APPLICATION OF INVENTORY MODELS IN MANAGEMENT OF RAW MATERIALS BY FOOD MANUFACTURING FIRMS IN KENYA

BY

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DECLARATION

This research project is my original work and has not been submitted for the award of a degree in this or any other University

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This research project has been submitted for examination with my approval for examination with my approval as a university supervisor

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DEDICATION

This project is dedicated to my family members and to all who let me stand on their shoulders so that I could see what they could not.

I dedicate this project to you, to thank you for all the efforts and resources in bringing me up and giving me an education.

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This study has been accomplished through the support and encouragement from various persons to whom I am greatly indebted.

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To all I say, God bless you

ABSTRACT

Proper inventory management represents one of the ways in which firms can manage their costs, and satisfy their customers by giving them quality products at the right prices. The objectives of the study were to research on the different inventory models that are applied by food manufacturing firms in Kenya to manage their raw materials and to determine the factors that are considered important for success in inventory management. The research adopted a descriptive research design to answer the research question.

The study realized that food manufacturing firms in Kenya apply a variety of inventory models to manage their raw materials. None of the firms interviewed applied a single model in isolation. Instead, firms used a combination of different models to manage different sets of raw materials. In conclusion, the food industry in Kenya is employing professionalism in their operations and most highlighted the benefits they have reaped. Efficient ordering systems and efficient material handling procedures were recorded as the most common areas in which companies had benefited. However, most companies are yet to achieve great success in meeting budgetary constraints of raw material management

The researcher recommends that despite the recorded benefits, there is a lot that needs to be done to achieve total efficiency in raw material management both in education of staff and in acquisition of proper systems. The knowledge base of inventory studies needs to be expanded through research so as to equip industry practitioners with more information in this field.

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CHAPTER ONE: INTRODUCTION

1.1 Background

The existence of any organization has its foundation on meeting its stakeholder's demands. Among the stakeholders are the shareholders, who demand return on their investment, employees who demand good working conditions and compensation for the services they provide and customers who demand quality products and services at the right prices for exchange. The ability to meet the demand of the customers as and when they arise makes the difference between success and failure of a company. Stevenson (2007) argues that poor inventory management hampers operations, diminishes customer satisfaction and increases operations cost. Thomas and Franklin (1981) note that the ability to satisfy customers is dependent to some degree on the availability of materials to manufacture goods and provide services; these materials are part of inventory.

Inventory forms a substantial amount of cash investment in business, hence the importance that should be attached to its proper management. Nahmias (2001) notes that management of inventories is just as important as management of cash. This is because inventory is cash (resources) temporarily held idle in the form of goods. Stevenson (2007) suggests that a typical firm will probably have about 30% of its current assets and perhaps as much as 90% of its working capital invested in inventory. Cash is usually controlled by frequent reconciliation of accounts and periodic cash flow forecasting being prepared and presented to financial managers for review. Important inventory management decisions are made by the purchasing managers and operations manager making decisions such as re-order level, economic lot to order and safety stock. Stevenson (2007) argues that

inadequate inventory control can result in both under and overstocking of items. Under-stocking results in, missed deliveries, lost sales, dissatisfied customers and production bottlenecks. Overstocking unnecessarily ties up funds that might be productive elsewhere.

Inventories are goods/ materials held available in stock for business (Thomas and Franklin, 1981). Stevenson (2007) also describes inventory as stock or store of goods. Companies maintain these materials to enable them provide services to their customers and meet demand of goods as and when it arises. Lucey (2002) observes that whether as a result of deliberate policy or not, stocks represent an investment by the organization. Anderson *et al* (2006) note that every organization holds inventory in one form or another and that managing inventory has attracted considerable attention from management scientists. Stevenson (2007) notes that inventories are a vital part of business, not only are they necessary for operations but also contribute to customer satisfaction by meeting their needs as and when they arise.

Lucey (2002) classifies inventory into three broad categories of; Raw materials, Work-in-Progress and Finished products. Items to be included in each category depend on the industry and company, as what is raw material to one company might be a finished product of another. Stevenson (2007) provides additional classification to inventories to include; replacement parts, tools and supplies and goods in transit to warehouse or to customers /pipeline inventory.

1.1.1 Importance of Holding Inventory

As noted by Lucey (2002) firms keep inventory for a number reasons, the most basic being to meet demand. Variations in this demand require that firms keep extra stock than

they would normally keep. This is known as buffer/safety stock. As described by Anderson *et al* (2006), buffer stock is additional stock kept in case customers demand is higher than expected, lack of which would lead to loss of customer goodwill. They argue that because demand will not be known with certainty, companies are compelled to stock additional materials, and that no matter how good our forecasting is, there is a necessity of stocking additional materials. Usage of materials can also vary. According to Mwangi (1983), there is an element of randomness in usage that may be fairly difficult to forecast. Therefore maintenance of adequate inventory is necessary to ensure stock availability when needed. Companies will also order more than they require to take advantage of quantity discounts. Discounts are important to companies as they reduce the cost of goods/services sold/rendered. This increases their profitability and allows them to pass low prices to its customers, increasing their customer loyalty and therefore enable it command a bigger market share.

The nature of demand of a company's product may be cyclic or seasonal, thereby compelling a company to hold inventory. Brown (1959) observes demand for a product is generated by complex interactions of many factors. If it were possible to understand the effect of each of these factors and how they interact, it would be possible to build a mathematical model that could give a very accurate estimate of future demand. The nature of a company's suppliers may compel it to order additional stock. Anderson *et al* (2006) states that an organization might anticipate a risk of disruption to its suppliers and therefore decide to increase its stock. As Lucey (2002) notes a company may unconsciously accumulate inventory. This can be due to obsolete items that have accumulated in stock, poor or non existence of inventory control systems, inadequate or

non existence of stock records and poor liaison between the production controls, purchasing and marketing departments.

Stevenson (2007) argues that the overall objective of inventory management is to achieve satisfactory levels of customer service while keeping inventory costs within reasonable bounds. Satisfactory customer service entails availing to the customers the right goods, in sufficient quantities, at the right place and time while costs of inventory are primarily the ordering and holding costs. Inventory management involves the application of models in business to specify quantities of goods and materials to be held in stock. According to Stevenson (2007) manufacturing firms carry supplies of raw materials, purchased parts, partially finished goods, as well as spare parts for machines, tools and supplies. Inventory management is primarily about specifying the size and placement of stocked goods.

Nahmias (2001), notes that inventory management is required at different locations, within a facility or within multiple locations of a supply network. This helps to protect the regular and planned course of production against the random disturbance of running out of materials or goods. The scope of inventory management also concerns the fine lines between replenishment lead time, carrying costs of inventory, asset management, inventory forecasting and valuation. Other important factors include; future inventory price forecasting, physical inventory, available physical space for inventory, quality management, replenishment, returns and defective goods and demand forecasting (Thomas and Franklin, 1981). Balancing these competing requirements leads to optimal inventory levels, which is an on-going process as the business needs shift and react to the wider business environment.

Inventory management involves a company seeking to acquire and maintain a proper merchandise assortment while ordering, shipping, handling, and related costs are kept in check. Inventory management models include systems and processes that identify inventory requirements, set targets, provide replenishment techniques and report actual and projected inventory status, handles all functions related to the tracking and management of material. This would include the monitoring of material moved into and out of stockroom locations and the reconciling of the inventory balances. Stevenson (2007), notes that management of the inventories has the primary objective of determining/controlling stock levels within the physical distribution function to balance the need for product availability against the need for minimizing stock holding and handling costs.

The amount of inventory held dictates the space requirement in a company. Among the components of inventory holding cost is the storage space occupied by the stock. Land, and therefore by extension space, is a limiting resource in many businesses and must as much as possible be efficiently utilized for the core business activity. The inventory management system employed will therefore dictate the inventory storage space requirements. Where a firm holds unnecessarily high level of inventory, more space will be used up to hold this stock, hence less efficient utilization of space.

1.1.2 The Manufacturing Industry

According to the Kenya Association of Manufacturers (KAM) directory (2011), the manufacturing industry in Kenya comprises more than 600 formal sector industries in small, medium and large enterprises. The industry is organized under KAM, which is the

premier representative organization for manufacturing and value addition industries in the country. KAM was established as a private body in 1959 to promote trade and investment. The industry has 13 sectors categorized on the basis of their raw materials.

The directory further shows that, the largest sector in the industry is the food, beverage and tobacco sector with over 155 industries. Out of these, 100 are in Nairobi and its environs. This industry is considered old compared to others in East African countries with 10% of the firms having been established before 1960 and about 47% of the firms established between 1980 and 2000. The food manufacturing industry plays an important role in ensuring food security in the country. According to the World Bank economic update of december 2010, the Kenyan manufacturing sector contributed over 14% of the Gross National Product (GDP). This comes second to Agriculture which contributed 25.7%, (World Bank, Kenya Economic Update, 2011)

Given this significance of the manufacturing industry in Kenya, there is a need to make it as competitive as possible. Production managers seeking to minimize unit production cost encounter challenges of both internal and external costs. They have little, if any, control over external costs such as buying price and inflation, as they are imposed by the industry environment and market forces. It is the internal costs that must be controlled (Williams *et al*, 2002). Inventory costs are an important component of the internal costs that can be controlled.

1.1.3 Food Manufacturing Firms in Kenya

Majority of the pioneering industries in Kenya during the colonial period were agro-based, processing local agricultural produce. By 2011, according to the a study by the

United Nations, in addition to the wide spectrum of agro-based industries there exists a wide range of food processing industries utilizing materials that are sourced both locally and from abroad. According to Brand Kenya (2011), food processing companies top the list of manufacturing firms in Kenya. Majority of food manufacturing firms in Kenya rely on local agricultural produce. In a study by the United Nations (2007) on the manufacturing industry in Kenya, it was observed that majority of firms have developed backward linkages with suppliers of technology and packaging materials. The only sector found to have well established linkages with their raw material suppliers were the horticultural firms. Rotich (2005) noted that among the problems facing the agro-industrial sector were seasonal and low quality raw materials and problems relating to raw material handling and distribution. It is therefore important to study how food manufacturing firms in Kenya manage their raw materials.

1.2 Statement of the Problem

Several studies have been done in Kenya regarding inventory management; Odeny (1987) studied drug shorting at Kenyatta National Hospital. Kariuki (1993) studied drug inventory management at the University of Nairobi Health Services while Ondiek (2000) did a survey of the organization for material management in Kenyan manufacturing firms. Several studies have narrowed down their scope to inventory management models. Mwangi (1983) studied the application of statistical forecasting in control of inventory of guest soap at Block Lodges. Mbewa (1984) applied EOQ in determining purchase quantity of 2 kg Kimbo at Ebrahims Supermarkets, while Gathumbi (1997) studied application of inventory models in drug management at the Nairobi City Council Health services. These studies did show that scientific models and indeed Operations Research

techniques have been applied in Kenya to manage inventory. Despite the numerous researches on inventory management, there is yet to be a research shedding light on models used specifically by food manufacturing firms.

Stevenson (2007) observes that some organizations have excellent inventory management, while many have satisfactory inventory management. He observed however, that too many have unsatisfactory inventory management and what is lacking is an understanding of what needs to be done and how it should be done. It is not until we know what models are used by Kenyan firms, that we can further evaluate the models for their effectiveness in inventory management. With the increased demand for food security, increased inflation and the rising cost of doing business in Kenya, there is a need to meet consumer needs at minimum costs. One of the costs that can be reduced is inventory costs. Further, since some food manufacturing firms such as those in the milling sub-sector rely on farm produce that comes in seasons, it would be important to study how such firms manage their inventory.

There is therefore a need to study how food manufacturing firms are managing their inventory, what models they use, and the factors influencing success of such models. This research will seek to bring into light the different inventory models applied by food manufacturing firms in Kenya to manage their raw materials.

This research is focused on the food manufacturing industry in Kenya. The subject of the research is the inventory models applied by food manufacturing firms in Kenya to management of their raw materials.

1.3 Objectives of the Study

The main objectives of this research are:

i. To determine inventory models used by food manufacturing firms in management of their raw materials;

ii. To establish success factors of inventory management models in food manufacturing firms.

1.4 Importance of the Study

This study will benefit manufacturing firms by revealing the different models used by successful food manufacturing firms. Firms can learn from other industrial players and benchmark themselves with market leaders to improve on their operations.

Academicians will also benefit from the study in that it will add to the body of knowledge in operations management, inventory management and supply chain management. It will form an informed basis of evaluating the appropriate inventory management tool in different business environments, as well as bridge the gap between school and industry practices. It will also add to the existing body of knowledge and open up more researchable topics.

Consultancy firms and government agencies also stand to benefit in their advisory capacity to manufacturers. With a clear picture of the inventory management situation in the industry, policy makers would be able to make informed decisions regarding the industry.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter will highlight the various inventory models that have been applied in inventory management. It will also discuss manufacturing firms that have developed and implemented ambitious and innovative inventory systems. With increased competition, firms are continuously looking for innovative ways of keeping their profitability high, hence need to cut their operating costs. One of the operating costs that are within a firms control are inventory related costs. There has been an increase in requirement for knowledge on mathematical theories which can be used to control and analyze stock (Bailey and Bedworth, 1982). Inventory models have combined these mathematical theories and other nonnumeric techniques to control inventory.

Odeny (1987) notes that the reason for increased attention to inventory management is that this asset forms part of the largest portion of many firms expenditure. Yobesh (1991) noted that management has the responsibility of coming up with policies that will minimize the total operating costs. Such policies can make a significant contribution to efficiency in the procurement function (Thomas and Franklin, 1981). There is therefore need to control stock like any other function of a firm. This not only ensures costs are cut, but also enhances efficiency. Mbewa (1984) noted that some of the developed mathematical models included; the classical inventory models, multi-product models, simulation, linear programming and dynamic programming models among others.

Economic Order Quantity is one of the oldest inventory models and has been used to manage inventory since the beginning of the 20^{th} century (Erlenkotter, 1989). Decisions

of when and how much to order was arrived at, from mathematical formulations. However, with time inventory management has taken a holistic approach, indicating a paradigm shift. As an example, the Japanese-originating model, Just In Time (J.I.T) is more of a management philosophy than a model focusing solely on inventory management. Morris (2008) describes JIT as a strategic philosophy which is concerned not with inventory levels exclusively but with promoting an environment in which the way to producing goods can be kept improving over time.

2.2 Inventory Management

According to Thierauf and Klekamp, (1975) there are four reasons for maintaining inventory. These include, pipeline inventory which are important where a significant amount of time is required to transport stock from the supplier to the factory. Inventory is also maintained in order to take advantage of quantity discounts where more units are produced than can be consumed in the immediate present. Inventory is also kept when the supply of a commodity is variable or seasonal, and in order to make goods available to customers on demand. The reasons however, may vary from one industry to another.

Factors influencing demand differ with industries, regions and time periods. Sharma (1999) observed that businesses operate under dynamic environments and that these environments need to be managed. Inventory management forms part of the internal environment that can be manipulated by the organization. Although, materials are sourced from parties external to the organization, managing these materials and the suppliers can enhance internal efficiency. Nahmias (2001) described inventory management as procedures and policies directed towards achieving efficiency with materials held.

2.3 Inventory Management Models

Stevenson (2007) observes that inventory management has two main concerns. One is the level of customer service, i.e. to have the right goods and services in sufficient quantities in the right place and time and the other being costs. Therefore the overall objective of inventory management is to achieve satisfactory levels of customer service at reasonable costs. He describes inventory turnover, and days of inventory on hand as two measures of inventory performance. Management must therefore establish inventory tracking and maintaining system and make decisions of order times and reorder quantities. Piasecki (2005) notes that long before the arrivals of computers, manufacturers were already reaping the financial benefits of inventory management by determining the most cost effective answers to when and how much to order.

Several inventory models have been applied to manage inventory as discussed next.

2.3.1 Economic Order Quantity (EOQ)

This is the simplest and most fundamental of all inventory models and has become the basis of analysis of more complex models, (Narasimhan *et al*, 2000). It describes a trade-off between fixed order costs and the holding costs. In their journal article, Economic Perspective, Hax and Candea, (1984) traced the history of EOQ to 1913 by Harris Ford Whitman an engineer with Westinghouse factory.

EOQ is the size of an order which minimizes the total annual costs of carrying inventory and the total ordering cost. The model is based on the assumption that there is only one product, non existence of stock-outs and the period of analysis is limited to one planning period. Other assumptions include; constant and known annual demand, product cost,

lead times and ordering cost. These assumptions are not practical in real life, but it's the simplicity and versatility of the model that makes it one of the most widely used inventory models (Narasimhan, *et al*, 2000).

2.3.2 Simulation

The origin of modern day simulators and simulation can be traced to flight training in the aviation industry (Nahmias, 2001). In the early development of the aviation industry, accidents were frequent. Orville Wright, a US army Lieutenant became the first person to die in a powered fixed-wing aircraft accident. The most sensible thing was to develop a ground-based simulator to prepare pilots to fly without exposing them to the danger of flying. Simulation is described by Stevenson (2007) as a numerical technique for conducting experiments which involve logical and mathematical relationships that interact to describe the behavior and structure of a complex real world system over time. It is used where a phenomenon that is observed may not be amenable to any qualitative evaluation in terms of finding a mathematical model. Real-world scheduling problems are often too complex to be amenable to mathematical analysis, (Nahmias, 2001)

Jacobs *et al* (2006) noted that simulation does not make lots of simplifying assumptions about a situation so as to build an algebraic model. Instead it aims at reproducing the complex random variation inherent in a real situation. There are several types of simulation techniques that can be applied but it is the Monte Carlo type simulation that is widely used. Nahmias (2001) notes that Monte Carlo simulation relies on past data that is already available. The data is organized into a frequency tables and then the probabilities of each demand level are established. Based on this data, and the use of random numbers,

which are either computer generated or from random number tables, simulation is then performed for future demand levels. Monte Carlo simulation therefore includes data with some element of uncertainty.

This enables reproduction of a series of weekly, future demand levels which are taken to imitate the real life pattern. The simulated demand helps to examine the effects of various inventory policies. Nahmias (2001) argues that in order to get reliable information, one is required to perform numerous repeated experiments for longer periods. This is because it would be risky to make any hard and fast conclusion regarding the operations of system, if the number of experiments is few. If the simulation is repeated many times, it is much more likely that the average simulated result would be as closely as possible to the expected real life result. The results are then used to generate performance tables and calculate the overall income left from various inventory policies, (Morris, 2008).

One of the advantages of simulation is that it is done without doing actual experiments. This eliminates the possible negative effects such experiments would have of a firm's profitability. Lucey (2002) notes that unlike EOQ that provides answers, simulation only enables experiments of such factors as overall costs of various inventory policies. It is up to the user of this information to make a rational business decision, while still considering other nonnumeric information. Simulation is used in situation where either or both the demand and level of distribution cannot be assumed to approximate any specific mathematical distribution, (Lucey, 2002). The technique is therefore used to replicate a typical series of situations which could have occurred in practice.

2.3.3 Just In Time (JIT)

According to Stevenson (2007), Just In Time is part of Japanese Toyota production and quality philosophy. It has its roots in the kanban system of material flow pioneered by Toyota (Nahmias, 2001). Other components of Toyota philosophy include work flexibility, Jidoka (quality at source) and uniform plant loading. According to the Toyota website, JIT was introduced to eliminate the need of large warehouses. JIT is therefore a strategic philosophy which is not only concerned with inventory, but also with promoting continuous improvement of the environment in which goods are produced. Narasimhan *et al* (2000), note that the Japanese, who are known for their innovation, use the analogy that bad units are like rocks hiding in water. If the water level is lowered, the rocks will show, and everyone is forced to fix the process rather than let it slide. The proponents of JIT argue that if the ordering or set up costs are driven towards zero and the inventory order quantity is driven to be as small as possible, then the average cycle stock will be very small. If the lead time is close to zero, (set up or order times is extremely short) the inventory level can be very low. There will therefore, be no need of holding buffer stock. If expected demand variance during the lead time is small JIT becomes a special type model where set up costs are very small and leadtime very short. Jacobs *et al* (2006) clarify that JIT is however unfavorable if demand level during leadtime is considerably uncertain or if leadtime is very uncertain and the cost of shortage is concern.

The objectives of JIT are zero inventories. Managerial accounts list inventory as an asset in their balance sheet, but proponents of JIT view inventory as a liability to be minimized by driving them out of the system. Anderson *et al* (2006) note that under JIT, it is assumed that, raw materials are held by suppliers, rather than at the factory. Suppliers are

required to deliver materials in small quantities and therefore constant and close relationship is maintained with the suppliers. Jacobs *et al* (2006) observed that practitioners of JIT have managed to reduce their suppliers close to a single supplier per item. This helps to maintain a tight level of control and communication. It also requires suppliers to be geographically close to production facility and to be bound on a kind of long term partnership relationship.

Walters (2006) observes that although JIT seems to be a particularly obvious idea, it can have a dramatic effect on the way materials are organized. This is because it does not do operations too early (leaving materials hanging until they are needed) and neither does it request them too late (which would give poor customer satisfaction), but at exactly the right time.

2.3.4 Pareto Analysis/ABC Analysis

Pareto Analysis was developed by Joseph Juran, a quality guru who named it after an Italian economist, Vilfredo Pareto. Pareto observed that 80% of land in Italy was owned by 20% of the population, (Thomas and Franklin, 1981). The model has since been applied to several areas including inventory management, software development and in business.

Detailed stock control uses time and resources. It can cost a considerable amount of money. Hence it is important that more efforts be directed to where they can be more cost effective. There is no point in elaborate and costly control procedures of items with insignificant values. Hence it is worth carrying out a Pareto analysis. Chandra (2007) defines Pareto analysis as the classification of inventory according to their money value,

frequency of use and according to their importance to the organization. Nahmias (2001) argued that the basic principle of Pareto analysis is the close control of high value items relative to low value items. It makes sense to closely manage costly goods and services and cheap ones loosely.

Sharma (1999) describes ABC analysis as a selective inventory control technique, based on the principle that it would be impossible to manage and control every item in inventory in the same way and skill.

Inventory under Pareto model are classified into three categories, (Hill, 1983)

Class A: Vital few: Consist of about 20% of the number of items consumed and controls about 80% of the total money allocated to inventory. They consist of; top priority items that are critical, where no stock-out is permitted and high priority items which are essential, where limited stock-out may be allowed. Class A items require close management attention and control.

Class B: consist of about 15% of total number of items, which controls approximately 15% of the money allocated to inventory. They comprise of medium priority items which are necessary items. Occasional stock-outs may be allowed.

Class C: Trivial many: Consist of about 65% of the total number of items consumed and controls about 5% of the total money allocated to inventory. They comprise of desirable items where stock-outs may be allowed and lowest priority items, which are needed and where stock-outs are permitted on a wide scale.

2.3.5 Material Requirements Planning (

Independent inventory models, such as EOQ worl not dependent on other stocks. However, th manufacturer uses a set of components to m commodities are related, Walters (2006). Accor developed by Joseph Orlicky in the 1960s aft Program. Before then, manufacturing firms were the EOQ. Dependent demand is dealt with usin plan on the deliveries of materials, (Orlicky; Wig As opposed to other models which utilize past Sharma (1999) notes that MRP utilizes pr requirements. A detailed schedule of products is raw materials. Hill (1983) argues that demand calculated. Walters (2006) illustrates how to arr being the equivalent of gross requirements less therefore requires a firm to have an elaborate, d about production plans, bill of materials, suppli control system to link the many parts of the firm advantages of reducing inventory, increasing s service and faster delivery times.

2.3.6 Marginal Analysis

Also known as the newsboy problem or single-p determining the optimal order quantity for peri

2.3.5 Material Requirements Planning (MRP)

Independent inventory models, such as EOQ works when the demand of a given stock is not dependent on other stocks. However, this is not always the case. When a manufacturer uses a set of components to make a product, the demand of these commodities are related, Walters (2006). According to the Toyota Website, MRP was developed by Joseph Orlicky in the 1960s after studying the Toyota Manufacturing Program. Before then, manufacturing firms were using re-order point type models such as the EOQ. Dependent demand is dealt with using MRP to explode a master schedule to plan on the deliveries of materials, (Orlicky; Wight, 1974).

As opposed to other models which utilize past data to forecast future inventory needs, Sharma (1999) notes that MRP utilizes production plans to find the inventory requirements. A detailed schedule of products is used to prepare and identify quantities of raw materials. Hill (1983) argues that demand should not be forecast when it can be calculated. Walters (2006) illustrates how to arrive at the amounts of inventory to order, being the equivalent of gross requirements less current stock and stock on order. MRP therefore requires a firm to have an elaborate, detailed, accurate and reliable information about production plans, bill of materials, suppliers, costs and so on, creating a complex control system to link the many parts of the firm. Walters (2006) notes that MRP has the advantages of reducing inventory, increasing stock turnover as well as better customer service and faster delivery times.

2.3.6 Marginal Analysis

Also known as the newsboy problem or single-period model, marginal analysis is used in determining the optimal order quantity for perishable goods. Shore (2004) described the

model as being characterized by fixed prices and uncertain demand for perishable goods. Most of the raw materials used in food industries are of limited life span, are hardly recyclable and neither do they have salvage values. The model was developed with a news vendor in mind. Lau and Lau (1998) state that the vendor must decide how many copies of the day's paper to stock in the face of uncertain demand and knowing that unsold copies will be worthless at the end of the day. This model therefore, becomes important to firms dealing with materials having a limited useful life. Such materials are not only lost on their expiry, but they also present a disposal challenge, both in cost and logistics as disposal must adhere to local authority and environmental regulations.

Ferguson and Koenigsberg (2007) note that the classical newsboy model assumes that if the order quantity is larger than the realized demand, a single discount is used to sell excess inventory or that excess inventory is disposed off. On the other hand, if the order quantity is less than demand, then profit is lost. Several extensions to the newsboy model have been done in the literatures for the single item considering random demands. More recently, single item newsboy problem is considered with random lot-size. Lau and Lau (1998) studied the multiproduct newsboy problem with different constraints. Khouja (1999) suggested a comprehensive extension of the single period inventory problem.

2.4 Application of Inventory Management Models

Ondiek (2000) noted that it was not until the past two centuries that purchasing of materials has been addressed seriously in books, colleges and universities. He observed that material purchasing was first brought into light by Charles Baggage in 1892. The first course in purchasing and supply chain management was introduced by Harvard

University in 1917. However, the first textbook was authored in 1933 by Howard Lewis of Harvard University (Dobler and Burt, 1996; Fearon, *et al* 1996)

Thomas and Franklin (1981), note that since the formulation of the Economic Order Quantity model, it has been applied extensively in both manufacturing and service sectors. Several modifications of the model have been made in order to overcome some of the assumptions of the model. These include the consideration of case of stochastic demand, limited life items and cases of lumpy demand. Modifications have also been made to include the consideration for quantity discounts and shortage or stock-out costs. Others include the situations where stock-out is allowed. This means that stock-out costs are incurred when the firm runs out of inventory. Stevenson (2007) argues that these costs may be difficult to quantify but they are significant and the avoidance of these costs is the main reason why stocks are held. There should be enough inventories to last between the time of order placement and time of receiving the order, (Brown, 1959). Further derivatives have been made for multiple items with constraints on resources and to take care of inflation in the economy

Walters (2006) notes that among the greatest success stories in manufacturing industry and inventory management is the application and integration of JIT model in Toyota Manufacturing Program. Since then, the family founded firm has risen to be one of the biggest and most profitable car manufacturing firms in the world (Pilkington, 1998).

2.5 Application of Inventory Models by Manufacturing Firms

Thomas and Franklin (1981) observed that operations Research was first applied in solving military problems in World War II, where interdisciplinary techniques were used

to gain superiority on battle fronts. It was not until later years during the Industrial Revolution that Operations research techniques were applied in industries and businesses (Demetrios and Papoulis, 1984). Since then techniques such as inventory management models have been applied in manufacturing firms. Techniques of Operations Research are now being applied to gain superiority in the manufacturing industry, (Hill, 1983). This is being done through formulation of models and publication of books and journals. One of the journals published by the International Federation of Operations Research Societies, the umbrella organization of Operations Research Societies worldwide, is the Manufacturing and Service Operations Management.

There are numerous success stories in inventory management. For instance, in 1985, the US retailer J.C Penney formed one of the world's first Efficient Customer Response tool (a JIT principle based operation system that extends to other organizations in the supply chain) with shops in Burlington (a fabric manufacturer) and Lanier clothing (a garment maker) to result in a 22% increase in sales and 50% reduction in stock, (Karabyus and Croza, 1995). The Japanese, who are renowned for the JIT model, argue that if there are small inventories between two departments or two companies or a company and its supplies, then the two will be forced to coordinate their schedule instead of depending on buffer to fix things and the customers will be able to receive more things made to order than having to accept something in the inventory which doesn't really fit.

Narasimhan *et al* (2000) observe that great importance should be attached to inventory management the way management places on other assets. One of the measures of performance placed on inventory is return on investment, ROI, calculated by getting the difference between sales and cost of goods sold, and dividing the answer by total assets.

Since inventory represent a means of meeting consumer needs and production efficiency the management of inventory revolve around the objectives of: customer satisfaction, inventory investment and production efficiency. Thomas and Franklin (1981) note that the explicit or implicit costs associated with these objectives always assists regardless of whether or not they can be measured accurately.

2.6 Application of Inventory Models by Food Manufacturing Firms

Food manufacturing firms have also been known not only to apply successfully inventory management models, but also to initiate ambitious projects. In 2001, Nestle, the world's largest food manufacturing firm spent over 2.4 billion US dollars to install a new internet based software that would handle all back office operations such as taking orders, dealing with suppliers, running factories and paying invoices. One of the objectives of the software was to minimize wasteful purchases and control inventory. In 2006 Brabeck, Nestle CEO declared success of the project (Thomas and Franklin, 2008).

2.7 Inventory Management in Kenya

According to Ondiek (2000), majority of Kenyan firms comprise service and marketing industries as compared to Japanese and American firms which are predominantly manufacturing firms. However, Kenyan manufacturing firms play an important role not only in the domestic economy but also in the larger East African economy, a fact that Kenya is usually referred to as the East African economic hub. Ngacho (1999) noted that Kenyan firms carried significant amount of inventory. He provides the reasons as: to take advantage associated with bulk discounts and reduced purchasing cycle, reduce the effects of inflation and fluctuation in demand and to hedge against the risks associated with seasonal and unreliable suppliers. Githiri, (2004) advises that keeping the right

stocks helps to reduce waste in companies. The reality is that manufacturing firms cannot do business without stock. However, it is the level of stock that can cause threats to many Kenyan firms as stocks eat up a substantial part of working capital (Ondiek, 2000).

In a survey of the organization for materials management in the Kenyan manufacturing firms, Ondiek (2000) found that on average Kenyan manufacturing firms were spending 56% of their annual turnover on materials and material related costs. He further quoted a similar study done in America in 1980 by Centre for Advanced Purchasing Studies (CAPs) indicating that American firms were spending 60% of annual turnover on materials. After this study American firms embarked on serious investigation on how to reduce this.

2.8 Applicable Theoretical Framework

In a study to determine the applications of statistical forecasting as a method of inventory control, Mwangi (1983) observed that the environment surrounding inventory usage is faced with uncertainties. Despite excellent forecasting tools, these models are only applicable with reasonable degree of confidence. In his survey of the organization for materials management in Kenyan manufacturing firms, Ondiek (2000) concluded that Kenyan firms were yet to give a lot of attention to material management.

This study highlights the different models that are used in management of raw materials by food manufacturing firms and the success factors associated with the different models. The objects of study were food manufacturing firms in Kenya. Food manufacturing firms were selected as they not only form the bulk of manufacturing firms in Kenya but also because there is no similar prior research.

In a survey of the organization for materials management in the Kenyan manufacturing firms, Ondiek (2000) noted that his survey was the first one of its kind in Kenya. Thus he suggested more researches to be done in the area as there was limited local literature on the same. This study adds to the existing body of knowledge as well as opening up further areas of study in the future, both to academicians and industrial practitioners.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Research Design

This research was a descriptive type of study. The items of study in the research were inventory management models applied to management of key raw materials used in the manufacturing process. The study was confined to food manufacturing firms in Nairobi due to the time and budgetary constraints. Data from 2009 and 2010 was used as it was for the most recent financial years that had elapsed by the time the study was being conducted. Where data for 2011 was available, it was preferred but where data for the preferred time periods was not available, prior years' data was used.

3.2 Population

The populations of interest were the large and medium food manufacturing firms in Nairobi. In determining the size of the firm, several different criteria have been applied and accepted as appropriate. These include, the number of employees in the firm, (Kenya Industrial Research and Development Institute, KIRDI, 2011), capital employed, volume of sales (turnover) and level and type of technology (Woodburn, 1984).

In this research number of employees was used as criterion for size of the firm. Firms with less than 20 employees are considered small, those with between twenty and two hundred employees are considered medium, while those with over two hundred employees are considered large, (KIRDI, 2011). There are more than 155 food manufacturing firms in Kenya (KIRDI 2011). Out of these, 100 are located within Nairobi. Firms within Nairobi formed the population of interest.

3.3 Sampling

The research adopted stratified-random sampling. Since the population covered different categories of food manufacturing firms stratified sampling was adopted, so as to be more representative. This method is most efficient when differential information is needed regarding various strata within the population known to differ with parameters, (Sekaran, 1992). The industry was stratified on the basis of size, that is, whether large, medium or small. The number of targeted firms for data collection was 80 firms all from Nairobi. This was due to time and budgetary constraints as already indicated. Further it can be argued that this largely reflects what generally occurs in Kenya, given Nairobi's food manufacturing firms represent the vast majority in Kenya at about 65% of the total, (100 out of 155). According to Sekaran (1992) sample size larger than 30 but less than 500 are appropriate for most business research. In a survey of organization for materials management in manufacturing firms in Kenya, Ondiek (2000) sampled a total of 55 firms. This provided the basis for valid and reliable generalizations and conclusions. Sekaran (1992) advises that probability sampling is applied where a sampling frame is available, representativeness is crucial and results will be generalized.

3.4 Data Collection

Primary and secondary data for relevant periods was collected. This was done with the help of persons in charge of operations, factory production, inventory management or any other authorized person/manager. Structured questionnaires consisting of close ended and open ended type of questions was used. Both self administered and interviewer administered questionnaires were used to collect data.

The questionnaire was organized in three sections. Section one, was designed to collect general demographic data, Section two, to collect data on the application of inventory models and section three was used to collect data on the success factors.

3.5 Data Analysis

Analysis was tied to each objective so as to reach reliable conclusions and achieve the purpose of the research. Analysis tools used were statistical packages, Excel and SPSS. Descriptive statistics such as mean, mode and percentages were used to achieve the objective of determining inventory models used by food manufacturing firms. Content analysis was done for qualitative and descriptive open ended questions to achieve the objective of determining success factors. This kind of analysis has been applied in similar studies by Mentzer and Cox (1984), Ondiek (2000), among others.

CHAPTER FOUR: DATA ANALYSIS, FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter covers data analysis, findings and discussions of the research. It summarizes the major findings of the research into the application of inventory models by food manufacturing firms in their management of raw materials and the success factors relating to the application of different models. Data has been summarized and presented in the form of percentages, graphs and tables. Out of the 80 questionnaires that were distributed, there were a total of 66 usable questionnaires returned. Given a response rate of 83%, this was considered satisfactory for analysis.

4.1.1 Industry Classification

The researcher classified the respondents into 7 categories for analysis purposes. These are; bakeries, drinks and beverage companies, flour millers, tea/ tobacco processors, fast-food companies, milk processors and bottling companies. This classification was done according to their raw materials and primary products. The respondents from each industry are illustrated as below.

Table 4.1.1 Industry Classification

Bakeries	52%
Drinks and Beverages Companies	17%
Flour Millers	11%
Tea/ Tobacco Processors	6%
Fast Food Companies	6%
Milk Processors	6%
Bottling Companies	2%

This classification is done in accordance with Kenya Association of Manufacturers directory (2011).

Table 4.1.2 Industry Age Distribution

The researcher sought to establish the age of responding companies. Data analysis indicates that companies had the following age distribution;

1 to 10 Years	24%
11 to 20 Years	29%
21 to 30 Years	19%
31 to 40 Years	5%
Over 40 Years	23%

Table 4.1.2 shows that majority of the companies had been in operation for less than 30 years. However, close to a quarter had been in operation for more than forty years.

4.1.2 Background Information

The researcher wanted to establish gender representation of the respondents. Out of the 66 respondents, 38 were male, representing 58% whereas female respondents were 28 representing 42%.

Table 4.1.3 Respondents Educational Background

The researcher also wanted to establish the respondents' educational background.

Post graduate	26%
Undergraduate	62%
Secondary school	9%
Diploma	2%
Certificate	1%

From table 4.1.3, the research indicates that a combined total of 88% of the respondents had at least a degree education while 9% of the respondents had secondary school certificate as their highest level of education. Given the high percentage of the respondents with secondary and post secondary education, it can be argued that they

generally had a good grasp of issues in their areas of work, including the management of inventory.

Table 4.1.4 Organization Size

5 -19 Employees	9%
20 – 49 Employees	22%
50 - 99 Employees	32%
100 - 199 Employees	25%
200 - 499 Employees	6%
Over 500 Employees	6%

The researcher classified companies according to size. Number of employees was used as an indicator of size of the firm (KIRDI, 2011). Majority of the companies had between twenty and two hundred employees. These, according to KIRDI (2011), are considered to be medium sized companies. Only 9% of the companies were small companies (with less than 20 employees).

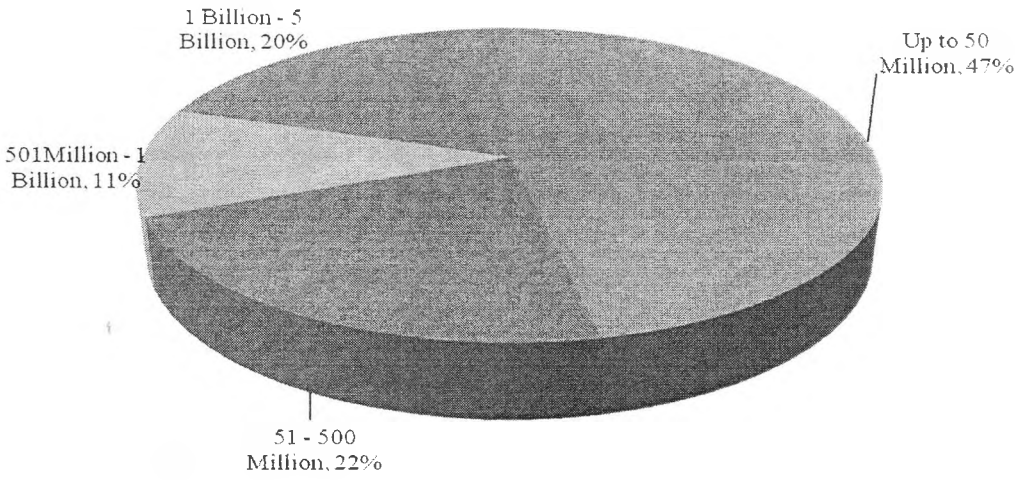
Table 4.1.5 Respondents' Role in the Organization

The researcher sought to establish the respondents' role in their organization. As illustrated in the tabulation below respondents were from different departments.

Production Manager	36%
Manager/ Administrator	25%
Procurement Manager	11%
Technical Officer	8%
Public Relations	5%
Distributor	5%
Marketer	3%
Miller	3%
Department Supervisor	1%
Logistics Manager	1%
Stores Manager	1%
Store Man	1%

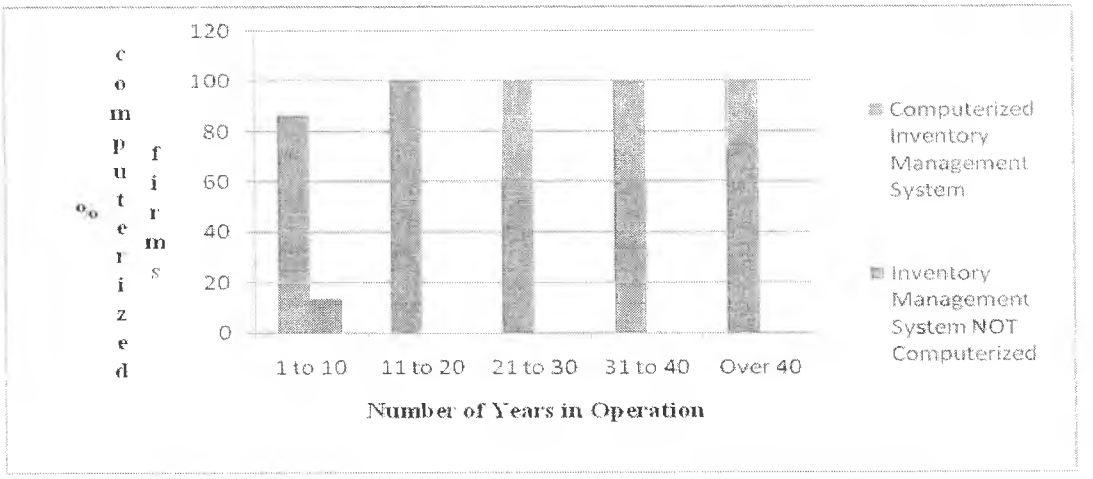
Despite respondents being from different departments, 55% admitted to dealing directly with raw materials or being in charge of departments dealing with primary raw materials. These were production managers, Procurement managers and Technical officers.

Figure 4.1.1 Respondent Company Annual Turnover



The researcher sought to establish the responding companies' annual turnover. From figure 4.1.1, the research shows that companies with a turnover of over half a billion shillings formed 31% of the respondents. Majority of the respondents were below the half a billion mark with the largest segment of 47% having turnover of less than 50 million shillings.

Figure 4.1.2 Computerization with Respect to Age



The researcher sought to establish a relationship between companies' age and computerization of inventory systems. Figure 4.1.2 shows that all companies over the age of 11 years had their systems of inventory management computerized. Of those below the age of 11 years, 87% of them operated computerized inventory systems.

4.1.3 Perceived View of Inventory

The researcher sought interviewees' view on inventory holding. The responses were captured and are summarized in table 4.1.6.

Table 4.1.6 Perceived View of Inventory

As an asset to be maintained, operation tool to meet customer demands, strategic competitive tool	42%
As an asset to be maintained and as a strategic competitive tool	36%
As an operation tool to meet customer demands	13%
As an asset to be maintained	7%
As an asset to be maintained and as an operation tool to meet customer demands	2%

Table 4.1.6 shows that most respondents' consider inventory as a tool to serve multiple organizational needs of being an asset to be maintained, as an operational tool to meet customer demands and as a strategic competitive tool. Only 7% exclusively view inventory as an asset to be maintained.

Table 4.1.7 Sources of Major Raw Materials

From Nairobi only	13%
Within Nairobi or outside Kenya	11%
From Kenya or outside, but not Nairobi	2%
From within Kenya but outside Nairobi	65%
Within Kenya only	7%
Outside Kenya only	2%

The researcher wanted to know where companies source their raw materials from. Table 4.1.7, shows that majority of the companies source their raw materials from outside Nairobi but within the Kenya. 13% source their raw materials exclusively from Nairobi. Only 2% of the companies source their raw materials exclusively by importation.

Figure 4.1.3 Respondents Perception of their Inventory System

The researcher sought to establish the respondents perception of their inventory systems. From figure 4.1.3, the research shows that, only 2% perceive their inventory management

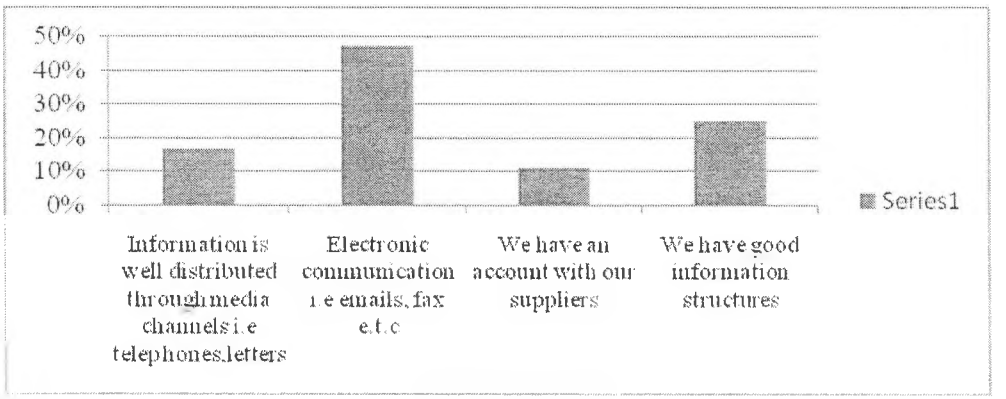
systems as fair, 15% classified their systems as being good. A majority of 83% thought of their of their systems as being either very good or excellent. Further analysis indicates that 94% of firms maintained a list of approved suppliers for their key raw materials, whom they frequently trade with. They hence maintain close contacts with these suppliers. These suppliers were said to be audited periodically to establish their ability to continue supplying raw materials and for quality and safery of food products. Major customers require audits of raw materials suppliers for assurance of quality and safety.

Table 4.1.8 Management of Material Suppliers

Application of rules and regulations	37%
Set objectives and standards	32%
Suppliers demand satisfaction	31%

The researcher sought to establish how companies managed their suppliers. The research findings indicate that in addition to scheduled supplier audits, 37% of the respondents had established rules and regulations for their suppliers to work as guidelines in management of their suppliers. They also had established performance levels for suppliers to meet so as to enhance collaboration. This isillustrated in table 4.1.8.

Figure 4.1.4 Sharing of Information with Suppliers



The researcher sought to establish how firms share information regarding materials with suppliers. The research found out that companies which do not share inventory related information with their suppliers in real time had established diverse ways to relay this information. Figure 4.1.4 show that the most common form of communication with their supplier was through electronic mail at 47%, followed by what they reffered to as good communication structures at 25%.

Table 4.1.9 Frequency of Stock Taking

Monthly	68%
Daily	18%
Weekly	14%

The researcher wanted to know the frequency of stock taking. The research realized that majority of companies conduct monthly stock count. Only 18% of companies conduct daily stock counts.

Table 4.1.10 Number of Employees in Charge of Inventory Management

The researcher also wanted to know the number of employees that were deployed to matters relating to inventory management. Table 4.1.9 shows that, 60% of the firms had allocated over 40 personnel to inventory management. Only 11% of the firms had allocated ten or less personnel to inventory management.

1 to 10	11%
11 to 20	7%
21 to 30	15%
31 to 40	7%
Over 40	60%

4.2 Application of Inventory Models

The main objective of this research was to determine the application of inventory models by food manufacturing firms in management of their raw materials. The study, as shown in table 4.2.1, found that no single firm applied a single inventory model in isolation to manage their raw materials; instead a combination of models was used for different sets of raw materials. The respondents indicated that the combination of the models was dependent on their knowledge of the model and the models availability in computer software used to monitor inventories.

Table 4.2.1 Application of Inventory Models

MODEL	% FIRMS USING
EOQ	68
SIMULATION	77
J-I-T	73
PARETO	83
MRP	54
MARGINAL ANALYSIS	56

4.2.1 Economic Order Quantity

Table 4.2.2 Establishment of EOQ Parameters

Parameter	Established	Not Established
Order Quantity	95%	5%
Order Frequency	71%	29%
Safety Stock Level	69%	31%

To fully apply EOQ in management of inventory, a firm must establish economic order levels, safety stock and ordering frequencies, among other factors. The researcher wanted to establish if firms had established these factors. Although only 68 % (table 4.2.1) of the firms are currently using EOQ in management of their raw materials, 95% of firms admitted to having established Economic Order Quantities for their raw materials, 71%

have established re-order levels and 69% have established safety stock levels for their raw materials as shown in table 4.2.2. Therefore despite having established parameters necessary for the application of EOQ model, not all firms apply the model fully. This was mainly due to the kind of software used to manage inventory.

4.2.2 Simulation

In order to apply simulation to manage inventory, a firm has to establish probabilities of demand of each item among other factors. 93% of respondents had established probabilities of demand for their raw materials. However, as shown in table 4.2.1 only 77% of these respondents actually apply the simulation technique to manage raw materials.

4.2.3 Just In Time

Table 4.2.3 JIT Operating Environment

JIT Parameter	Yes	No
Established Partnership with Suppliers	95%	5%
Easy sourcing of Raw materials	80%	20%
Experience Shortage of Raw Materials	92%	8%

The researcher sought to establish if firms have established factors necessary to employ JIT in management of raw materials. Table 4.2.3 shows that, 95% have established partnership with their suppliers, a prerequisite to JIT application. JIT also requires relatively easy sourcing of items to avoid delayed deliveries and holding buffer stocks. 80% of the respondents described their sourcing of raw materials to be between moderately easy to very easy. As a result of the partnership with their suppliers, 92% declared that they rarely fell short of raw materials, as shown in table 4.2.3. Of the 73 % who were found to apply JIT, only 56% were using it to a greater extent, 44% were

applying it to a lesser extent. This can be attributed to the fact that JIT has not been in use for a long time as other models. It requires more complex structures than the conventional models. The researcher observed that firms in Kenya embracing JIT.

4.2.4 Pareto Analysis.

The respondents did not provide their classification of raw material according to Pareto analysis. However all respondents admitted to having established this classification. A total of 83 % were applying ABC analysis on some of their raw materials.

4.2.5 Material Requirements Planning

Table 4.2.4 Material Requirements Planning Parameters

MRP Parameter	Established	Not established
Defined Production plan	100%	0%
Maintain List of Raw Materials	100%	0%
Detailed Program for Each Product Demand	98%	2%

The researcher sought to establish if firms have established factors required to employ Material Requirements Planning (MRP) in inventory management. MRP requires a firm to establish product demand quantities and to use this information to pull inventory levels by establishing quantities of inventory that would be required to meet the stated demand. A firm must therefore establish schedules of production and a list of all materials required to meet product demand. Table 4.2.4 show that, 98% of respondents have detailed programs for each product demand and that 100% maintained production plans and list of all raw materials that are required and held for production. However, 54% of the respondents admitted to knowingly applying MRP to manage inventory levels.

4.2.6 Marginal Analysis

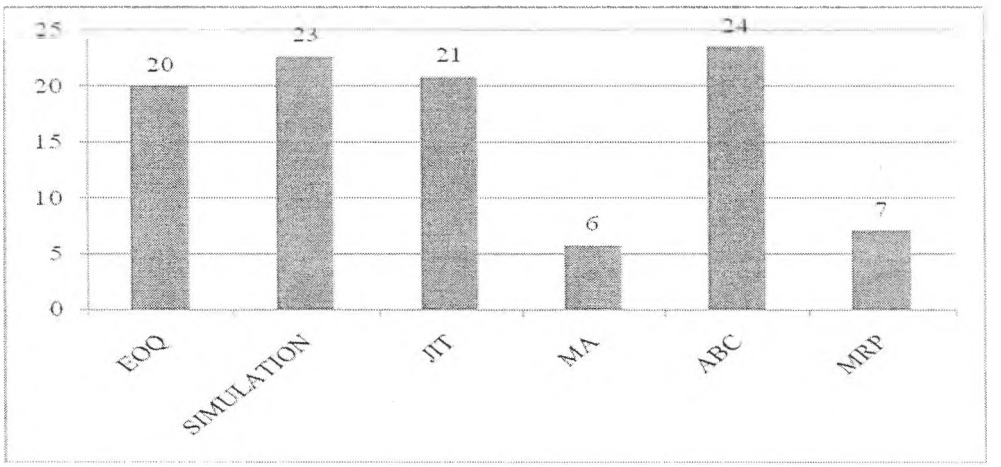
Of all the inventory management models, Marginal analysis had one of the least applications at 56%.

Table 4.2.5 Dealing with Perishable Materials

Schedule Special Production	43%
Invested in Preservation Technology	34%
Dispose to other branches	18%
Reduced Purchase of Materials	5%

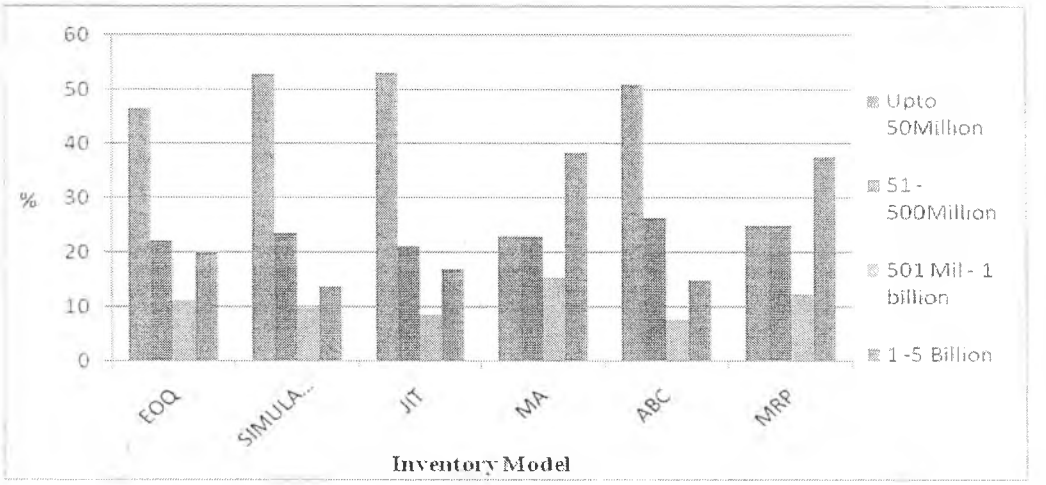
The researcher sought to establish how firms dealt with perishable raw materials. Of those who dealt with perishable items and did not apply Marginal analysis technique, Table 4.2.5 shows that, 43% scheduled their perishable materials to special production while 34 % had invested in preservation technology.

Figure 4.2.1 Summary of Models Application



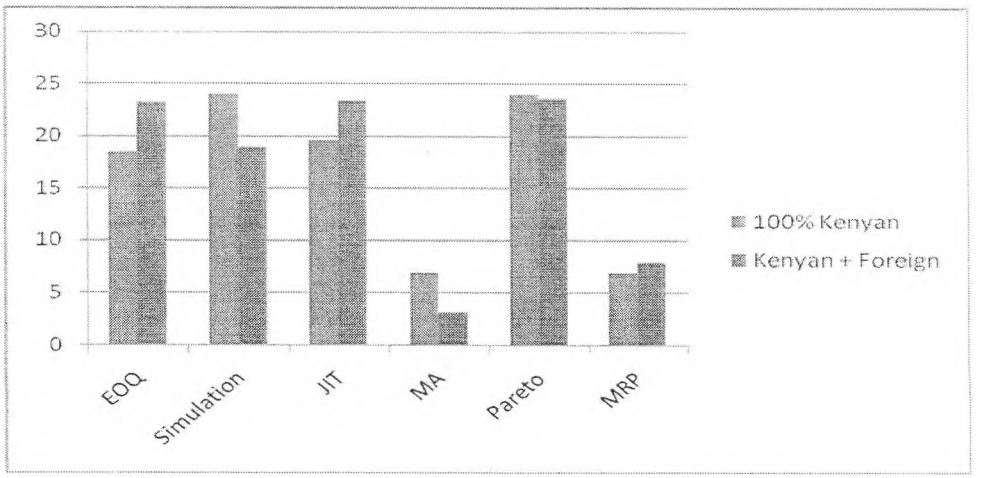
On average, Pareto Analysis has the highest level of application at 24% followed closely by Simulation at 23%. Marginal Analysis has the least level of application at 6% followed by Material Requirements Planning at 7%

Figure 4.2.2 Models Application According to Firm's Turnover



The researcher sought to establish relationships of inventory models application with the firms turnover. As shown in figure 4.2.2, firms with turnover of one billion shillings mostly apply Marginal Analysis and Material Requirements Planning. Firms with less than 50 Million shillings turnover mostly apply EOQ, Simulation and Pareto analysis. The use of all the models does not change significantly among firms with turnovers of between 50 million to one billion shillings.

Figure 4.2.3 A Comparison of Model Application Relative to Ownership



The researcher sought to establish relationships between companies' ownership with the types of inventory models they apply. Figure 4.2.3 shows that, companies that are 100% Kenyan-owned were found to use EOQ and Simulation more than those jointly owned by Kenyans and foreigners. Those with joint ownership were found to use JIT more than the locally owned firms.

4.3 Success Factors

The second objective of the research was to determine the major success factors associated with application of the different inventory management models. The research therefore focused on the factors that industry practitioners consider to be important in evaluation of inventory management systems. Different benefits that companies had indicated as prerequisite for success were highlighted. The collected responses were categorized into nine groups. Different firms listed different combinations of the factors. The table below summarizes these factors. Only 3% of respondents could link increased profitability to good inventory management. Majority of the respondents associated bulk

discounts, reduced purchasing cycles, reduction of inflation and customer loyalty with good inventory management.

Table 4.3.1 Summary of Inventory Management Success Factors

Bulk discounts enjoyed	28%
Reduced purchasing cycles	15%
Reduction of inflation effect	14%
Customers royalty due to sustainable production	12%
Good companies operations evading economic fluctuations	9%
Efficient production systems	6%
Cost effective systems	5%
Good brand management	4%
Seasonal raw materials management	4%
Profitability attributed to good inventory management	3%

Table 4.3.2 Constraints to Effective Inventory Management

The researcher also wanted to know the major constraints that respondents thought could hinder effective inventory management.

Finance	26%
Land	26%
Technology Upgrading	19%
Stores	15%
Policies	3%
Bad Competition	3%
Economy Fluctuations	2%
Raw Materials	2%
Perishable Goods	1%
Weather Changes	1%
None	2%

Table 4.3.2 shows that, a combined 86% of the respondents were constrained by finances, land, technology and stores. Some 2% indicated that they faced no constraints.

Table 4.3.3 Individual Firms Achievements in Inventory Management

Quality Management	32%
Price and Demand Forecasting	12%
Good Management of Raw Materials	8%
Inventory Management	8%
Reconciliation of Inventory Management	8%
Technology Advancement	7%
Reduced Replenishment Time	7%
Better Management of Space for Raw Materials Storage	6%
Low Wastage of Raw Materials	4%
Proper Assortment of Raw Materials	4%
Good Relations with Suppliers	4%

When asked what they considered were the strong points of their inventory models, the respondents gave a variety of benefits, which were clustered and summarized in table 4.3.3.

Majority of the respondents, 32% associated proper inventory management with good quality of their products. This is because with perishable raw materials poor raw material management could adversely affect the quality of products.

Table 4.3.4 Benefits Realized for Proper Inventory Management

Efficient ordering and stock replenishment	41%
Efficient stock storage and material handling	32%
Reduce raw material waste	14%
Sustaining good relations with suppliers	8%
Meeting constraining budgetary allocation	5%

The researcher also wanted to determine the major areas of success recorded by food manufacturing firms. Table 4.3.4 summarizes these benefits.

Majority of the respondents indicated that they had benefited from their inventory systems by registering success in ordering and replenishment of stock and had developed efficient stock storage and material handling. Despite 95% respondents indicating that they had established strategic partnerships with their suppliers, little success has been recorded in developing sustainable supply chain relations with their suppliers and in meeting the allocated monetary budgets.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes the findings and makes conclusions based on the main research objectives. The research was conducted to establish the application of inventory management models in management of raw materials by food manufacturing firms and to establish success factors of inventory management.

5.2 Summary and Conclusions

The analysis indicates that food manufacturing firms use a variety of models in management of their raw materials. All the respondent companies were found to apply a set of models for different sets of raw materials. This was because, different materials require different handling, were different in their nature, for instance from the perishable materials that require preservation to materials that have extended life cycles and so on. Sources of these materials are also diverse and also are their availability. Some materials are seasonal while others are available throughout the year. The variability of processes, raw materials and products within the food manufacturing industry has necessitated the application of different models. This is consistent with Mwangi (1983), who noted that material usage is so random that it becomes difficult to forecast.

The study has highlighted the models used in raw material management. Although the industry is not young in Kenya (having been around since the pre-colonial era), it is yet to be one of the key movers of innovation. Just In Time, Marginal Analysis and Material Requirement Planning are among the recent models being applied by big food

manufactures in Europe, Asia and America. However, the application and knowledge of these models in the Kenyan industries is limited compared to the other models of inventory management.

Most of the inventory management systems are computerized and most firms have established links with their suppliers. Karabyus and Croza (1995) documented similar supply chain integrations in the United States of America and Europe. However, few local companies have fully exploited these infrastructures to establish efficient supply chains. There is only a small proportion (8%) of firms that have developed successful linkages with their suppliers. Odeny (1987) noted the need for increased attention to raw material management. This research has established the existence of supply chain linkages and firms laying down procedures to manage their material suppliers. This indicates the increase in attention being given to inventory management.

Few companies (5%) have been able to operate within the budget allocated to inventories, yet 44% admitted to holding excess raw materials. There is therefore need for companies to be more aggressive in raw material management. With the rapid growth of communication and information technology and need to continuously cut operation costs, it is important that food manufacturers exploit these opportunities to enhance their competitiveness. Githiri (2004) advised that proper inventory management could be used to reduce wastage of materials. This research established that as a result of professionalism in inventory management, few companies (4%) were experiencing problems with material wastage.

The findings of this research confirm that indeed, operation research techniques are being applied by Kenyan food manufacturing firms in inventory management. This is consistent with Mbewa (1984) who noted some mathematical models that were being applied in management of inventory.

5.3 Recommendations

There is a lot that companies can learn among themselves; different companies have recorded success across a spectrum of areas in inventory management. What needs to be done is for industrial practitioners to benchmark with successful practitioners both within and outside the industry.

There is need to fully exploit the established partnerships with material suppliers to manage inventory more efficiently. Although 95% of firms have established partnerships with suppliers, 92% still experience raw material shortage. This indicates there is plenty of room for improvement to establish efficient supply chains.

5.4 Limitations of the Study

The findings of this study should be viewed in light of the limitations of the research. It was difficult convincing the respondents on the purpose of the research. Some held back important information for fear that it might be used by their competitors. Of importance to note is that none of the respondents were willing to divulge information on their Pareto classification of raw materials. Generalization of the findings of the study should be done bearing in mind that data collected was from firms in Nairobi only. Other parts of the country could generate different findings.

Access to individual companies and to senior personnel was a big challenge. There was also the limitation of time both for the researcher and the respondents. The intended respondents were sometimes fully engaged in their duties and had to refer the researcher to other personnel who, sometimes were not well acquainted with issues relating to inventory management.

5.5 Suggestions for Further Research

The research was targeting raw materials held by food manufacturing firms. It would also be important to determine how other inventories including work-in-progress and finished products are managed. Other segments in the wider manufacturing sector can also be researched, to determine models applied by them.

Data collection was limited to firms within Nairobi County. It would also be important to study how manufacturing firms outside Nairobi manage their inventory. Further in-depth studies can also be conducted to determine factors that determine the types of models firms use to manage their inventory.

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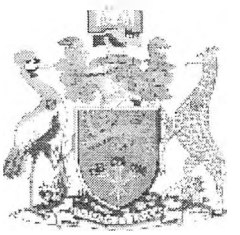
APPENDICES

APPENDIX 1: LETTER OF INTRODUCTION

University of Nairobi



School of Business

RE: TO WHOM IT MAY CONCERN

The bearer of this letter Mr. Wilson Kamau Munyui, Registration Number D61/70161/2009 is a Master of Business Administration (MBA) student of the University of Nairobi.

He is required to submit as part of his coursework assessment a research project report on a management problem. We would like the student to do their project on real project affecting firms in Kenya. We would therefore appreciate if you assist him by allowing him to collect data in your organization for the research.

The results of the report will be used solely for academic purposes and a copy of the same will be availed to the interviewed organization on request.

Thank you

DR. W. N. IRAKI

CO-COORDINATOR, MBA PROGRAM

APPENDIX 2: QUESTIONNAIRE

SECTION ONE: General Demographic Information

1. Name of your organization

_____

2. Gender of respondent
   Male ( )
   Female ( )
3. What is your highest level of education
   a) Post graduate ( )
   b) Undergraduate ( )
   c) Secondary School certificate ( )
   d) Other (specify) _____

4. What role do you play in your organization?

_____

5. How long has your organization been operating in Kenya?

_____

6. What is the size of staff in your organization?
   ☐ 5 – 19 ☐ 20 – 49 ☐ 50 – 99 ☐ 100 – 199
   ☐ 200 – 499 ☐ Over 500

7. Describe your company ownership
   a) 100% owned by Kenyans citizens ( )
   b) Joint ownership between Kenyan and non Kenyan ( )
   c) 100% owned by foreigners ( )
8. What is your annual turnover in Ksh?
   d) Up to 50 million ( )
   e) 51 Million – 500 Million ( )
   f) 501 Million – 1 Billion ( )
   g) 1 Billion – 5 Billion ( )
   h) Over 5 Billion ( )
9. Are you directly involved in management of Raw materials
   Yes ( )
   No ( )
10. How long have you been involved in raw material management? _____

11. What is your primary function?

_____

_____

_____

12. How many employees are involved in management of raw materials?

_____

SECTION TWO: Application of Inventory Models

1. How many departments does your organization have, (list them)

_____

_____

_____

_____

_____

2. Please list your major raw materials

_____

_____

_____

_____

3. How do you view inventory as an organization? (you can chose more than one)
   (a) As an asset to be maintained ( )
   (b) As a liability to be minimized ( )
   (c) As a strategic competitive tool ( )
   (d) As an operation tool to meet customer demands ( )
4. Where do you source your raw materials from
   (a) Within Nairobi ( )
   (b) Outside Nairobi but within the country ( )
   (c) Outside the country ( )
5. On the scale below, what best describes your organization's raw material management

Poor	fair	good	very good	excellent
( )	( )	( )	( )	( )

6. Do you maintain a list of approved suppliers for each raw material?
   Yes ( )
   No ( )

7. Is your inventory management system computerized?

YES ( )

NO ( )

If yes, are your suppliers able to access information on levels of raw material?

YES ( )

NO ( )

If yes please give details

_____

_____

If NO, how do you share/ pass this information with/ to suppliers?

_____

_____

_____

8. How do you manage your suppliers?

_____

_____

_____

_____

9. What is your frequency of scheduled stock taking? _____

10. Indicate to what extent you have used the following inventory management models, if you use any other model please include it

Inventory Model	Highly Used	Moderately Used	Never used
Economic Order Quantity			
Simulation			
Just in Time			
Pareto Analysis			
Material Requirement Planning			
Marginal Analysis			

11. On the table below, indicate whether you have established the following parameters for your raw materials

	Parameter	Established	Not Established
	Economic order quantity		
	Optimal order frequency		
	Safety stock levels		

12. What proportion of your raw material store is occupied by obsolete/ expired raw materials?

(a) <5% ( )
(b) 6 – 10% ( )
(c) 11- 15% ( )
(d) 15 – 20% ( )
(e) >21% ( )

13. Describe the ease of sourcing your primary raw materials

Difficult	fair	moderate	Easy	Very easy
( )	( )	( )	( )	( )

14. Have you established strategic supply chain partnership with your raw material suppliers

(a) YES ( )
(b) NO ( )

15. Dealing with raw material shortages

(a) How often do you fall short of supply?

_____

(b) How do you deal with these shortages?

_____
_____
_____
_____
_____
_____

16. Dealing with Excess supply

a) What volumes do you consider to be excess supplies?

_____
_____
_____
_____

b) How do you deal with excess raw materials?

_____
_____
_____
_____

17. Have you classified your raw materials in any way?

YES ( )

NO ( )

If yes, provide details of your classification, % number and % value of each class

_____

_____

_____

_____

_____

18. Do you maintain a detailed program of each product demand?

YES ( )

NO ( )

Do you maintain a production plan?

YES ( )

NO ( )

Do you maintain list of all raw materials?

YES ( )

NO ( )

Are the programs of product demand, production plans and list of materials factored in while placing orders for Raw materials?

YES ( )

NO ( )

19. Do you maintain probabilities of demand for raw materials

YES ( )

NO ( )

If YES, is this information used in determining demand for raw materials, explain.

_____

_____

_____

20. How do you deal with perishable raw materials?

_____

_____

_____

21. Briefly explain how you manage your raw materials

_____

_____

_____

_____

SECTION THREE: Success Factors

1. What do you consider the major benefits of your inventory management model?

2. What are your firm's major constraints to effective inventory management?

3. What do you consider as your major success factors in raw material management?

4. What are your major success areas in raw material management?

5. Would you recommend your inventory management system to other organization, Comment

6. Please provide us with any other information that in your opinion might be useful to this study

Thank You for Taking Time to Fill This Questionnaire

APPENDIX 3: KENYA ASSOCIATION OF MANUFACTURERS DIRECTORY.

1 Africa Spirits Ltd Food	26 Crown Foods Ltd
2 Agriner Agricultural Development	27 Cut Tobacco (K) Ltd
3 Al-Mahra Industries Ltd	28 Deepa Industries Ltd
4 Alliance One Tobacco Kenya Food	29 Del Monte Kenya Ltd
5 Alpha Fine Foods Ltd	30 E & A Industries Ltd
6 Alpine Coolers Ltd	31 East African Breweries Ltd
7 Annum Trading Company Limited	32 East African Sea Food Ltd
8 Aquamist Ltd	33 Eastern Produce Kenya Ltd
9 Belfast Millers Ltd	34 Eastern Produce Kenya Ltd (Kakuzi)
10 Bidco Oil Refineries Ltd	35 Erdemann Co. (K) Ltd
11 Bio Foods Products Limited	36 Excel Chemicals Ltd
12 Breakfast Cereal Company (K) Ltd	37 Farmers Choice Ltd
13 British American Tobacco Kenya	38 Frigoken Ltd
14 Broadway Bakery Ltd	39 Giloil Company Limited
15 Brookside Dairy Ltd	40 Glacier Products Ltd
16 C.Czarnikow Sugar(EA) ltd	41 Global Allied Industries Ltd
17 Cadbury Kenya Ltd	42 Global Beverages Ltd.
18 Candy Kenya Ltd	43 Global Fresh Ltd
19 Capwell Industries Ltd	44 Gonas Best Ltd
20 Carlton Products (EA) Ltd Food	45 Hail & Cotton Distillers Ltd
21 Centrofood Industries Ltd	46 Highlands Canners Ltd
22 Chirag Kenya Limited	47 Highlands Mineral Water Co. Ltd
23 Coca-Cola East Africa Ltd	48 Homeoil
24 Confec Industries (E. A) Ltd	49 Insta Products (EPZ) Ltd
25 Corn Products Kenya Ltd	50 Jambo Biscuits (K) Ltd

51 Jetlak Foods Ltd	76 Palmhouse Dairies Ltd
52 Karirana Estate Ltd	77 Patco Industries Limited
53 Kenafric Industries Limited	78 Pearl Industries Ltd
54 Kenblest Limited	79 Pembe Flour Mills Ltd
55 Kenya Breweries Ltd	80 Premier Flour Mills Ltd
56 Kenya Nut Company Ltd	81 Premier Food Industries Limited
57 Kenya Sweets Ltd	82 Proctor & Allan (E. A.) Ltd
58 Kenya Tea Development Agency	83 Promasidor (Kenya) Ltd
59 Kenya Wine Agencies Limited	84 Rafiki Millers Ltd
60 Kevian Kenya Ltd	85 Razco ltd
61 Koba Waters Ltd	86 Re-Suns Spices Limited
62 Kwality Candies & Sweets	87 Smash Industries Ltd
63 Lari Dairies Alliance Ltd	88 Softa Bottling Co. Ltd
64 London Distillers (K) Ltd	89 Spice World Ltd
65 Mafuko Industries Ltd	90 Spin Knit Dairy Ltd
66 Manji Food Industries Ltd	91 Sunny Processors Ltd
67 Melvin Marsh International	92 Super Bakery Ltd
68 Mini Bakeries (Nbi) Ltd	93 Trufoods Ltd
69 Miritini Kenya Ltd	94 UDV Kenya Ltd
70 Mount Kenya Bottlers Ltd	95 Unga Group Ltd
71 Nairobi Bottlers Ltd	96 Usafi Services Ltd
72 Nairobi Flour Mills Ltd	97 Uzuri Foods Ltd
73 NAS Airport Services Ltd	98 ValuePak Foods Ltd
74 Nestle Kenya Ltd	99 W. E. Tilley (Muthaiga) Ltd
75 Nicola Farms Ltd	100 Wrigley Company (E. A.) Ltd

Source: http://www.kam.co.ke/?itemId=7, Kenya Association of Manufacturers Website.