

**PERFORMANCE MEASUREMENT FRAMEWORK FOR THE
POTATO SUPPLY CHAIN IN KENYA**

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DECLARATION

I would like to declare that this submission towards the award of Master of Business Administration is my original work and does not contain any work published previously by any other person.

Signed _____ date _____

Peter Munge Mwangi

D61/60186/2010

This project has been presented for examination with my approval as the appointed supervisor.

Signed _____ date _____

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DEDICATION

I dedicate this research to my wife Judy for your love and support over the years.

I also dedicate this study to the potato farmers in Kenya who work hard to keep the crop growing year after year.

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ABSTRACT

In Kenya, potato is the second most important food crop after maize in terms of production volumes. Potato makes an important contribution to food and nutrition security and rural incomes. Globally, potato ranks fourth as the most important crop after rice, wheat and corn. In the USA and Canada potato is considered the most important vegetable. Part of the reason why potato is so popular is that it can be eaten in very many forms. These forms include French fries, mashed potatoes, crisps, wedges and many other variations. Potato also contains vitamin C apart from starch and other minerals. In many cases, food or agricultural commodities are grown far away from the point of demand creating a huge supply chain management challenge. A proper supply chain is thus essential to address these challenges. This study sought to determine the applicability of the supply chain performance measurement model proposed by Aramyan, Ondersteijn, van Kooten, and Lansink (2005) for quantifying agri-food chains in Kenya. The focus was on the potato supply chain. In the model, the key measurement parameters are efficiency, flexibility, responsiveness and food quality. A descriptive research design was used to test the measurement framework and the population taken was the potato crisps processors in Nairobi. The study established that efficiency, flexibility, responsiveness and food quality are important in the performance of the potato supply chain. The study recommends a structured adoption of performance measurement for the potato supply chain. This can be achieved by designing effective performance dashboard based on the conceptual framework. This can be adapted to the context of the firms in question to be most effective as a tool for decision making and to provide overall visibility of the supply chain.

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ABBREVIATIONS AND ACRONYMNS

BSC	Balanced Score Card
CIP	Centro Internacional De la Papa (International Potato Centre)
EVA	Economic Value Added
GIZ	Deutsche Gesellschaft fur Internationale Zusammenarbeit (German Corporation for International Cooperation)
KALRO	Kenya Agricultural and Livestock Research Organization
KENAPOFA	Kenya National Potato Farmers Association
MOA	Ministry of Agriculture
NPCK	National Potato Council of Kenya
SCOR	Supply-chain operations reference-model

CHAPTER I: INTRODUCTION

1.1 Background of the Study

In Kenya, potato is the second most important food crop after maize in terms of production volumes. Potato contributes significantly to food and nutrition security and rural incomes (Muthoni & Nyamongo, 2009). In high altitude zones where maize production is poor as a result of low temperatures, potato yields are very high. In cold temperatures, the production season of maize is very long and the yields are poor while potato performs better at the low temperatures which are associated with high altitudes in Kenya. Potato is a perishable crop. This makes it very critical to optimize the supply chain.

In terms of dependence by people for nourishment, potato ranks fourth after rice, wheat and corn (Salunkhe & Deshpande, 2012). Potato is considered the most important vegetable crop in the USA (Guiné et. al, 2010) and Canada (Government of Canada, 2014). The state of Idaho in the USA is considered a “potato state” and the crop contributes to 15% of the gross state product. Idaho state demonstrates how a region can tap into its comparative advantage of climate to emerge as a region of excellence in production and research of a crop. Part of the reason why potato is so popular is that it can be eaten in very many forms. These include French fries, mashed potatoes, crisps, wedges and many other variations. Potato also contains vitamin C apart from starch and other minerals (Brown, 2005).

Kenya Vision 2030, (2007) recognizes agriculture as one of the key sectors that will contribute significantly to the attainment of the vision. The proposed interventions in agriculture include adding value to produce before they reach the market, increased productivity, better utilization of high and medium potential land and improving access to markets by small holders. Potato is mainly grown by small holders in Kenya. Giving attention to the crop will contribute to equity and wealth creation in the rural areas. This is one of the anchors to the economic and social pillars of this development blueprint.

Supply chain management in agriculture is very recent in business literature and is one of the most important areas to meet the challenges of globalization (Bhagat and Dhar, 2011). Agriculture is as old as civilization. With the many changes that have occurred in human civilization, most households no longer grow their own food. In many cases, food or agricultural commodities are required a long distance away from the point of growing. In the delivery of these commodities, many players are involved.

Bijman (2002) defines an agri-food chain. This is a supply chain that is concerned with the production and distribution of agricultural and horticultural products. From this definition, the potato sub-sector can be looked at as a supply chain. What makes this supply chain different from other supply chains are the following features. Firstly, agri-food chains are partly biological increasing risk and variability. Secondly, the products are perishable and thirdly are the concerns of the consumers and society such as food safety, animal welfare and environmental concerns.

There is increased interest by researchers on agri-food chains (Wijnands and Ondesteijn, 2006). Bhagat and Dhar (2011) state that in agricultural supply chains, stable and common relationships from the various players will result to fair and efficient supply chains contributing to the overall objective of the supply chain in question.

Closely related to supply chain management is the Value chain concept. In his book *Competitive Advantage*, Michael Porter (1985) states that the objective of the sequential activities of the firm is to create value that exceeds costs in the customer's eye. Kaplinsky & Morris, (2001) describe a value chain as activities that are required to bring a product or service from conception through the different phases of production, delivery to consumers and final disposal after use. Taking a value chain approach in these activities implicitly means value creation is the ultimate objective. Since competitive advantage is moving away from an individual firm to the supply chains in which the firm is operating (Wijnands and Ondesteijn, 2006), it is imperative for a firm, sector or industry to pay more attention to the whole supply chain. It is therefore not surprising that, supply chain management has become a very popular strategy in the 21st century (Ivanov & Sokolov, 2009).

1.1.1 Supply Chain Performance Measurement

It has been shown that the adoption of supply chain management in organizations has had very impressive results (Stadtler & Kilger 2007). First described by Oliver and Weber in 1982, the concept of supply chain referred to a new way of strategic management of logistics. In this view, organization recognize the need for collaborative relationship and see competitiveness as being relevant beyond themselves to other entities such as suppliers and customers (Felea & Albastroiu, 2013). Competitiveness therefore exists in the context of the interrelationship between a firm and other members in the supply chain.

Several models are used in the description, analysis, evaluation and design of supply chains. The SCOR model by the Supply-chain council (2015) and the one proposed by Lambert and Cooper (2000) have been widely adopted by supply chain authorities such as Van der Vorst (2006) and Aramyan, Ondersteijn, van Kooten, and Lansink (2005). In both of these conceptual frameworks, performance measurement is recognized as a key element. According to Van Der Vorst (2006), performance measurement can be used to direct the Design and the management of a supply chain to achieve the desired performance. It is also an important tool in the discussion and the evaluation of potential supply chain relationships.

Supply chain performance is the degree to which a supply chain fulfils end-user and stakeholder requirements with respect to the relevant performance indicators at the point in time that is in question (Van Der Vorst , 2006) . Accordingly, supply-chain performance measures gives internal and external stakeholders important information for decision making and policy formulation.

The conceptual framework by Lambert and Cooper (2000) is anchored on the objectives of the supply chain and it identifies four important elements that include the network structure, the chain business process, the network and chain management and the chain resources. These elements enable the supply chain to meet its objectives. To determine if these elements deliver the objectives of the supply chain, the framework consists of performance measurement.

The SCOR model by the Supply-chain council (2015) distinguishes three key players (the supplier, the firm and the customer) in the supply chain. For each player, the concern is to

source, make and deliver to the subsequent stage. Planning for each player in this model, planning and return logistics are envisaged. The Supply-chain council, (2015) recognizes the importance of supply chain performance measurement and their SCOR model identifies performance measures that include reliability, responsiveness, flexibility and assets

There are many performance measures at the firm level (Wijnands and Ondersteijn, 2004). An example of a model for performance measurement is the Balanced Scorecard by Kaplan and Norton (1992) that measures Financial, Customer, Internal Business processes and Learning and growth. While there are many approaches and models of measuring performance at the firm level Wijnands and Ondersteijn (2004) acknowledge that performance indicators at the supply chain level are still being developed.

As far as Agriculture is concerned, Aramyan et. al.,(2005) proposes that four dimensions are used to measure agri-food chains. These are efficiency, flexibility, responsiveness and food quality. These four dimensions can further be decomposed to provide more specific measures. Accordingly, measures of efficiency include cost, profit, return on investment and inventory. Cost includes production cost, Distribution cost, transaction cost and inventory as a measure is composed of warehousing, capital, storage, insurance and damage and losses. They note that flexibility can be measured in terms of customer satisfaction (pre-transaction, transaction and post-transaction), volume flexibility, delivery flexibility and number of backorders, number of lost sales and number of late orders. As far as responsiveness is concerned, the measures include fill rate, product lateness, customer response time, lead-time and shipping errors. The fourth dimension that Aramyan et. al.,(2005) proposes food quality. This measure is specific to agri-food chains. The specific attributes of food quality include product quality, sensory properties and shelf life, product safety and health, product reliability and convenience, process quality, production system, environmental aspects and marketing.

Developing supply chain performance indicators is not without challenges. One challenges involves the conflict of relevance between the overall supply chain performance and the performance of the individual actors. This implies that an optimal supply chain does not necessarily benefit all the actors equally. The other challenge is that the relevance of information

differs between the various levels of the supply chain. Some information may be so important strategically such that supply chain actors avoid sharing the information freely (Wijnands and Ondersteijn, 2006).

1.1.2 The Potato supply chain in Kenya

As indicated earlier potato is the second most important crop in Kenya after maize. The crop is grown in high altitude areas of 1500-3000 metres above sea level. In these high altitudes, potato has a comparative advantage over maize (Muthoni and Nyamongo, 2009). Maize has very poor yields at high altitudes and the production season is very long. On the other hand, tuberization of potato at high altitudes is very good.

With sufficient radiation and day length, potato grows best at an average (Day and night) temperature of 21⁰C (Havekort. et al, 2008). They observe that in many regions the threshold is 27⁰C for Day temperatures and 15⁰C for night temperatures. The table below summarizes their findings.

Table 1.1: Potato growing conditions

Latitude	Growing season with respect to altitude
40 ⁰ -60 ⁰ North or south	Summer. As altitude rises the growing seasons become shorter
30 ⁰ -40 ⁰ North or south	Spring or autumn at sea level and summer crop at >=100m above sea level
20 ⁰ -30 ⁰ North or south	Winter crop at sea level and summer crop above 1500m above sea level
0-20 ⁰ North or south (tropical)	Growing is best at >=2000 m above sea level

Source: Adapted from the work of Havekort et. al, (2008)

The entire country of Kenya is within 5⁰ North and 5⁰ South of the equator with the equator passing through the country. This implies that potato is best grown at high altitudes. At high altitude, maize, the most important crop performs poorly giving potato an advantage. In Kenya, the potato crop produces higher yields in cold high altitude areas than in the warm low altitude areas. The potato production areas are around Mount Kenya, Aberdares, Mau, Cherangani hills, Nandi escarpment and Taita hills (Kirumba et al, 2004).

In Kenya, small scale potato farming accounts for 70% of the production area and small scale farmers account for 90% of all the potato farmers. These farmers cultivate the potato crop on less than 0.2 hectares of land. Large scale farmers on the other hand account for 0.05% of all the potato farmers and cultivate 2% of the total potato acreage. It is estimated that the large scale farmers cultivate an average of 10 hectares. KENAPOFA (as cited in Janssens et. al, 2013), estimates that there are 500,000 potato farmers whose cultivation area covers 128,000 hectares. However, according to Janssens et al, (2013), the exact number of potato farmers is not clear.

Janssens et al, (2013) document that most of the potato grown in Kenya is sold fresh with only 1-2% being processed. The fresh potato is mainly sold in open air markets. Storage is nonexistent and often, the product has to be sold as soon as it is harvested

Potato production in Kenya is characterized by low yields, soil fertility challenges, pests and diseases, low adoption of storage, low mechanization and lack of financial support to farmers. The supply chain is also not optimal and the trade is largely informal. Seasonality of production caused by dependence on rain leads to periods of gluts and shortage (Janssens et al, 2013).

The government of Kenya (2007) has identified agriculture as one of the six pillars for the realization of vision 2030. Against this background and in recognition of the importance of the potato crop, the government of Kenya with the support of Dutch Ministry of Economic affairs conducted a research on the seed potato and ware potato value chain in Kenya. The research by Janssens et al, (2013) concluded that there is an urgent need to develop the potato value chain with trust amongst the players as a key requirement. Janssens et al, (2013) documented the existing ware potato supply chain. As it can be seen in Appendix I, there are many players in the supply chain. In this supply chain, the trade is often informal.

1.2 Statement of the problem

The importance of supply chain performance measurement is to direct the supply chain towards the required performance as defined by the stakeholders to all internal and external stakeholders for decision making and policy formulation has been recognized by Van Der Vorst (2006). In any organization or sector where a supply chain exists, performance measurement will aid stakeholder expectation. The potato supply chain in Kenya is no exception.

Performance measurement will provide visibility to the stakeholders. Visibility is extremely important in supply chains in the face of complexity because it enables control (Posadas, 2000). Visibility, according to Heaney (2013) is a critical strategy for optimizing cost and service. Visibility implies that the stakeholders have a view of the critical elements that they desire avoiding delays in action and surprises.

According to Chan (2003) supply chain performance measurement provides feedback with regard to meeting the expectations of customers as well as the strategic objectives of stakeholders. The result of this feedback is an improvement of quality and efficiency. This is achieved because the participants are able to act on quality and efficiency concerns when raised by other supply chain actors. This regular back and forth communication and action is very important because it addresses the expectations within the supply chain.

Abu-Suleiman as cited by Nedaa Agami, Mohamed Saleh & Mohamed Rasmy (2012), summarizes the importance of supply chain performance measurement. They state that supply chain performance measurement is important to drive organizational actions, to provide a framework for decision making and to close the loop for control purposes. This supports the assertion of Van Der Vorst (2006), Heaney (2013) and Chan (2003) as stated above.

The Potato value chain in Kenya has been described by Janssens et al, (2013) as sub-optimal. It is characterized by informal trade, internal outlook and powerful traders and middlemen. As an important crop second to maize in Kenya and with growing population and urbanization, the potato supply chain must be given attention. Muthoni and Nyamongo (2009) Documented challenges in production. Janssens et al, (2013) cites challenges that relate to sub-optimal production inputs and Kaguongo et al. (2008) states that the quality of these inputs is often poor due to low returns from potato growing.

The challenges facing the potato sub-sector require a supply chain approach with measurement as a key attribute. Performance measurement will aid the development of the supply chain and help in directing it to meet the performance objectives of the stakeholders as stated by Van Der Vorst (2006). Of the studies carried out for the potato supply chain in Kenya, none has focused

on supply chain performance measurement according to the researcher's knowledge. In the researcher's reckoning, this gap required attention.

1.3 Objective of the study

To determine the applicability of the agri-food chain performance measurement model proposed by Aramyan et. al.,(2005) to the potato supply chain in Kenya.

1.4 Value of the Study

The study aimed to provide an insight into the configuration of the potato supply chain and the key elements that are important to enable the supply chain to deliver its objective.

For potato processors the study indicated what is important to measure as well as what is being measured or not measured. This helped illuminate the key items that are considered to be important at the processing stage of the potato supply chain.

To the government and policy makers the study is a step to enable measurement of the ware potato supply chain and the elements of the supply chain. They will therefore be able to implement sustainable measures to develop the potato sub-sector.

Researchers will use the study towards identifying the endemic problems that afflict the potato supply chains and the areas where further research is needed. Other researchers will use this research as a reference on the performance measurement of agricultural supply chains and other supply chains.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

In business, performance is a key concern to all stakeholders. In many instances, this has been financial. Many methods of measuring performance at the firm level exist. These include Return on Investment (ROI), Economic Value Added (EVA) and profitability. Kaplan and Norton (1992) came up with a comprehensive way in which performance in businesses can be measured through the popular multidimensional Balanced Scorecard.

Modern agriculture is intimately intertwined with business hence the concept of Agribusiness that was first defined by Davis and Goldberg (1957). Today, agribusiness takes a holistic approach of meeting the expectations of all stakeholders and the society. Agriculture is seen even by developing countries as a commercial enterprise whose role goes beyond providing food for the subsistence of those who engage in it.

Van der Vorst (2006) gives a broad definition of performance as Supply-chain performance is as the degree to which a supply chain fulfils end-user and stakeholder requirements concerning the relevant performance indicators at any point in time and states that performance measurement aims to support the setting of objectives, evaluating performance, and determining future courses of action on a strategic, tactical and operational level.

2.2 Supply Chain Performance Measurement

As far as Supply chain performance is concerned, several approaches of measuring performance exist. These include the SCOR[®] model, the Balanced Scorecard (BSC), Activity Based Costing (ABC), Multi-criteria analysis (MCA), Life Cycle Analysis (LCA), Data Envelopment Analysis (IEA) and traditional Accounting methods such as Economic Value Added (EVA).

Aramyan et. al.,(2005) studied each of the following approaches in supply chain performance measurement and described the features of each method as well as the advantages and limitations of each method.

The SCOR[®] approach is the Supply-Chain Operations Reference proposed by the Supply-chain Council. The Supply-Chain Council breaks down a supply chain into the following processes; plan, source, make, deliver and return. In these processes, multiple performance criteria for performance management are reliability, responsiveness, flexibility, cost and efficiency of asset utilization This model is generic and is therefore applicable to all industries (Supply-chain Council, 2015). The principal advantages of this method are that it considers the entire supply chain, it is balanced and it is multi-dimensional. The disadvantage with this approach is that it does not describe every business process or activity. It also fails to adequately address training, quality, information technology and administration (Aramyan et. al , 2006).

Developed by Kaplan and Norton in 1992, the Balanced Scorecard (BSC) takes into account both financial and non financial measures. A balanced scorecard contains four perspectives namely financial, customer, internal business process and the learning and growth perspective. The financial perspective considers financial measures such as cost of manufacturing or total logistics cost. The customer measures customer related concerns such as on-time delivery and fill rate. The internal business processes measures attributes that lead to excellence such as forecast capabilities and lastly. The organization's capacity for learning and growth with respect to sustainability is measured using the learning and growth perspective. The balanced scorecard's main advantages are its balanced view that considers financial and non-financial measures and the appropriate connection between top level and middle level management concerns. Its weakness is that it is not a quick fix and its complete implementation must be staged (Aramyan et. al , 2006)

Activity Based Costing (ABC) first accumulates indirect resource costs for each activity for a certain area and assigns the costs of each activity to the product, service or other cost objects that uses the activity (Horngren et. al, 2008). ABC enables the attribution of costs to cost drivers for every supply chain process, element or attribute. Aramyan et. al (2004) cite the advantages of this approach in supply chain performance management. The advantages are that the approach

gives insight beyond financial information and recognizes how costs behave for different activities. Its drawbacks are that it is costly and difficult to collect initial data and to determine appropriate cost drivers.

Multi-criteria analysis makes use of various Dimensions as defined by the management based on the objectives of the organization. The process involves the identifying the Desired outcomes, the criteria to judge these outcomes and the weights for the criteria. It has the advantage of being participatory and interactive. It is also broad based covering financial and non-financial metrics, as well as quantitative and qualitative measures. Its Drawbacks include the difficulty in assigning weights (Aramyan et. al, 2006).

Economic value added also called residual income is the difference between after-tax operating income and the cost of capital. It is very useful for project evaluation. The advantages of using EVA are that it takes into account the cost of capital and allows project to be viewed separately. However, it is difficult to calculate EVA among the divisions in an organization. Another shortcoming is that EVA cannot measure detailed supply chain performance EVA can be considered as part of other measures such as the Balanced Score Card and Multi-criteria analysis (Aramyan et. al, (2004).

Lastly is the Life Cycle Analysis (LCA) that looks at the entire life of a project. Life cycle analysis takes into account input use and environmental impact of an entire supply chain from extraction to disposal. Its main advantage is clear mapping of the resources required in the supply chain. It also determines where there are large environmental burdens. Its disadvantages are that the existence of conflicting environmental indices that lead to confusion (Aramyan et. al, 2006)

2.3 Supply Chain Performance Indicators

Gunasekaran et al., (2001) note the importance of performance indicators to various stakeholders such as decision making and developing of policy. They also acknowledge that the development of an integrated supply chain has to been in tandem with the development of supply chain

performance indicators. This applies to agricultural supply chains too according to Aramyan et. al.,(2005).

Many studies have been carried out to determine the most appropriate metrics to indicate the performance of supply chains. Aramyan et. al, (2004) studied literature in this subject from 1979 to 2004 and noted some common themes across industries that included steel production, manufacturing, food, transport, horticulture and multi-industry studies. From the study, Aramyan et. al.,(2005) concluded that supply chain performance can be measured in using dimensions of efficiency, flexibility, and responsiveness. They further noted that supply chains are different and this must be taken into account.

2.4 Supply Chain Performance in Agri-Food Chains

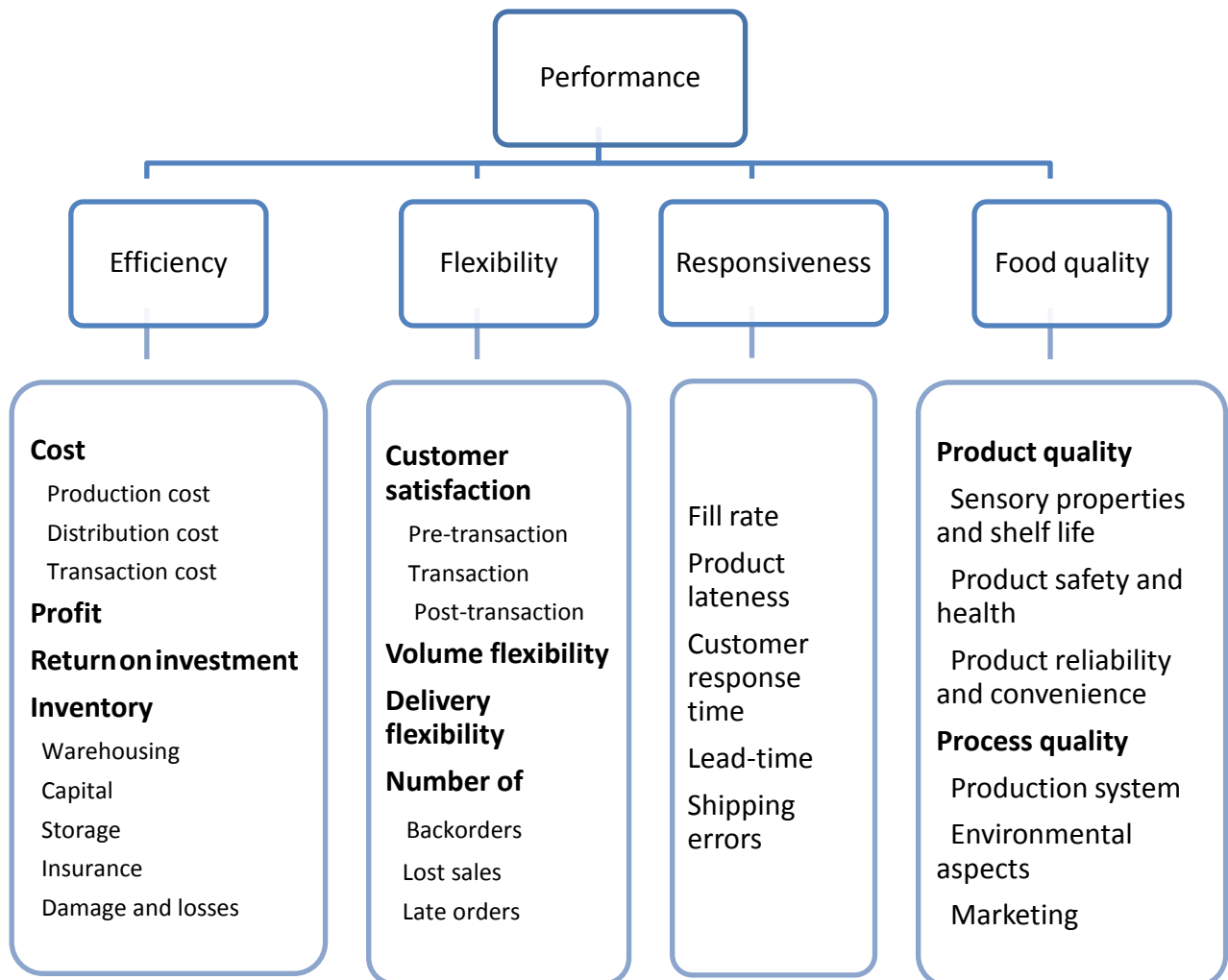
Van der Vorst and Van der Spiegel (as cited in Aramyan et. al, 2006) describe the specificity of agri-food supply chains. These are characterized by perishability, long production throughput time, seasonality of production, natural biological or environmental variability, physical features such as taste, size and shape and perceived quality. Other characteristics cited include product safety, convenience, government regulations, and storage and transport requirement peculiarity for perishable products.

Accordingly, the perishability of agricultural produce introduces quality management for both the product and the handling processes as an important factor (Aramyan et. al, 2006) that must be taken into account in supply chain performance. As far as food quality is concerned, Aramyan et. al.,(2005), take the work of Luning et, al (2002) that defines food quality. The dimensions for food quality in the work include food safety and health, sensory properties, shelf life, product reliability and convenience. Process quality is then considered in terms of production system characteristics, environmental aspects.

2.5 Conceptual Framework

According to Aramyan et. al.,(2005), adding food quality to the measures of efficiency, flexibility, and responsiveness results in a complete conceptual framework to achieve the aims of measuring supply chain performance in agri-food chains. The potato supply chain in Kenya can therefore be evaluated using the conceptual framework proposed by Aramyan et. al.,(2005). The conceptual framework has been summarized in figure 1 below.

Figure 1: Conceptual framework of performance indicators for agri food supply chains



Source: Aramyan, Ondersteijn, van Kooten, and Lansink (2005)

2.5 Summary

A study of the various dimensions of evaluating the food supply chain has been done. A conceptual framework has been proposed by Aramyan et. al.,(2005) that adequately addresses the specificity of agri-food products. It is reckoned that this conceptual framework is applicable to the potato supply chain in Kenya.

CHAPTER III: RESEARCH METHODOLOGY

3.1 Introduction

In this chapter, the research methodology is discussed. The level of analysis with respect to supply chain management is defined. The population, sampling, the data collection is outlined. The design and structure of the data collection instrument has also been discussed.

3.2 Research Design

A descriptive design was used to test the measurement framework indicated in the objective of the study. Aramyan, Lansink and van Kooten (2005) used a descriptive method to test the proposed model on the Dutch tomato supply chain and collected data using questionnaires. For this study, the same approach was taken. The interest of the study was potato processors in Kenya. These are both industrial and cottage industry processors that are registered with the Kenya Bureau of Standards. The processors buy potatoes from growers and process them into potato chips, fries, bhajia and crisps among other products. They in turn sell them through channels such as supermarkets and wholesalers.

3.3 Population and Sampling

Data from the Kenya Bureau of Standards (2014) indicates that there are more than 200 crisps processors. Some of the processors in the list make crisps from arrowroots and bananas and some process potato crisps. Of those who process potato crisps, there are some who process other items too. This study focused on those who process potato crisps in Nairobi County. According to Appendix 3, there are 73 organizations that fit the criteria. This is the population of the study. In the study, the respondents were the managers or owners in the organization. In the researcher's reckoning, these respondents have a good understanding of the business to be able to provide the required data.

Simple random sampling was used in the collection of the data. To determine the sample size, the normal approximation to the hypergeometric was used. This is because the population size was small (Morris, 2004).

The sample size n was obtained using the expression $n = Nz^2pq/[E^2(N-1) + z^2pq]$

where;

n =sample size

z =the value corresponding to the desired level of confidence in the distribution

p and q are the population proportions

E =accuracy of the sample proportions

N =The population size

The confidence interval used for sample size determination is 90%. Morris (2004) suggests that p and q should be taken as 0.5 respectively in such cases. An accuracy level of sample proportions was taken as 9%. Using these values, the sample size obtained was 39. This means that, 39 potato crisps processors were targeted in the survey.

3.4 Data collection

Primary and secondary data was used. Primary data was collected by administering questionnaires to the respondents. The secondary data sources complemented primary data and were obtained from published and unpublished sources such as books, journals and symposia compilations.

Aramyan et. al.,(2005) provided four dimensions of measuring supply chain performance in agri-food chains. Later, Aramyan et. al., (2005) tested the framework for the Dutch tomato supply chain. Consistent with this work, the researcher carried out the study using similar methodologies. The questionnaire administered contained a Likert scale as well as open-ended and closed-ended questions. The administration was done orally where trained enumerators presented the items orally and entered the responses on the questionnaires. Questions were related to the four dimensions shown in figure 1.1 above.

Definitions of the various elements of the model were given and explained to the respondents by the enumerators. The respondents in the questionnaire were asked to suggest other possible indicator and to provide their perception of importance to the firm in question. The Likert scale used contained 5 levels with 5 being very important and 1 being not important. The researcher was also interested in whether the said parameters are measured in the firm or not. Pre-testing of

the questionnaire was done on 10% of the target population. The researcher was involved directly in the pilot test as well as the eventual data collection. Debriefing was done after the pilot test and continuously during the data collection period. The goal here was to improve the quality of data and to avoid problems such as ambiguity, inability to answer questions and misunderstanding among other challenges expected during data collection.

3.5 Data Analysis

The questionnaire included sections where respondents indicated if a particular item was being measured as a “Yes”, “No” or “Partially” answer. Where partially was indicated, an explanation was sought to clarify what is meant. This was to take into account industry specificities. For example, it is possible that some respondents did not engage in warehousing, yet it is one of the Likert items on the questionnaire.

To correct for differences in the perception of the respondents, the relative importance weight was calculated. As cited by Aramyan et. al.,(2005), the relative importance of indicator i , and respondent j was calculated as $W_{ij}=(X_{ij})/(X_j)$. In this expression X_{ij} is the value of the indicator i for respondent j and X_j is the average ranking for all indicators for respondent j . This was done for all indicators and respondents.

Descriptive statistics contained scores and mean scores for each item in the Likert scale, whether the item was being measured in the farm as well as mean weights. The researcher also calculated the standard deviation of the scores and the standard deviations of the relative weights. This enabled inferential statistics to be carried out. Inferential statistics such as correlation analysis and chi square tests were used to establish the relationship between the selected variables and for hypothesis testing.

The regression equation was :

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \varepsilon$$

Where Y =performance of potato supply chain, X_1 =efficiency, X_2 = flexibility, X_3 = responsiveness and X_4 = food quality, while β_1 , β_2 , β_3 and β_4 are coefficients of determination and ε is the error term. This generated quantitative reports through tabulations, percentages, and measures of central tendency.

CHAPTER IV: DATA ANALYSIS, RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents data analysis, interpretation and discussions on the applicability of the agri-food chain performance measurement model. The main objective of the study was to determine the applicability of the agri-food chain performance measurement model proposed by Aramyan et. al.,(2005) to the potato supply chain in Kenya.

4.2 General Information

Data was collected from managers or owners in the organization. The study focused particularly on top level management staff where three top level managers who deal directly with day to day management of the companies were considered because they would be conversant with the subject matter of the study. The study targeted 39 potato crisps processors in Nairobi where 39 questionnaires were issued. Of the 39, 31 questionnaires were returned of which 2 were incomplete. This narrowed down to 29 completed questionnaires indicating a response rate of 74%. This was adequate for the purpose of the research. The data was thereafter analyzed based on the objectives of the study and the findings are as presented below.

4.3 Background information of the respondents

Background information of the respondent serves to illuminate the salient features of the population of research. Of the 29 respondents in the study, 19 were male while 10 were female. This accounted for 65.5% and 34.5% respectively. All respondent were willing to disclose their ages. Most of the respondents were in the 30-39 years age bracket which comprised of 14(48.3%). 20.7%(6) were in the age bracket 40-49 years, 17.2%(5) were less than 30 years while 13.8%(4) were 50 years and above.

The level of education was defined using five intermediate variables mainly; no schooling, primary, secondary, technical and university. Respondents did not hold back this information and all respondents disclosed this vital information. One's level of education provides a good picture of how one understood the topic and elements of the study. This was important to in as far as

clarifying items in the questionnaire was concerned. Furthermore, education level provided a clue on how individuals were willing to contribute to the development of research knowledge on the area of study. Of the 29 respondents in the study, majority 34.5% (10) had technical education qualification. 31.0% (9) had university education, 17.2% (5) had secondary level of education, 10.3% (3) had primary level while 6.9% (2) had no formal schooling.

The type of food product processed by the organisation was categorized into potato crisps, cassava crisps, fried peanuts and a combination of all the above. Majority of the respondents 82.8% (24) indicated potato crisps as the major food product that their organisation processed. 6.9% (2) processed fried peanuts. 1 respondent representing 3.4% indicated they processed cassava crisps. 3.4% (1) of the respondents indicated that they processed a combination of all the above representing by while a similar number said that they processed other products.

Respondent were also asked to indicate the position they held in the organization. The position is important as it helps depict the level of awareness of the respondents as junior staff could be less informed than senior staff especially on management issue. Junior staff could be more informed than senior staff on factors affecting employees. In this case, position held was categorized into sales manager, general manager, production manager, owner and others. 48.3% (14) respondents indicated that they were sales managers. 24.1% (7) were general managers, 13.8% (4) were owners, 10.3% (3) were production managers while 3.4% (1) held other positions in their organizations. The study went further to classify these in terms of owner, manager and others. 65.5% (19) were managers, 31.0% (9) were owners while 3.4% (1) were classified under others.

Another variable of interest was how long the respondents had worked in the organization they were in. Period spent in the organization was important as it helped explain the respondent's knowledge on important issues of the organization. In this case it helped explain employees' awareness on the applicability of the agri-food chain performance measurement model proposed by Aramyan et. al.,(2005) in their organizations. Majority of the respondents had worked in the organization between 2 to 5 years. This was found to be 44.8% (13). 31.0% (9) had been in the organization for 6-10 years, 13.8% (4) had been there for more than 10 years while 10.3% (3) had been in the organization for less than 2 years.

Of the 29 respondents, 44.8 %(13) had specialized in food production, 27.6 %(8) were in sales and marketing while 17, 2 %(5) specialized in business administration and management. 10.3 %(3) had their field of specialization as accounting and finance. Respondents were also asked to indicate whether or not they had supply chain measures in their organizations. 96.6% (28) indicated to having supply chain measures in their organizations while 3.4 %(1) did not.

4.4. Model Analysis

The supply chain performance model was analysed in terms of efficiency, flexibility, responsiveness and food quality. Correlation analysis of variable under study was conducted to establish where there was any significant relation between dependent and independent variables under study. Correlation is a powerful tool to measure presence of a relationship between two or more variables. It tries to establish whether there is positive or negative relationship between variable and using statistical correlation coefficient determine the strength of this relationship. This was then tested for significance at 5%. The result of the analysis is tabulated in table below;

Table 4.1 correlation analysis

Correlations N=29 (Correlation at 0.05 level, ** at 0.01 level, 2 tailed)

		Perfo	Eff.	Flex.	Respo.	quality
Performance	Pearson Correlation	1				
	Sig. (2-tailed)					
Efficiency	Pearson Correlation	.154*	1			
	Sig. (2-tailed)	.031				
Flexibility	Pearson Correlation	.151*	.220**	1		
	Sig. (2-tailed)	.034	.002			
Responsiveness	Pearson Correlation	.054	.197**	.236**	1	
	Sig. (2-tailed)	.044	.006	.001		
Food quality	Pearson Correlation	-.097	.071	.218**	.364**	1
	Sig. (2-tailed)	.033	.325	.002	.000	

Source: Author, 2015

Table 4.2: Coefficient analysis

Model	Unstandardized		Standardized	t	Sig.
	Coefficients				
	B	Std. Error	Beta		
1 (Constant)	1.408	1.131		1.333	.001
Efficiency	.471	.228	0.203	2.110	.031
Flexibility	.247	.127	.217	2.732	.034
Responsiveness	.426	.115	.316	3.617	.044
Food quality	.257	.103	.125	2.592	.033

Source: Author, 2015

From the data in the above table the established regression equation was

$$Y = 1.408 + 0.471X_1 + 0.247 X_2 + 0.426 X_3 + 0.257 X_4$$

From the above regression equation it was revealed that holding efficiency, flexibility, responsiveness and food quality constant, the performance of food supply chains would be at 1.408, a unit increase in efficiency would lead to an increase in supply chain performance by 0.471, a unit increase in flexibility would increase the performance of supply chains by 0.247, a unit increase in responsiveness would increase the performance of supply chains by 0.426 while a unit increase in food quality would increase the performance of supply chains by 0.257. All the variables were significant as their significant value was less than ($p < 0.05$).

The results from multiple regression analysis are as displayed below;

Table 4.3: Model summary

Model Summary ^b					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.889	.0790	0.736	.22462	1.786

a. Predictors: (Constant), efficiency, flexibility, responsiveness and food quality.

b. Dependent Variable: performance

Source: Author, 2015

Adjusted R squared is coefficient of determination which tells us the variation in the dependent variable due to changes in the independent variable. From the findings in the above table the value of adjusted R squared was 0.736 indicating that there was variation of 73.6 percent on supply chain performance due to changes in efficiency, flexibility, responsiveness and food quality. R is the correlation coefficient which shows the relationship between the study variables. From the findings shown in the table above it is notable that there exists strong positive relationship between the study variables as shown by 0.899. The Durbin-Watson's d tests the null hypothesis that the residuals are not linearly auto-correlated. The value of Durbin-Watson was at 1.786 which indicates no autocorrelation among the variables.

The analysis of variance ANOVA was also conducted as shown on the table below.

Table 4.4: ANOVA

		ANOVA ^a				
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.724	4	0.431	2.993	.020 ^b
	Residual	12.678	25	0.507		
	Total	14.402	29			

a. Dependent Variable: performance
b. Predictors: (Constant), efficiency, flexibility, responsiveness and food quality.

Source: Author, 2015

The model is significant at 95% confidence level ($p=0.020$) indicating that supply chain performance can be predicted from efficiency, flexibility, responsiveness and food quality.

4.4.1 Efficiency

The study sought to establish the importance of efficiency in performance measurement.

Table 4.5 Descriptive Statistics for Efficiency

Efficiency Parameter	Mean	Standard Deviation
Production cost	4.59	.501
Cost of inputs and raw materials	4.45	.736
Distribution cost	4.41	.501
Profit	4.34	.553
Return on investment	4.28	.455
Cost of storage	4.28	.649
Cost of insuring inventory	4.21	.774
Warehousing cost	4.10	.409
Cost of capital	4.00	.463

Source: Author, 2015

The indicators of efficiency were cost of inputs and raw materials, production cost, distribution cost, transaction cost, profit, return on investment, inventory, warehousing, capital, storage, insurance, damage and losses. respondents were required to rate the given statement on a scale of 5 with 1 being a not important and 5 being very important. Mean which is a measure of central tendency was used. The results are as shown above. Production cost was ranked first among the important indicators of efficiency with a mean of 4.59. The respondents also indicated that the cost of inputs and raw materials, distribution cost, profit, return on investment, cost of storage, cost of insuring inventory, warehousing cost and cost of capital to be important indicators of efficiency with means ranging from 4.00 to 4.45. The study revealed that efficiency is important in the performance of potato supply chain. Efficiency in potato supply chain was in terms of cost of inputs and raw materials, production cost, distribution cost, transaction cost, profit, return on investment, inventory, warehousing, capital, storage, insurance, damage and losses. The results further found a significant correlation between efficiency and performance ($p=0.031$).

4.4.2 Flexibility

The study further sought to establish the importance of flexibility in performance measurement of supply chains. Respondents were required to rate the given statement on a scale of 5 with 1 being not important and 5 being very important. The results are as shown below;

Table 4.6 Descriptive Statistics for Flexibility

Flexibility Parameter	Mean	Standard Deviation
Customer satisfaction when making sales	4.48	.785
Number of late orders	4.41	.568
Number of lost sales	4.38	.728
Ability to adapt to changes in delivery requirements	4.34	.721
Customer satisfaction after sales	4.34	.814
Customer satisfaction before selling	4.34	.814
Ability to increase production and sales volume	4.14	.743
Number of backorders	4.03	.865

Source: Author, 2015

The various indicators of flexibility in the supply chain were ranked using means and associated standard deviation. Customer satisfaction when making sales was ranked first among the important indicators of flexibility. Number of late orders, number of lost sales, ability to adapt to changes in the delivery requirements, customer satisfaction after sales, customer satisfaction before selling, ability to increase production and sales volume and the number of backorders were also ranked as important among the indicators of flexibility in the supply chain with means ranging from 4.03 to 4.41. The study found it to be important in the potato supply chain. Customer satisfaction when making sales number of late orders, number of lost sales, ability to adapt to changes in delivery requirements, customer satisfaction after sales, customer satisfaction before selling, ability to increase production and sales volume, and number of backorders, were all found to be important in the flexibility of the potato supply chain. More so there was a significant correlation between flexibility and performance ($p=0.034$). A significant relationship

was observed between performance of potato crisps firm and firms flexibility of the supply chain.

4.4.3 Responsiveness

It was also necessary to establish the importance of responsiveness in the performance of the potato supply chain. Respondents were required to rate the given statement on a scale of 5 with 1 being a not important and 5 being very important. The results are as shown below;

Table 4.7: Descriptive Statistics for Responsiveness

Responsiveness Parameter	Mean	Standard Deviation
Shipping errors	4.34	.897
Fill rate	4.24	.636
Customer response time	4.21	.861
Product lateness	4.14	.639
Lead time	4.14	.833

Source: Author, 2015

From the various indicators of responsiveness in the supply chain, shipping errors was ranked first among the important indicators of responsiveness with a mean of 4.34. Secondly ranked was fill rate with a mean of 4.24, thirdly ranked was customer response time with a mean of 4.21. Product lateness and lead time each had a mean of 4.14 being important indicators of responsiveness in supply chain performance. This means that responsiveness is important in the potato supply chain. Shipping errors, fill rate, customer response time, product lateness and lead time were all important in the responsiveness of the potato supply chain. There was a significant correlation between responsiveness and performance ($p=0.044$).

4.4.4 Food Quality

The study further sought to examine the importance of food quality in the performance of the potato supply chain. Respondents were required to rate the given statement on a scale of 5 with 1 being a not important and 5 being very important. The results are as shown below;

Table 4.8: Descriptive Statistics for Food Quality

Food Quality Parameter	Mean	Standard Deviation
Product safety and health	4.45	.572
Product reliability and convenience	4.41	.501
Product quality	4.34	.553
Sensory properties and shelf life	4.34	.614
Process quality	4.31	.471
Marketing	4.31	.712
Environment aspects	4.21	.675
Production system	4.10	.618

Source: Author, 2015

Product safety and health was ranked first with a mean of 4.45 among the important indicators of food quality that affect supply chain performance. Product reliability and convenience, product quality, sensory properties and shelf life, process quality, marketing, environment aspects and production system were also ranked as important in the supply chain performance with means ranging from 4.10 to 4.45. The study further established a significant correlation between food quality and performance of potato supply chain ($p=0.033$). Product safety and health, product reliability and convenience, product quality, sensory properties and shelf life, process quality, marketing, environment aspects and production system were all important when it came to the quality of food and the supply chain as well.

4.5 Chi-square Tests

Further chi-square test was conducted on all variables to establish the goodness of fit between independent variables and firm performance. Using chi-square tests, the result are displayed on the table below.

4.5.1 Relationship between Efficiency and Performance of Potato Crisps Supply Chain

The analysis first looked at the relationship between efficiency and performance of potato crisps supply chain. Chi-square test was employed with the results tabulated below;

Table 4.9: Relationship between efficiency and performance

	Value	Df	Asymp.Sig. (2-sided)
Pearson chi-square	39.221 ^a	2	.022
Likelihood Ratio	37.066	2	.020
Linear-by-linear Association	69.124	1	.800
N of Valid Cases	13		

Source: Author 2015

A Pearson chi-square statistic, $\chi^2=39.221$, and $P=0.022$ was obtained indicating significant relationship between efficiency and firms performance. The results are consistent with the assertion by Fredriksson and Gadde (2003) who described efficiency in the supply chain as a compound evaluation of quality, delivery, cost, and overall capability that is not only planned and reviewed in the relationship but also a measure of the relationship. The efficiency of the producing/using system is influenced by serial interdependencies through relationships. Efficiency is thus evaluated of several parties within the exchange system and negotiated interdependencies determine efficiency goals. Fredriksson and Gadde (2003) add that efficiency means exploitation of interdependencies, reliability and control of resources to ensure resources utilization and control of damages and losses.

4.5.2 Relationship between Flexibility and Performance of Potato Crisps Supply Chain

Similarly, supply chain flexibility as a measure of performance was tested against firm's performance with the result tabulated below;

Table 2.10: Relationship between flexibility and performance

	Value	Df	Asymp.Sig. (2-sided)
Pearson chi-square	17.200 ^a	2	.044
Likelihood Ratio	17.066	2	.044
Linear-by-linear Association	69.124	1	.902
N of Valid Cases	9		

Source: Author 2015

A significant relationship was observed between performance of potato crisps firm and firms flexibility of the supply chain. A $\chi^2=17.200$ with a $p=0.044$ indicated a small significant relationship. The results agree with Sanchez and Perez (2005) who asserted that the different dimensions of flexibility in the supply chain include product flexibility, volume flexibility, routine flexibility and delivery flexibility. They argued that Product flexibility is the ability to handle difficult, non-standard orders, to meet special customer specifications, and to produce products characterised by numerous features, options, sizes, and colours. Volume flexibility is the ability to effectively increase or decrease aggregate production in response to customer demand). Volume flexibility directly impacts supply chain's performance by preventing out-of-stock conditions for products that are suddenly in high demand or by preventing high inventory levels. Delivery flexibility is the ability to adapt to changes in the delivery requirements.

4.5.3 Relationship between Responsiveness and Performance of Potato Crisps Supply Chain

Responsiveness was characterized by shipping errors, fill rate, customer response time, product lateness and lead time. The variables were tested against firm performance using contingency table in chi-square and gave the following results;

Table 4.11: Relationship between responsiveness and performance

	Value	Df	Asymp.Sig. (2-sided)
Pearson chi-square	27.210 ^a	2	.042
Likelihood Ratio	27.066	2	.049
Linear-by-linear Association	19.124	1	1.801
N of Valid Cases	6		

Source: Author 2015

A significant p-value was observed with a $\chi^2=27.210$ with a $p=0.042$ indicating presence of a relationship between responsiveness and firm performance in supply chain. The results concur with Holweg (2005) who defined responsiveness in the supply chain as “ability to react purposefully and within an appropriate time-scale to customer demand or changes in the marketplace, to bring about or maintain competitive advantage” (p.605). According to Holweg, Improving responsiveness in a supply chain, incurs costs for two primary reasons: (1) excess buffer capacity and inventories need to be maintained, (2) investments to reduce lead times need to be made.

4.5.4 Relationship between Food Quality and Performance of Potato Crisps Supply Chain

Firm’s performance in supply chain was further tested against food quality in crisps firm industries with the result tabulated as below;

Table 4.12: Relationship between food quality and performance

	Value	Df	Asymp.Sig. (2-sided)
Pearson chi-square	21.200 ^a	2	.048
Likelihood Ratio	19.066	2	.0410
Linear-by-linear Association	16.124	1	.498
N of Valid Cases	9		

Source: Author 2015

A person chi-square statistic, $\chi^2=21.20$, and $P=0.048$ was obtained indicating significant relationship between firms performance and food quality as a measures of performance in crisps firm industries. The results are consistent with DeBenedetti (2015) who asserts that quality is essential in the supply chain. When supply chain quality is poor, products are more likely to break or wear out before their warranty period expires. Further, the Marketing Supply Chain greatly impacts a company's ability to effectively deliver its brand to market.

4.6 Measurement of Supply Chain Performance Indicators in the Firms

Respondents were further asked to indicate whether or not they measured the indicators of efficiency, flexibility, responsiveness and food quality. Majority of the respondents indicated that they measured the supply chain performance indicators. This was ascertained by 86.2 %(25) of the respondents while 13.8 %(4) indicated that they do not measure these indicators.

Other measure cited by respondents included cycle time which was indicated to be very important.

CHAPTER V: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the discussion of key data findings, conclusion drawn from the findings and recommendations made. The conclusions and recommendations made focused on addressing the objective of the study. The objective of the research was to determine the applicability of the agri-food chain performance measurement model proposed by Aramyan et. al.,(2005) to the potato supply chain in Kenya.

5.2 Summary of Findings

It was found that the model proposed by Aramyan et. al.,(2005) is applicable to the population of study. This implies that relevant key performance indicators relating to the various dimensions of supply chain performance as proposed in the model can be derived by individual firms. Performance dashboards based on the key parameters are very important in focusing individual and organizational behaviour towards a competitive supply chain

The study established that efficiency affects the performance of the potato supply chain in Kenya. Efficiency was characterized by cost of inputs and raw materials, production cost, distribution cost, transaction cost, profit, return on investment, inventory, warehousing, capital, storage, insurance, damage and losses. Supply chain efficiency, therefore, is the measure of getting the right product to the right place at the right time at the least cost. While processors want to measure their own supply chain efficiency, it's often the customer who ultimately evaluates them. Supply chain efficiency must ensure that it upholds the promise to the customer while eliminating non-value add or waste in the process. The food industry is subjected to a number of external factors (consumer taste, income, demographics, etc.), making it necessary for the supply chain to be sensitive to, and respond to, these dynamics.

Flexibility was found to affect the performance of the potato supply chain in Kenya. Flexibility was characterized by customer satisfaction when making sales, number of late orders, number of lost sales, ability to adapt to changes in delivery requirements, customer satisfaction after sales, customer satisfaction before selling, ability to increase production and sales volume, and number

of backorders. Flexibility can improve the company's competitiveness and can enable an organization to improve its efficiency. It is therefore a significant measure of supply chain performance. Flexibility in the supply chain adds the requirement of flexibility within and between all partners in the chain, including departments within an organization, and the external partners, including suppliers, carriers, third-party companies, and information systems providers. It includes the flexibility to gather information on market demands and exchange information between departments in an organization.

The study found that responsiveness affects the performance of potato supply chains. This variable can be measured by shipping errors, fill rate, customer response time, product lateness and lead time. Responsiveness allows use of market knowledge and a virtual corporation to exploit profitable opportunities in a volatile market place. This requires the slashing of process lead times and costs throughout the chain. A responsive supply chain works collaboratively among stakeholders to exchange information in a feedback loop in order to produce enough of a product to satisfy uncertain demand. Operational responsiveness provides companies with the flexibility to quickly react to these types of events and remain a strong player in the supply chain game.

The study also revealed that food quality affects potato supply chain performance. Food quality was characterized by product safety and health, product reliability and convenience, product quality, sensory properties and shelf life, process quality, marketing, environment aspects and production system. Quality is a major goal for the consumer and food safety is one of the most critical issues. Contamination and hazards in food and agricultural products may occur at any stage of the food supply chain, from the field to the table. The contaminants can be physical, chemical, and biological agents and these hazards can occur anywhere along the food supply chain. Production of quality and safety food is therefore one of the challenges in modern civilization. Consumers are becoming increasingly concerned over food quality and safety arising from the globalization of trade in food, processing, intensive agriculture, environmental pollution and natural and man-made disasters.

5.3 Conclusion

The study concludes that the model proposed by Aramyan et. al.,(2005) for quantifying agri-food chains is applicable in the potato supply chain in Kenya. Parameters of efficiency, flexibility, responsiveness and food quality are important to potato crisps processors in the potato supply chain in Kenya.

Performance dashboards can therefore be developed to focus entire organizations to continuously improve the performance of the supply chains. The components of these performance dashboards can be determined at the firm level based on the firms strategy and what the firm considers to be the key performance parameters.

In today's world, an effective and efficient supply chain is a great contributor to customer satisfaction regardless of whether the customers resides next door or across the globe. The function of a supply chain does not end when goods are provided to the customer. Post transaction activities play an important role in customer service and provide valuable feedback that can be used to further improve supply chain performance.

5.4 Recommendations

To have an effective and efficient supply chain, performance measurement and improvement are important in the entire supply chain. Focusing an organization or industry to supply chain improvement involves communicating clearly to the entire organization or industry. Often, this is done best by using a few Key Performance Indicators (KPIs). These are easy to communicate and track.

Potato growers and suppliers require support to improve total product and process quality. Governments, industry, farmers, consumers and other stakeholders should be involved in improving the entire supply chain and developing the Key Performance Indicators that are important to the supply chain and to them as individual organizations or groups.

5.5 Limitations of the Study

The study focused on a single segment of the potato supply chain in Kenya while entire potato supply chain in Kenya is composed of growers, traders, processors and consumers as well as input suppliers among other players. The conclusions are therefore specific to this segment of the potato supply chain.

5.6 Suggestions for Further Study

The study should be done to cover the entire potato supply chain from production to consumption. This involves testing the model developed by Aramyan et. al.,(2005) in each supply chain process. There is also need to study if the potato supply chain players understand the concept and importance of supply chain. This is because taking an entire supply chain view rather than focusing on their individual roles will result in a more competitive potato industry in Kenya.

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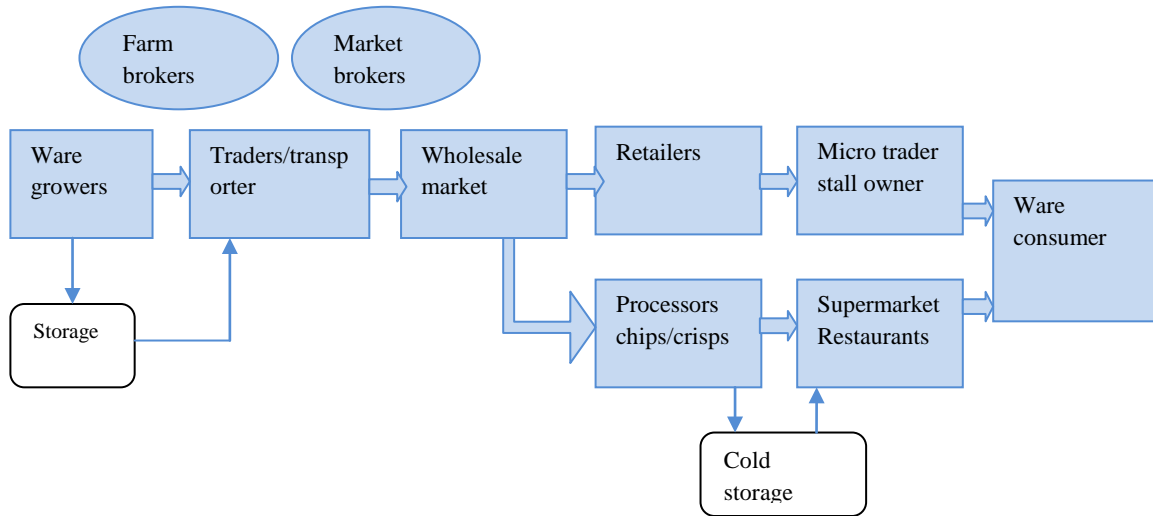
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APPENDIX 1: THE POTATO SUPPLY CHAIN CONFIGURATION IN KENYA



Source (Janssens et. al, 2013)

APPENDIX 2: QUESTIONNAIRE



PERFORMANCE MEASUREMENT FRAMEWORK FOR THE POTATO SUPPLY CHAIN IN KENYA

Master of Business Administration, University of Nairobi

Survey Questionnaire

The Overall objective of the study is to improve the performance of the Potato Supply chain in Kenya

There are no wrong answers

Your opinion is very important

Master of Business Administration Survey Questionnaire

Background information (Please answer the following questions)	
Date of Interview	
Name of Enumerator	
Name of respondent	
Name of the organization	
Type of food products processed by the organization	
Position in the organization	
Telephone Number	
Physical address	
Respondent number	

Socio-Demographic Characteristics		
(Please answer questions 1.1-1.9. Indicate with an X the selected option)		Code
1.1 Age of the respondent	Less than 30	1
	30-39	2
	40-49	3
	50 and above	4
1.2 Gender	Male	1
	Female	2
1.3 Highest Education level	No schooling	1
	Primary	2
	Secondary	3
	Technical	4
	University	5
	Other (Specify)	6
1.4 Type of respondent	Owner	1
	Manager	2
1.5 What is your position in the organisation/Department?.....		
1.6 Number of years working experience	Less than 2 years	1
	2-5 years	2
	6-10 years	3
	More than 10 years	4
1.7 What is your field of specialization?.....		
1.8 Do you have supply chain measures in your organization?	Yes	1
	No	2

Indicate if your perception of the importance of the following performance measurement items to your business. Tick the appropriate box. (Very Important=VI, Moderately Important =MI, Slightly Important=SI, Not Important =NI. Please tick one. Please indicate with 0, 1 or 2 for each if you measure it or not or if you partially measure it). Please feel free to refer to the definitions at the end of this questionnaire

Measure	Very important	Important	Moderately important	Slightly important	Not Important	Do you measure these items (Yes=1, No=0, Partially=2)
EFFICIENCY INICATORS						
Cost of inputs and raw materials	VI	I	MI	SI	NI	
Production cost	VI	I	MI	SI	NI	
Distribution cost	VI	I	MI	SI	NI	
Profit	VI	I	MI	SI	NI	
Return on investment	VI	I	MI	SI	NI	
Warehousing costs	VI	I	MI	SI	NI	
Cost of capital	VI	I	MI	SI	NI	
Cost of storage	VI	I	MI	SI	NI	
Cost of insuring inventory	VI	I	MI	SI	NI	
Customer satisfaction before selling	VI	I	MI	SI	NI	
Customer satisfaction when making sales	VI	I	MI	SI	NI	
Customer satisfaction after sales	VI	I	MI	SI	NI	
Ability to increase production and sales volume	VI	I	MI	SI	NI	
Ability to adapt to changes in delivery requirements	VI	I	MI	SI	NI	
Number of backorders	VI	I	MI	SI	NI	
Number of lost sales	VI	I	MI	SI	NI	
Number of late orders	VI	I	MI	SI	NI	
Fill rate	VI	I	MI	SI	NI	
Product lateness	VI	I	MI	SI	NI	
Customer response time	VI	I	MI	SI	NI	
Lead-time	VI	I	MI	SI	NI	
Shipping errors	VI	I	MI	SI	NI	
Product quality	VI	I	MI	SI	NI	
Sensory properties and shelf life	VI	I	MI	SI	NI	
Product safety and health	VI	I	MI	SI	NI	

Product reliability and convenience	VI	I	MI	SI	NI	
Process quality	VI	I	MI	SI	NI	
Production system	VI	I	MI	SI	NI	
Environmental aspects	VI	I	MI	SI	NI	
Marketing	VI	I	MI	SI	NI	

Indicate other supply chain measures that you would consider to be important to your business and to what extent. (tick the appropriate box for your proposed measure)

		Very important	Important	Moderately important	Slightly important	Not Important
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Please give any other comment which you consider to be important to the study_____

Definitions

Cost of inputs and raw materials	How much the raw materials and inputs cost
Production cost	Cost of processing. From raw materials to packaging
Distribution cost	How much it costs to ensure products reach customers
Profit	Selling price minus total costs
Return on investment	Benefit to the investor resulting from an investment of some resource
Warehousing costs	The cost of keeping products in a warehouse e.g security, rent e.t.c.
Cost of capital	How much it costs to borrow from banks or elsewhere in terms of interest and payments to shareholders
Cost of storage	Costs such as maintenance, control of pests e.t.c.
Cost of insuring inventory	Insurance to cover that is exposed to risks such as theft and fire
Customer satisfaction before selling	Does the customer find it easy or pleasant even before purchase
Customer satisfaction when making sales	Does the customer find it easy or pleasant when purchasing
Customer satisfaction after sales	Does the customer find it easy or pleasant after purchasing
Ability to increase production and sales volume	In case of a sudden increase in orders, is the organization capable of responding fast
Ability to adapt to changes in delivery requirements	Suppose customers change their requirements and preference, will the organization be able to adapt quickly
Number of backorders	A customer order that cannot be filled when presented, and for which the customer is prepared to wait for some time.
Number of lost sales	Profit foregone because the orders could not be fulfilled for whatever reason.
Number of late orders	Orders coming to the company late from its customers
Fill rate	Percentage of customer or consumption orders satisfied from stock at hand. It is a measure of an inventory's ability to meet demand
Product lateness	Product delivered late
Customer response time	How fast can the organization respond to a customer request for a products
Lead-time	The time between the initiation and completion of a production process.
Shipping errors	Shipping the wrong products, the wrong quantity or to the wrong customer
Sensory properties and shelf life	How does the product look, taste, feel or smell
Product safety and health	Is the products safe for human consumption
Product reliability and convenience	Will the product perform its required function
Production system	Are customers concerned by factors such as artificial flavours, colour e.t.c. in the production system
Environmental aspects	Does the product harm the environment
Marketing	Does marketing affect quality expectations

APPENDIX 3: LIST OF POTATO CRIPS PROCESSORS IN NAIROBI COUNTY

FIRM	PHYSICAL ADDRESS	PERMIT NO.	PRODUCT	BRAND
BERACAH INDUSTRIES	LANGATA	13294	POTATO CRISPS	CHICHI
BHAGWANJI FOODS LTD	PARKLANDS	16436	POTATO CRISPS	BHAGWANJI
BHAGWANJI SWEET AND FARSAN MART	PARKLANDS	19693	POTATO CRISPS	BHAGWANJI POA
BIRIKINA FOOD LTD.	SATELLITE-KINYANJUI ROAD	5052	CRISPS	BIRIKINA
BOOKS FIRST LTD [NRB]	MWANZI RD WESTLANDS	6925	POTATO CRISPS	BOOKS FIRST
BOUNTFUL SNAX ENTERPRISES	NGONG	20278	POTATO CRISPS	BSNAX
BRIGHT BONIKA FOOD	UPPER KABETE, UNIVERSITY WAY	7519	CRISPS(POTATO, CASSAVA, ARROW ROOT AND BANANA)	LBF
C AND R FOOD INDUSTRIES LTD	DAKAR ROAD - INDUSTRIAL AREA	1537	POTATO CRISPS AND POTATO STICKS	C AND R
CEACLIFF ENTERPIRSES	LANDI MAWE	11769	FRIED PEANUTS/POTATO CRISPS	CEACLIFF
CHIRAG (K) LTD	OFF ENTERPRISE RD, INDUSTRIAL AREA	2643	POTATO CRISPS	CHIGS
COA GENERAL MERCHANTS	KARIOBANGI SOUTH	3779	POTATO CRISPS	KENYA BEST BITES
DANS SELF SELECTION STORES	SAIKA	11071	POTATO CRISPS	DANS SELECTION STORES
DEEPA INDUSTRIES LTD	SASIO ROAD, INDUSTRIAL AREA	114	POTATO CRISPS	TROPICAL HEAT
DELUXE FOOD INDUSTRIES LTD	ROAD A, OFF ENTERPRISE RD	2302	POTATO CRISPS	YANKEE DOODLE
DOKASON ENTERPRISES	KOMAROCK ESTATE	3821	POTATO CRISPS	ITAWA BYTE CRISPS
FONGO INVESTMENTS	KOMAROCK PH. II	2583	CRISPS (POTATO, BANANA, ARROW ROOT, CASSAVA)	FONGOS
FUN AN SHOP LTD	DIAMOND PLAZA-PARKLANDS	4914	CRISPS	FUN N SHOP
FUN TIME INVESTMENT	UMOJA 1, INNERCORE	4319	POTATO CRISPS AND PEANUT	FUN TIME FAST FOODS
GALAIYA FOOD INDUSTRY	ENTERPRISE RD.	2297	CRISPS	GOLDEN DELIGHT
GNOMIS QUALITY PRODUCTS	KASARANI-MWIKI RD	19931	POTATO CRISPS	GNOMIS

GREENERS GROCERIES SUPPLIES LTD	NAIROBI	16718	POTATO CRISPS	GREENERS
HAPPY EATER LTD	NGARIAMA ROAD	3443	POTATO CRISPS	GOLDEN HAPPYS
HILNNICS ENTERPRISE	KIBERA	19622	POTATO CRISPS	HILNNICS
HOME DELISH	MUNAE RD, NGARA	2607	ASSORTED SNACKS (POTATO CRISPS, STICKS AND CHEVDA A	HOME DELISH
HOMES AND LIFESTYLES LTD	JERUSALEM ESTATE	14285	ASSORTED SNACKS (CHEVDA GANTHIA CRISPS FRIED GROUNDNUTS)	EXTRA TASTY
JAVAN ENTERPRISES	NAIROBI	7109	POTATO CRISPS (SALTED AND CHEESE AND ONION)	JAVAN
JAY GANESH SWEET MART ENTERPRSES	PARKLANDS	16808	CRISPS	JAY GANESH SWEET MART ENTERPRISES
JEMUS ENTERPRISES	NAIROBI	5272	FRIED PEANUTS, POTATO CRISPS, GATHIA AND FARFAR	JEMUS SMART PIPES
JOKA INVESTMENTS	HURUMA	16715	POTATO CRISPS	JOKA
KARA SMART FOOD	UTHIRU 87	7523	CRISPS(POTATO, CASSAVA, ARROW ROOT AND BANANA)	KARA
KARAN FOODS	RIVER ROAD-NAIROBI	8657	POTATO CRISPS	KARAN FOODS
KELLMWANZ SNACKS	KOMOROCK SECTOR 1	3476	POTATO CRISPS	KELLMWANZ SNACKS
KISMART ENTERPRISES	UMOJA II	2618	POTATO CRISPS	KISMART CRISPS
KRISTAS LTD	DAR-E-SALAAM ROAD - INDUSTRIAL AREA	5930	CRISPS	KRISTA'S
LADOS FOODS	JERICHO LUMUMBA	2289	CRISPS	LANDOS
LOGIK SUPPLIERS	NGONG TOWN	9153	POTATO CRISPS	BITY BITZ
LUCKY FOODS LIMITED	LUCKY SUMMER	17156	POTATO CRISPS	MSAFIRI
MAASHAR INVESTMENTS	BABA DOGO	16631	POTATO CRISPS	MAASHAR PRODUCTS
MARKSTARS AGENCIES	NGONG ROAD	300	CRISPS(POTATO, BANANA, ARROW ROOT AND CASSAVA) AND	MARKSY
MARUTI INDUSTRIES - PACKERS	PARKLANDS	9326	POTATO CRISPS, PAPADUM, GANTHIA	MARUTI
MILPHA INDUSTRIES	UTHIRU	17891	POTATO CRISPS	AMMEYS
NIPOA FOOD SNACKS		6237	FRIED PEANUTS, POTATO CRISPS, GANTHIA, FARFAR AND S	NIPOA
NORDA INDUSTRIES LTD	MOMBASA RD, NAIROBI	7274	POTATO CRISPS	POPULAR

NORDA INDUSTRIES LTD	MOMBASA RD, NAIROBI	8526	POTATO CRISPS	BITEZ
ONE STOP ENTERPRISES	RAMESH GAUTAMA RD, NGARA	1408	POTATO CRISPS	OSE
PAMCO FOOD DISTRIBUTORS	KAHAWA WEST	12115	POTATO CRISPS AND GROUNDNUTS	PAMCO PRODUCTS
PIONEER FOODS LTD	AVON CENTRE, ENTERPRISE ROAD	450	CRISPS (POTATOES AND MATOKES)	DEPYS
POOJA PROVISION STORE	5TH PARKLANDS ROAD KIRIMA HOUSE	19280	Potato Crisps	POOJA
PROPACK (KENYA) LIMITED	ROAD 1 OFF BABA DOGO RD, RUARAKA	1615	POTATO CRISPS AND POTATO RINGS	KRACKLES
PROPACK (KENYA) LIMITED	ROAD 1 OFF BABA DOGO RD, RUARAKA	18789	POTATO CRISPS	BLUE LABEL
QSOLS INVESTMENTS	KAMITI ROAD/MIREMA DRIVE	15456	POTATO CRISPS	KRAKOOS
RICAN (K) LIMITED	RABAI ROAD	17796	POTATO CRISPS	JOY TIME
ROBATO ENTERPRISES	EMBAKASI	17436	POTATO CRISPS	ROBATO
ROYAL SNACKS LTD	3RD PARKLANDS, NEXT TO RIDGE COURT	13795	POTATO CRISPS	BREAKTIME
ROYAL SNACKS LTD	3RD PARKLANDS, NEXT TO RIDGE COURT	20295	POTATO CRISPS	ROYAL SNAX
SAIMA INDUSTRIES	PANGANI	3740	POTATO CRISPS MASALA STICKS	RICKYS
SAWA BEST FOODS	JERICHO MARKET	2653	POTATO CRISPS	SAWA BEST
SESIA HONEY FOODS ENT.	RABAI RD- JERICHO ESTATE	2170	CRISPS	SESIA SNACKS
SHREE SAI FARSAN AND SWEET	WESTLANDS	19429	CRISPS	SHREE SAI
SNACK KING	HIGHRIDGE	13215	CRISPS	ABHIS
SUPA SAM SNACKS	KARIOBANGI LIGHT INDUSTRIES	2054	POTATO CRISPS	SUPA SAM
SUPA SNACKS LTD	BAMBURI RD, INDUSTRIAL AREA	1154	POTATO CRISPS	AMIGOS
SUPA SNACKS LTD	BAMBURI RD, INDUSTRIAL AREA	20097	POTATO CRISPS	TUZO
TOKIKO INVESTMETNS	VILLAGE MARKET	12151	CRISPS	TOKIKO

TRINITY TOUCH SUPPLIES	NAIROBI NAIVASHA HIGHWAY -	12232	POTATO CRISPS	TRINITY TOUCH
ULTRA FOODS COMPANY	DONHOLM	18645	POTATO CRISPS	ULTRA
VINA ENTERPRISES LTD	KOMBO MUNYIRI ROAD	3122	CRISPS	VINAS
WAMART ENTERPRISES	KOMAROCK	2561	CRISPS	WAMART ENTERPRISES