Effect of Supply Chain Traceability on Performance of Food and Beverage Manufacturing Firms in Nairobi City County, Kenya

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Abstract
the main objective of the study was to determine effect of supply chain traceability on performance of food and beverage manufacturing firms in Nairobi City County. The study was informed by contingency theory, normal accident Theory, resource review theory and Theory of constraints. This adopts descriptive survey research design. The population for the study constituted 204 HODs in the inspection, quality and technical departments from the sixty eighty (68) food and beverage manufacturing firms in Kenya. Simple random sampling was used to select a sample of 102 respondents from 34 food and beverage manufacturing firms. This study used structured questionnaires to collect data relevant to the study. Descriptive analysis was used to delineate the demographic pattern of target respondents in frequency, while inferential statistics was used to find causal effect relationship. The findings revealed that product traceability and process traceability positively and significantly influenced the performance of foods and beverage manufacturing firms. Notably, there is a holistic approach concerning the handling of products along the supply chain. As well, process traceability harmonizes the information about each of the products in a way that the information can easily be traced. Besides, safety and quality of the final firm products are largely dependent on input traceability. Consequently, the study recommended for firms to fully adopt product traceability measures within the supply chain to easily trace the movement of their products right from raw goods to finished products
Keywords: *Supply Chain Traceability, Product Traceability, Process Traceability Performance and Food and Beverage Manufacturing Firms*

INTRODUCTION

Supply chain traceability has emerged as a critical supply chain component in almost all sectors and is used extensively in different contexts (Goswami, 2014; Guercini and Runfola, 2009; Kumar et al., 2017a; Machado et al., 2018). It has become one of the reliable solutions for organizations looking for a mechanism to track and trace products, manufacturing activities, and collect related information in order to manage business activities and comply with government regulations. Adding a component of sustainability in this widely accepted ISO definition, the United Nations (UN) Global Compact and Business for Social Responsibility(BSR) (2014) propose a more comprehensive definition of traceability: he ability to identify and trace the history, distribution, location, and application of products, parts, and materials (ISO, 1994), to ensure the reliability of sustainability claims, in the areas of human rights, labor (including health and safety), the environment and anti-corruption.

However, traceability applications vary according to the sectors and types of the supply chain (Shamsuzzoha and Helo, 2011). For instance, in logistic companies, traceability is more about tracking and tracing the consignments using unique traceability codes, when they traverse the supply chain (Bujak and Zając, 2013), while, in the case of food and beverage sectors (which directly impact consumer health), in addition to product tracking and tracing, traceability also facilitates record keeping and maintenance of information to comply with government regulations (Charlebois et al., 2014).

Similarly, in the food and beverage sectors manufacturing firms, traceability is still a voluntary measure with brands using it to project a positive image and convey a sustainable aspect of the product to customers (EgelsZandén et al., 2015). Regardless of its numerous applications, the core idea of traceability remains the

same and is defined by Olsen and Borit (2013) as, the ability to access any or all information relating to that which is under consideration, throughout its entire lifecycle, by means of recorded identifications.

Nowadays, sustainability has become a new management principle for firms to steadily compete in the market. On the public side, food crisis has increased consumers' awareness of safety on their consumption. Based on this awareness, governments of many countries have legislated firms in the food supply chains to implement the traceability system in order to identify sources of deficiency and be able to withdraw hazardous products on the market precisely and efficiently. Firms in different industries have implemented traceability systems to increase supply chain performance. Nowadays, traceability in food industry has become mandatory for many countries around the world, for example, European Union countries, Japan, and the United States (Bechini et al., 2018).

Further to this enforcement, firms have to struggle with increasing cost to apply traceability system (Pettitt, 2014; Regattieri et al., 2017). However, many academic researchers have proved that traceability does not always increase costs (Hobbs et al., 2015; Decker et al., 2019; Roth et al., 2018). Furthermore, it provides many benefits, for instance, clear ability assignment, higher customer satisfaction, less recall, etc. In some other industries, for example, automobile, traceability is known as a system to help actors in a supply chain increase their operational performance rather than cost burdens (Robinson and Malhotra, 2015).

Previous studies have shown that information about food products and production processes can be lost internally within companies, as well as between companies in supply chains (Bertolini, Bevilacqua, & Massini, 2016; Donnelly, Karlsen, & Dreyer, 2012; Randrup et al., 2018). According to Frederiksen (2002), more detailed studies of each step in the supply chains are needed to better document each process. Such studies are important to improve the traceability of food. Jansen-Vullers, Van Dorp, and Beulens (2013) concluded that traceability requirements appear to be similar across the industries studied, but Ringsberg and Jönson (2010) found that no shared consensus regarding traceability exists and performance of food and beverage manufacturing firms.

Firm performance is the focal point of any business and just through performance are firms ready to develop and advance (Gavrea *et al*., 2011) point out that. Similarly, the survival of a business is to accomplish set goals and objectives (Muduenyi *et al*., 2015). Yazdanfar (2013) indicates that one of the vital pre-condition for long-term firm survival and achievement is firm productivity. The degree to which an association is fruitful in the present aggressive business condition is enormously controlled by the ability to capably and decidedly deal with its associations with both inside and outer partners, for example, suppliers (Dries *et al*., 2014).

However, as established by many studies, achievement in the creation and management of these traceability within food and beverage manufacturing (Abdullateef *et al*., 2013). Additionally, the mechanisms through which buyer-supplier relationship enhances performance are not well understood (Zablah *et al*., 2004). Consequently, firm managers have minimal direction on where to concentrate their traceability in supply chain efforts. Thus, this research provides comprehensive knowledge to firms, especially in food industry, to help them gain the understanding on traceability in supply chain affect their performance.

Statement of the Problem

New research shows that traceability with suppliers on environmental practices improves manufacturing performance (Regattieri et al., 2017). However, research on supply chain traceability practices has attracted little attention especially on their effect on performance of food and beverage manufacturing firms. In addition, previous review shows that various investigations have proposed different approaches to implement traceability in supply chains (Goswami, 2014; Guercini and Runfola, 2019; Kumar et al., 2017a; Machado et al., 2018). There have been far less research on identifying the consistency to supply chain traceability and how their

influence performance, particularly in food and beverage manufacturing industry. Very few studies have been carried out in developing countries like Kenya on supply chain traceability practices.

This study examined the problem of effects of supply chain traceability on performance of food and manufacturing firms in the Kenyan context and this was in line with the findings of (Sun et al, 2017:Charlier and Valceschini 2008), who had done research on supply chain traceability and recommended a further studies on other sectors of manufacturing firms. Despite the afore-mentioned findings, the studies available had only focused on general traceability aspects but none of them touched on the effects of supply chain traceability on performance of food and beverage manufacturing firms in Nairobi City County.

Theoretical Review

Contingency theory considers the impact of environmental factors on an organizational structure, strategic decision making, and efficiency and effectiveness-driven performance criteria (Donaldson, 2001; Ruekert et al., 1985). In the context of traceability, firms implement a contingent response to products demands on the firm from the external environment (e.g. stakeholder concerns, competitive environment, industry characteristics), the internal environment (e.g. top management directives), with the overall strategy of improving product competitiveness of the firm (Thompson, 1967; Luthans & Stewart, 1977). In line with this thinking, Barratt et al. (2007) explain that implementation of traceability initiatives for product can enable firms to create unique resources that others may not be able to imitate and differentiate firms from their competitors.

Normal Accident Theory by Perrow (1999) agues contrasts between systems dominated by complex or linear interactions and between systems characterized by tightly coupled or loosely coupled subsystems. Perrow (1999) argues that interactive process traceability is important because it multiplies the opportunities for hard to understand accidents to occur. For Perrow, large, differentiated process systems with sub process systems that interact in a variety of ways are more likely to have unplanned, unexpected, unfamiliar, ambiguous or incomprehensible sequences, and are made obscure by complicated transformation processes, feedback loops and branching. Events in linearly interactive systems, with fewer, less differentiated components interacting in simple sequences are easier to predict and understand. Less process traceability are more easily controlled because interactions are simple, transformations are fewer and easier to understand and the number and variety of participants involved is less.

Empirical reviews

Product traceability

Furtado and Zisman (2015) focus on how product traceability can help organizations transition to the agile paradigm. In particular, they argue that traceability can help to mitigate the typical lack of understanding of a project's "high-level scope" or issues with control by management. Trace links between artifacts created following the plan-driven paradigm and artifacts created following the agile paradigm can help to address these challenges.

A study by Narsimhalua et al (2015) on influence of product traceability Factors on Australian Food Supply Chain Performance The objective of the study is to understand the interrelationship between the level of traceability (breadth, depth and quality of information) and the resources required (technology, financial and human) in achieving the given level of product traceability and contribution of supplier-buyer relationship on the supply chain traceability performance using a case study based approach. The study shows as the dairy products are split into individual unit for the retail stores and not associating the batch number to the product movement from the distribution center to the retailers would create the critical traceability point where the

product's flow of information could be lost. The other important finding shows that the effective uniform tracking and tracing system would help in efficiency gain by reducing the product receiving time from 4hours to 20 minutes, which can reduce in humanly efforts at this stage and may help inachieving huge cost savings.

A study by Khan et al (2017) on Implementing product Traceability Systems in Specific Supply Chain Management (SCM) through Critical Success Factors (CSFs). The primary result indicates towards; that improving the HSCM with the higher level of Halal awareness. Assuring HI will enhance the consumer satisfaction which leads to a competitive advantage for the organization. Academic researchers, industrial practitioners and Supply Chain executives can understand the complex interrelationship of CSFs by visualizing the TISM. It can help the management, lobbies and government to develop the policies regarding the implementation.

Bonetti and Pasotti (2014) presented and discussed the main results of an empirical survey among 69 Italian metallurgical companies, aimed at: a) quantifying material and information flows normally processed by companies; b) analysing suitability of current traceability systems to an effective traceability process; c) identifying major criticalities of current traceability processes; d) investigating influence of company size, phase of the supply-chain and suitability of traceability system on the extent of such criticalities. Briefly, results indicate that products specialization affects material flows along the supply-chain. Moreover, traceability systems adopted by the sample are mainly suitable to an effective traceability process. However, some criticalities of current traceability processes do not depend on company size, phase of the supply-chain or suitability of traceability system

Process traceability

Ramesh (2017) investigates how organizational, environmental, and technical factors influence requirements process traceability practices and it effect on performance. In his study, he distinguishes between high-end users and low-end users of traceability and gives a list of factors that affect traceability and recommendations for how companies can transition from low-end to high-end traceability practices. While some traceability practices are reported, the rise of the agile paradigm calls for a new study of these aspects.

Arkley and Riddle (2016) investigate process traceability challenges and conclude that it is essential to select appropriate roles for traceability management. Due to their knowledge of the system, developers are better suited to create high-quality links than, for example, separate quality assurance teams. However, while developers could create high-quality links, they often do not see the direct benefits of traceability. The authors suggest that organizations should ensure that goals and needs of developers are addressed in traceability development contracts that define traceability management of shared artifacts. The findings of our study suggest that the potential of using traceability for collaboration can in fact motivate developers to see a benefit of investing in traceability.

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Research Gap

The existing studies on supply chain practices and their impact on the performance of the firm have majorly focused on the public enterprises. Such studies have not brought out the implication of the Supply Chain Management practices to the private sector organizations. The present study is based on supply chains

traceability majority of which are and thus attempt to fill this gap in literature. Gaps also exist with regard to the supply chain traceability that has been examined by the past scholars. Apopa (2018) reviewed practices s such as supplier selection, supplier collaboration, risk management and supplier chain policies. Mayaka (2011) on the other hand focused on practices such as information sharing, Quality Control, Just in time, Customer relationship management, order fulfillment, and returns management. Some prominent supply chain management such as supply chain traceability has not been well addressed and thus the need to fill this gap. Despite of the existence of the aforementioned studies on Supply Chain Management practices, none has been carried on supply chain traceability in food and beverage manufacturing.

Material and methods

The study adopted a descriptive survey research design. Descriptive surveys were therefore systematically employed to draw data from the respondents. The population for the study constituted 204 HODs in the inspection, quality and technical departments from the sixty eighty (68) food and beverage manufacturing firms in Kenya. A sample size of 102 respondents sixty eight (68) respondents thus 50 % of the total population (204) was drawn for quantitative data from 34 food and beverage manufacturing firms in Kenya . Simple random sampling technique was used to obtain thirty-*four* (34) food and beverage manufacturing firms in Kenya for the study. This study used structured questionnaires to collect data relevant to the study. Face validity was assured in this study because it seems logical to the researchers to investigate supply chain traceability and performance of food and beverage manufacturing firms. Factor validity was assessed through use of exploratory factor analysis using Kaiser-Meyer-Olkin estimate of sampling adequacy, Bartlett's test of sphericity and varimax rotations components. The Cronbach's alpha was also employed to estimate the reliability of an instrument. A reliability values of 0.6 to 0.7 and above are considered by many researchers as acceptable (Cooper & Schindler, 2006; Malhotra & Birks, 2006)

Data Analysis and model specification

Descriptive statistics such as mean, standard deviations, reliability coefficients, and inter-correlations were computed to understand the results better. The hypotheses were then tested using multiple linear regression, Pearson correlation was used to check the strength and direction of the correlation relationship and to alleviate multicollinearity problem. The first Model specification was for direct effect of supply chain traceability and performance of food and beverage manufacturing firms. The effects wad statistically processed using the specified linear equation (1) as shown below;

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \varepsilon$$

Where;

X_1: Represents product traceability

X_2: Represents process traceability

Y: Represents the dependent variable (firm performance)

Y_1 Represent the respective Y intercept

'β_1' to 'β_4': Represent the effect of slope coefficients denoting the influence of the associated independent variables over the dependent variable.

'ε_1' Represent the error terms

Findings and Discussion

The study employed different statistical techniques aided by SPSS version 24 software to analyze the data. This chapter describes the data analysis, presentation and interpretation of the findings. Out of the 102 questionnaires administered, 98 questionnaires were retrieved making a response rate of 96.08%. According to

Sekaran & Uma (2013) response rate of 30% is acceptable for surveys and therefore response rate for this study is sufficient for further analysis.

Sample characteristics

The background information or characteristics provides the researcher with critical information concerning the unit under investigation. The study sought to establish the demographic characteristics which included gender, age, education qualifications and experience in the organization projects. From the findings 3(54.1%) of the respondents are female while 45 (45.9%) are male. The findings indicate there was almost an equal representation of male and female heads of department though the female HoDs comprise the majority. As such, the study collected key perspectives on effect of supply chain traceability on performance of food and beverage manufacturing firms from a representative sample of HoDs. Regarding the age, 33 (33.7%) are within the 31 to 40-year age bracket followed by 32 (32.7%) that are between 41 to 50 years of age. Heads of department below the age of 30 years were listed represented. There is a possibility that the job requires years of experience which goes with advanced age of the holders of the position. The findings on the education level of the respondents indicated that 34 (34.5%) have a degree, 26 (26.5%) Masters while 9 (9.2%) Diploma level of education. The level of education of the heads of department suggests that they are better placed to articulate how supply chain traceability affects the performance of their firms. Finally, 37 (37.8%) of the HoDs have worked in the organization projects for a period ranging from 5 to 9 years, 34 (34.7%P for 1 to 4 years while 17 (17.3) for 10 to 14 years. Notably, the heads of departments have worked in the organization projects long enough to give a detailed account of supply chain traceability in their organization and how it affects performance.

Univariate Analysis

The study univariate analysis comprises of descriptive and correlation analysis. Descriptive results showed that process traceability had mean of 4.08 (SD = 0.92) which showed agreement by majority of the respondents on process traceability. The overall mean response was 3.94 (SD = 0.91) which showed agreement by majority of the respondents on Product traceability. Firm performance had overall mean response was 3.85 (SD = 0.99) which showed agreement by majority of the respondents. There was a strong relationship between product traceability and performance of food and beverage manufacturing firms in Nairobi City County (r = 0.681, p-value < .01). Also, the study exhibited a strong relationship between process traceability and performance of food and beverage manufacturing firms in Nairobi City County (r = 0 .600, p-value < .01).

Table 1 Univariate Analysis

	Mean	Std. Dev	Performance	Product traceability	Process traceability
Performance	3.85	0.99	1		
Product traceability	4.08	0.92	.681**	1	
Process traceability	3.94	0.91	.600**	.550**	1

** Correlation is significant at the 0.01 level (2-tailed).

Multivariate Analysis

The purpose of the regression analysis was to get the relationship between the variables and come up with predictions model. Table 1 illustrates the model summary of multiple regression model, the results showed that all the two supply chain traceability parameters (product traceability and process traceability) explained 60.9 percent variation of performance of food and beverage manufacturing firms (R squared =0.609). Study findings in table 2 indicated that the above discussed coefficient of determination was significant as evidence of F ratio of 36.166 is Signiant with p value 0.000 <0.05 (level of significance). Thus, the model was fit for determining

the effect of supply chain traceability on performance of food and beverage manufacturing firms in Nairobi City County.

The first objective of the study sought to determine the effect of product traceability on performance of food and beverage manufacturing firms in Nairobi City County. Research findings confirmed that product traceability have a significant effect on performance of food and beverage manufacturing firms basing on β_1= 0.322 (p-value = 0.001 which is less than α = 0.05) implying that product traceability have a significant effect on performance of food and beverage firms. In line with the results, Brofman Epelbaum and Garcia Martinez (2014) confirmed that the application of product traceability positively related to sustainable performance of supply chain.

The second objective of the study sought to examine the effect of process traceability on performance of food and beverage manufacturing firms in Nairobi City County. Findings showed that process traceability had coefficients of estimate which was significant basing on β_2 = 0.21 (p-value = 0.012 which is less than α = 0.05) hence we conclude that process traceability has a significant influence on performance of food and beverage firms. This implies that for each unit increase in process traceability, there is up to 0.012 unit increase in performance of food and beverage firms. Also, the effect of process traceability is shown by the t-test value of 3.309 which implies that the effect of process traceability surpasses that of the error. Consistent with the findings, Bosona and Gebresenbet (2013) elucidated that process traceability allows locating and recalling defective products throughout the supply chain thereby improving on firm performance. As well, Martins and Machado, (2012) elucidated that process traceability leads to continuous improvement of the production process, responding to demands for more efficiency.

Table 2 Coefficients of Estimate

	Unstandardized Coefficients			Standardized Coefficients	
	B	**Std. Error**	**Beta**	**T**	**Sig.**
(Constant)	0.223	0.298		0.747	0.457
Product traceability	0.320	0.097	0.322	3.309	0.001
Process traceability	0.222	0.087	0.210	2.547	0.012
Model Summary Statistics					
R	0.780				
R Square	0.609				
Adjusted R Square	0.592				
Std. Error of the Estimate	0.497				
Change Statistics					
R Square Change	0.609				
F Change	36.166				
df1	4				
df2	93				
Sig. F Change	0.000				

a Dependent Variable: Performance food and beverage manufacturing firms

Conclusion and Recommendations

There is overwhelming evidence of a positive link between product traceability and the performance of food and beverage manufacturing firms. The implication is that there is a holistic approach concerning the handling of products along the supply chain. In so doing, it is easier for the firms to ensure that the products are of the right quality and quality. Besides, there is a likelihood of shorter lead time between the ordering of a product and its delivery to clients. The reason for this is that the movement of the product is tracked right from raw

goods to finished products. The eventual outcome is enhanced performance of the food and beverage manufacturing firms.

Besides, process traceability positively influenced the performance of food and beverage manufacturing firms. The findings suggest that process traceability harmonizes the information about each of the products in a way that the information can easily be traced. In so doing, the firms can inspect the processes involved in the production and identify and eliminate potential losses in production. Consequently, the firms elicit improved performance through process traceability.

The study has indicated that product traceability positively influences the performance of food and beverage manufacturing firms. It is, therefore, crucial for firms to fully adopt product traceability measures within the supply chain to easily trace the movement of their products right from raw goods to finished products. Besides, for food safety purposes, product traceability is of utmost significance because of the ability to trace the ingredients used in a product. As such, with implantation of product traceability, it will be much easier for the firms to meet the required food safety and quality standards.

Since process traceability enhances the performance of food and beverage manufacturing firms, the heads of department must put in place modalities to facilitate the tracing of processes right from the raw materials to the finished products. Other than that, to ensure there are minimal interruptions in the firms' operations, it is vital to trace the processes where the products are refined gradually. Finally, the firms need to ensure that each product is assigned an identification number.

Since the current research was limited to food and beverage manufacturing firms in Nairobi City County, Kenya, there was a limited sample available from the population. A larger sample and a more specific instrument might be desirable and might validate the study findings. Finally, future research could expand to other industries and contexts since supply chain traceability varies from one sector to the other.

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