and Sophatsathit (2011) who found out that through extensive management of the logistics information systems and integration of the appropriate technology in the supply chain process, modern organizations are more likely to meet the customer needs and enhance efficiency thus gaining more performance and competitiveness.

Table 1: Descriptive Analysis for Logistics Information System Management

Statements	Mean	Std. Dev.
Our company has an active database for keeping all logistics information	3.29	1.00
The available database is designed in a secure and easily accessible manner	3.38	.82
Through a well-managed and designed database we are able to monitor the logistics of the company	4.00	1.20
Our company has an effective system for monitoring the inventory	4.28	1.23
The inventory levels and flow are appropriately controlled using the adopted system	3.82	.88
The company through the management is committed towards embracing the best systems of managing inventory	3.56	1.16

The company has an active systems for engaged and sharing information with suppliers	3.49	.92
The product process in our company is monitored by effective systems	4.02	1.25
The management of the organization has been committed on embracing information technology in key supplier chain frameworks	3.59	1.01

4.3 Descriptive Analysis for Policy and Governance Framework

The study sought to assess the moderating effect of policy and governance framework on the relationship between logistics information systems management and the performance of food and beverage manufacturing firms in Kenya. The findings are as summarized in Table 2.

The findings revealed that most of the respondents disagreed that their companies were always alert on changes in policies and regulations and that the companies through the management always ensures that it is visible in the policing process The findings imply that some aspects of policy and governance framework have a hand in reducing lead time than others. This shows the need for companies to keenly analyse on how to integrate the policies in their logistics planning for effectiveness and efficiency (Mathenge & Dihel, 2011). Generally, the findings imply that policy and governance framework had a moderate extent of influencing the role of fourth party logistics on the performance of food and beverage processing firms in Kenya. In a study on the effect of partner collaboration in logistics, McNichols, and Brennan (2016) established that the policies set to govern the way logistics operations are carried out in organizations define how effective the logistics framework adopted can become hence the need for continued focus on policies before having given logistic frameworks put in place.

Table 2: Descriptive Analysis for Policy and Governance Framework

Statement	Mean	Std. Dev.
Our company is always alert on changes in policies and regulations	2.99	0.97
The company through the management always ensures that it is visible in the policing process	3.98	1.33
The company has emphasized on carrying out logistics with partners who have adhered to the existing policies	3.76	1.55
The company always ensures that there is a control framework for the logistics operations	3.67	1.03
The level of our company's control in fourth party logistics has been high	3.82	1.01
The management has set out a standard for adhering to the existing logistics policies	3.49	1.25

There is a significant level of transparency between our company and its logistics partners	3.76	1.48
The company frequently carries out risks assessment on the fourth party logistics partners	3.15	0.97
Through adherence to the existing policies in logistics management our company has enhanced its effectiveness	4.01	1.18

4.4 Performance of Food and Beverage Manufacturing Firms

The study sought to find out the performance of the food and beverage manufacturing firms in Kenya. The respondents were asked to indicated their level of agreement on specific statements drawn from the key measures of performance used in the study. The findings as shown in Table 3 imply that as per the opinions of the respondents, the food and beverage manufacturing firms are fairly and unstably performing thus calling for a high need for improvement and continued focus on key logistics management frameworks that could enhance their performance.

Table 3: Descriptive Results on Firm Performance

Statement	Mean	Std. Dev.
Our company has continually met the customer needs in terms of timeliness thus enhancing their satisfaction	3.51	1.01
Our customers are always willing to do business with us and also refer others	2.77	0.76
We have embraced consistency in the production to maintain high quality of our supplies	2.51	0.98
The distribution of our products is effectively done to minimize on poor quality on transit	2.61	1.16
The costs of managing inventories have reduced in our company due to focus on lead time management	2.64	1.48

4.5 Hypothesis Testing

The first hypothesis of the study was that logistics information system management does not significantly influence the performance of food and beverage manufacturing firms in Kenya.

Model summary, ANOVA test, and regression coefficients were used to display the results on the regression model for the second hypothesis of the study. The model was as follows:

$$Y = \beta_0 + \beta_1 X_1 + e$$

The model summary results as shown in Table 4 revealed that the R-square(R^2) for the model was 0.360. This implies that logistics information system management has 36% impact on the variation in the performance of food and beverage processing firms in Kenya.

The ANOVA results on the other hand revealed that the F-statistic was 64.617 at a significant level of 0.000. This being less than the standard P-value of 0.05, the findings imply that the model could significantly predict the relationship between logistic information system management and the performance of food and beverage processing firms in Kenya.

The regression model results revealed that the β for the variable (logistics information system management) was 0597. From the findings, the following model can be deduced:

$$Y = 1.105 + 0.597X_1 + e$$

The results imply that when regressed alone with the dependent variable (performance of food and beverage processing firms), a unit change in logistics information systems management would influence up to 59.7% of the performance of food and beverage processing firms in Kenya. The P-value for the variable in the model was 0.000 which implies that being less than the standard p-value of 0.05, logistics information systems management has a significant and positive influence on the performance of food and beverage processing firms in Kenya.

Table 4: Regression Results on Logistics Information System Management
Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.600a	.360	.354	.73924

a. Predictors: (Constant), Logistics Information System Management

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	35.312	1	35.312	64.617	.000b
1	Residual	62.845	115	.546		
	Total	98.156	116			

a. Dependent Variable: Firm Performance
b. Predictors: (Constant), Logistics Information System Management

Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	1.105	.206		5.361	.000
1	Logistics Information System Management	.597	.074	.600	8.038	.000

a. Dependent Variable: Firm Performance

The second hypothesis of the study was as follows:

H_{o2}: Policy and governance framework does not significantly moderate the relationship between logistics information systems management and performance of food and beverage manufacturing firms in Kenya.

The findings as shown in Table 6 revealed that the moderator (policy and governance framework) had a moderating effect on the relationship between logistics information systems management and the performance of food and beverage processing firms. This is as shown by Beta coefficient of 0.095 and a P-value of 0.041<0.05. However, the findings revealed that policy and governance framework has no direct relationship with the performance of food and beverage processing companies.

Table 4.1: Moderating effect of Policy and Governance

Model Summary

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.325	.224		1.449	.150
Logistics Information* Policy and governance framework	.095	.056	.082	1.703	.041
Policy and governance framework	-.094	.065	-.050	-1.448	.150

a. Dependent Variable: Performance

CONCLUSIONS AND RECOMMENDATIONS

The study concluded that logistics information system management has significant influence on performance of food and beverage manufacturing firms in Kenya. The sub-constructs of logistics information system management that is database design and management, inventory management system and supply and production management systems influence performance positively.

It is recommended that manufacturing firms in Kenya should have an improved logistics information system management system as it leads to high performance. The firms should have a database design and management, an inventory management system and a supply and production management systems.

The study also recommends that future scholars and researchers should aim to test the relationship between logistics information system management system and performance using different sub constructs apart from database design and management, an inventory management system and a supply and production management systems. This can bring rigour and offer platforms for comparison of findings.

REFERENCES

Abrahamsson, M. (2008). The role of Logistics in Corporate Strategy. *Business Process Management Journal*, 10(2), 54-68.

Alavi, M., & Carlson, P. (2012). A review of MIS research and disciplinary development: *Journal of Management Information Systems*, 8 (4), 45–62.

Aldin, N., Brehmer, O., & Johansson, A. (2004). Business development with electronic commerce: refinement and repositioning. *Business Process Management Journal*, 10(1), 44-62.

Atos, K. (2012). The elements of a successful logistics partnership: *International Journal of Physical Distribution & Logistics Management*, 26(3), 7-15.

Bagchi, P. & Skjoett-Larsen, T. (2012). Integration of Information Technology and Organizations in a Supply Chain: *International Journal of Logistics Management*, 4(1), 89-108.

Bourlakis, C. & Bourlakis, M. (2015). Information technology safeguards, logistics asset specificity and fourth-party logistics network creation in the food retail chain, *The Journal of Business & Industrial Marketing,* 20 (2), 88–99.

Bowersox, J., Closs, J., & Cooper, M. (2010). *Supply Chain Logistics Management* (3rd Ed); Boston, Mass: McGraw-Hill.

Bumstead, J. & Cannons, K. (2012). *From 4PL to managed supply-chain operations*, Logistics & Transport Focus, 4(4), 18–24

Deloitte (2012). *Strategic Review of Logistics Outsourcing in Kenya.* Nairobi: International finance Corporation-World Bank Group Press. Retrieved February 2017

Deloitte (2016). *Optimizing supply chain management.* Turning a Cost into a Value Proposition Accessed on 30th June 2017

Hirakubo, N., & Kublin, M., (2011). The relative importance of supplier selection criteria: the case of electronic components procurement in Japan. *International Journal of Purchasing and Materials Management*, Spring, 35(4), 19-24.

ISO (2010). '*Quality management and quality assurance vocabulary,* International Organization for Standardization, Geneva

Kenya Association of Manufacturers, (2016). *Kenya manufacturers & Exporters Directory.* (11th ed.). Nairobi: Kenya Association of Manufacturers

Kenya Institute for Public Policy Research and Analysis. (2013). *Kenya Economic Report.* Nairobi: KIPPRA

KNBS (2010). *Kenya Manufacturing Firms Survey.* Nairobi:

Kothari, C. R. (2014). *Research Methodology Methods and Techniques* (2nd ed.). New Delhi: New Age Publishers

Mathenge, J., & Dihel, N. (2011). *The Role of Clearing and Forwarding Agents in Reforming the EAC Logistics Sector. Africa Trade Policy Notes,* Nairobi: Africa Trade Policy.

McNichols, T. & Brennan, L. (2016). Evaluating Partner Suitability for Collaborative Supply Networks, *Int. J. Networking and Virtual Organizations, 3*(2), 220-237

OECD (2016). *Actualizing Organizational Memory with Information Systems*", Information Systems Research, Pearson Education Limited, Essex

Payan, J. M. (2013). *A review and delineation of cooperation and coordination in marketing channels.* European Business Review*, 19(3), 216-233.

Ross, D., & Forsythe, J. (2012). *Supply Chain Efficiency through Collaboration.* Logistics Quarterly, Winter.

Samson, M. (2012). *The driving factors of 3PL logistics management in Kenya Procurement Oversight Authority*, Quarterly PPOA Bulletin, 6 (4), 212-250 Nairobi

SoonHu, S. (2010). A decision model for evaluating third-party logistics providers using fuzzy analytic hierarchy process. *African Journal of Business Management, 4*(3), 339-349.

Tilokavichai, V., & Sophatsathit, P. (2011). An Organization-Wide Analysis of ERP and Information Systems Interrelationship for Logistics Support', *Journal of System and Management Sciences* 7(1), 59-68.

Tilokavichai, V., Sophatsathit, P., & Chandrachai, A. (2012). Analysis of Linkages between Logistics Information Systems and Logistics Performance Management under Uncertainty: *European Journal of Business and Management*, 4(9), 22-39

USAID (2012). *Selecting and implementing vendor managed inventory systems for public sector supply chain*: Deliver Project, USAID

Wardaya, M.S., Hadiwidjoyo, D., & Surachman, E., (2013). Improving Competitiveness of the National Industry of Logistics Service Providers through Collaboration from the Perspective of Consumer Goods Manufacturing Companies in East Jav: *International Journal of Business and Management Invention* 2 (5), 27-38

Wisner, J.D. (2010). A structural equation model of supply chain management strategies and firm performance. *Journal of Managerial Issues* 10 (2), 27- 46

World Bank (2013). *Kenya economic update:* Accelerating growth and poverty reduction in the Kenya.

World Bank (2013). *Reducing Supply Chain Barriers Could Increase Global GDP Up To 6 Times More Than Removing All Import Tariffs Report*", Switzerland

Zailani, S. & Rajagopal, P. (2005). Supply chain integration and performance: US versus East Asian companies, Supply Chain Management: *An International Journal,* 10(5), 379-393

Zhang, N., Goh, M., & Meng, F. (2011). Conceptual modeling for supply chain inventory visibility. *International Journal of Production Economics* 133(2), 578–585