REAL-TIME INFORMATION PROCESSING AND SUPPLY CHAIN OPTIMIZATION AMONG SUPERMARKETS IN NAIROBI, KENYA

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DECLARATION

I declare that this research project is my original work and has never been submitted to any other University for assessment or award of a degree.

Signature…….. Date……

WILBERT CHWEYA MAKORI

D61/61830/2010

This project has been submitted with our authority as the university supervisors.

Signature……. Date ……

PETERSON MAGUTU

Signature……. Date ……

ERNEST AKELLO

DEDICATION

To you, my beloved wife Rose Mokeira and the two little exhibits of our union; Frederick and Griffins, my brother Evans and my mother, the late Mary, my friends, Ogechi, Mose and Sibota for cheering me on and offering your monetary support.

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LIST OF ABBREVIATIONS

ERP	Enterprise Resource Planning.
GPS	Global Position System
IT	Information Technology
LAN	Local Area Network
POS	Point of Sale
RFID	Radio Frequency Identification
ROSCI	Return on Supply Chain Investment
SC	Supply Chain
SCM	Supply Chain Management
SD	Standard Deviation
SMS	Short Messaging Service
TFHA	Transportation Federal Highway Administration
WAP	Wireless Application Protocol
WLAN	Wireless Local Area Network
XML	Extensible Markup Language

ABSTRACT

Real-time information processing is a management slogan that is spreading across organizations like bush fire. Some companies have implemented the use of real-time information processing and have reaped from what they sowed. The study was conducted to find out the types of real-time information processing used by supermarkets in Nairobi, Kenya, to determine the benefits of real-time information processing and to establish the relationship between real-time information processing and supply chain optimization.

The research adopted a descriptive cross-sectional survey of supermarkets operating in Nairobi, Kenya. The descriptive approach was used to try to find out the types of real-time information processing technology used in the supermarkets and the benefits of real-time information processing. A sample size of 50 respondents was drawn from a list of 105 supermarkets. Data was collected from the field through use of questionnaires and then analyzed using SPSS and presented in tables and figures. The study revealed that all supermarkets in Nairobi, Kenya, use real-time information processing technology with the following technologies in use: barcodes, mobile phones, internet, RFID, and GPS. The study indicated that two major benefits are accrued through the use of real-time information processing. These are: improved inventory management and increased supply chain visibility and reduction in labor costs. The findings also indicate mixed relationships between real-time information processing and various supply chain optimization indicators. There was a significant positive relationship between real-time information processing and inventory turnover, ROSCI and number of warranty claims. However, there was no significant relationship between real-time information processing and other indicators. This include: warehousing cost, number of orders with complaints, number of customer complaints, transport cost number of accidents, number of times data malfunctioned among others. The study recommends that supermarkets need to train their staff on the use of these technologies for them to reap maximum benefits. The study also recommends the increase in the use of mobile phones, RFID and internet since they had significant relationship with inventory turnover, ROSCI and number of warranty claims.

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

Firms operating in the current business world are faced with stiff competition, increased customer demands, and rapidly changing business environment (Bosire, 2007 and Stuart 2011). Equally, today's Supply Chain Management (SCM) need coordination and integration of activities and resources across firms which spread through decentralized geographical locations and have a high degree of operational complexity (Chopra et al., 2007). Moreover, there is a growing need for supply chains to embrace responsiveness due to more sophisticated and ever-changing customer demands (Dreyer et al., 2008).

According to Folinas et al., (2004), firms are increasingly facing pressure to expand beyond the frontiers of their traditional supply chains as customers demand online order status, trucking capabilities, electronic proof of delay, immediate service based on call centers and online customer service systems, self-service and personalized interactions.

Supermarkets are no exception to these challenges. The nascent industry in Africa is faced with the need to increase sales volume and stiff competition (Olamide et al., 2013). The industry is equally being saturated due to urbanization and need to address newer competition challenges including restaurants and home shopping delivery which ;coupled with changing demographics affect tastes and preferences and consequently per capita spending of its customers (Kumar, 2008).

The solution to these challenges is quick movement to entire supply chain (SC) optimization and paradigm shift to real-time information processing technologies (Dreyer, 2008). As Folinas et al., (2004) argues, in the modern business environment SC should be a way for achieving short-term economic benefits and gaining long-term competitive advantages. Hence, any firm that takes advantage of current environment and implements an end to end supply chain enabled with the best in class real-time information processing technologies will have a competitive edge (Genpact, 2011; Chopra, 2007).

The shift to real-time information processing has a milliard of benefits which include: increased productivity, improved SC visibility, cost reduction, reduction of overall inventory, increased customer service, and increased latency and value of data (Hackthorn 2004; Hensley, 2010;). SC, therefore, need not only to sense but also respond to changes in real time and use information to drive intelligent tactical decision-making whenever exceptions occur (Stuart, 2011). As Dreyer (2008) posits, accesses to continuously updated real-time demand and event information is a pre-requisite for competitive supply chain planning and control as it enhances visibility into real-time demand information, and is a vital element in the planning and control environment.

1.1.1 Real-time Information Processing

Real-time information processing systems are systems characterized by speed of response and are able to quickly respond to circumstantial changes and come up with appropriate feedback (French, 1996). Real-time enterprises, on the other hand, are organizations that

enable automation of processes spanning different systems, media, and enterprise boundaries by providing real time information to employees, customers, suppliers, and partners and implementing processes to ensure that all information is current and consistent across all systems, minimizing batch and manual processes related to information. In these systems, the correctness of the system behavior depends not only on the logical results of the computation, but also on the physical instant at which these results are produced meaning that in strict real-time systems a late result is not just late but wrong. Real-time systems are characterized by time, deadlines, fastness, and predictability (Ecker et al., 2009).

The effective working of real-time information processing and integration depends on the installation of key technologies. Different studies show that there exist a number of real-time information processing technologies which include: ERP, RFID, internet, GPS, mobile- phones, barcodes, among others. These technologies have helped firms in inventory management, supply chain integration, supply chain visibility and planning and execution (Ajayi et al., 2010).

Real–time information processing systems should be vigilant systems able to detect changes and enhance managerial visibility from the field to corporate headquarters and help decision makers at strategic, tactical and operational level take action. Its benefits in supply chain management include: errors are caught at point of entry and are fixed, increased employee productivity, better control over inventory and increased inventory turnover, reduced paperwork, reduced bullwhip effect, improved customer relationships

and increased customer satisfaction which collectively help make the supply chain more efficient (Houghton et al., 2002 ; Pisello, 2006; Hensley, 2010; Nishanthet al., 2013).

1.1.2 Supply Chain Optimization

Supply chain optimization is concerned with decisions about the optimal number of operating facilities and their locations, number of suppliers, the quantity of products to manufacture and the flow of such products to minimize costs. Network optimization models, on the other hand, seek to facilitate optimal material sourcing, processing, activity, material and product flow in the entire supply chain, taking into account forecasts for future requirements (Lyson et al., 2007).

Dealers in information technology and Electronic Components waste billions of dollars a year due to time and cost inefficiencies at different points of supply chains. These inefficiencies are driven by the lack of industry-wide process and data standards that enable end-to-end automation of core supply chain processes such as catalog management, order management, inventory management, and customer service and support (Malcolm, 2000).

Time and cost have also been wasted due to use of manual techniques in data process and information sharing and this directly results into lost or incorrect orders, late deliveries, high clerical and labor costs, excessive buffer and obsolete inventory costs, and ultimately, low customer loyalty and retention (Convery, 2004).

Use of RFID, Mobile Commerce, ERP, internet, barcodes and other technologies to synchronize and integrate activities help to optimize the entire supply chain (Samaranayake, 2009; and Siauet al., 2009).Supply Chain optimization has a milliard of benefits which include: Improved demand visibility reduction in inventory carrying costs, reduction in transport cost, reduction in lead time, reduction in obsolescence costs, making of informed purchasing decisions, reduced product returns, fewer wrong product orders and Clerical costs reduction (Malcolm,2000). The success of these technologies, however, may be hindered if there is lack of training, failure of the technologies and lack of management support (Lyson et al 2007).

1.1.3 Supermarkets in Nairobi, Kenya

Bore (2007), defines a supermarket as a departmentalized self- service store offering a wide variety of food and household merchandise. Supermarkets are usually driven by the marketing strategy of all under one roof as they stock a wide range of merchandize for their customers.

The supermarket industry is still at its early development stage in most African countries except in South Africa. Unlike the supermarkets in Africa; supermarkets in more advanced economies have developed ways to attract, retain and grow customer value over time (Olamide et al., 2013). Supermarket industry in Kenya dates back to the mid seventies when Uchumi supermarkets opened shop in Nairobi with the industry witnessing rapid growth in the nineties these rapid growth is attributed to; changes in supply chain management, Foreign Direct Investment (FDI), urbanization and the rise of

the middle class in countries like Kenya and South Africa, (Bosire, 2007; Olamade et al., 2013).

From their initial establishment in urban areas the supermarkets are rapidly spreading in Kenya and eating into the once ecological niche of food retail industry as they spread their wings further into the city suburbs (Neven et al., 2005). Currently there are over one hundred supermarkets in Nairobi, Kenya and they can be classified in terms of their market share as first tier, second-tier and third tier with the first tier comprising of supermarket who are the clear market leaders (i.e. Uchumi and Nakummat) and the second comprises of Tuskys, Ukwala and Metro Cash and Carry (Neven et al., 2004; Bosire, 2007; Bore, 2007).

Supermarkets use various techniques to increase sales volume which include: price appeal, display techniques, self-service, attractive and convenient facilities, advertising and promotion, large but well-managed inventories, and diversified lines of merchandise (Belzet al., 2011).

1.2 Statement of the Problem

Companies operating in the current business environment are faced with many challenges including: operating in a rapidly changing environment, stiff global competition, rapid technological innovations, limited visibility of supply and demand, limited integration between planning and execution, low data latency and increased planning cycle time (Hugh et al., 2006; Ajayi et al., 2010; Stuart, 2011). These challenges are driving

enterprises to adopt the practices of Real-time information processing that provide real time information to all SC partners and implement processes to ensure that all information is up-to-date across all systems, minimizing batch and manual processes related to information (Khosla, 2002; Dreyer,2008).

According to Neven et al., (2006), the supermarkets in Nairobi, Kenya, play a key role in offering a variety of goods and services in both the capital and the suburbs. The supermarkets handle a large number of customers, deal with numerous transaction and large volumes of goods with some that are highly perishable. Supermarkets too, are being saturated due to urbanization and growth of others in residential neighborhoods leading to stiff competition. They also are faced with new competitive threats (restaurants and home shopping). Moreover, changing demographics affect tastes and preferences of their customers and consequently per capita spending (Kumar, 2008). In order to deal with these challenges these supermarkets need to invest in real-time information technologies (Dreye2008).

Past studies indicate that a number of benefits are accrued from adoption of real-time information processing technologies. Hugh et al., (2006) found out that real-time information processing reduces operations costs and leads to customer satisfaction. However, the study was in the aviation industry and not in the retail industry. Equally, the study does not say whether real-time information processing leads to supply chain optimization. Meiller (2010), in his studies found out that real-time information processing has also been used in improving tracking surgical equipment, and managing

bottled gas delivery in the Health sector thus reducing related inventory costs and improving accountability. The study, however, is not in the retail industry and concentrated on the use of RFID technology without addressing other types of real-time information processing technologies. Dreyer (2008) looked at the possible benefits of adoption of real-time information processing in the Norwegian food industry and found out that it will lead to productivity due to reduction in costs of operations. However, this was on the perceived impact of real-time information processing. Studies in supermarkets in Kenya include: Neven et al., (2005), looked into the impact of the rise of domestic supermarkets on urban consumers of and supply chains for fresh fruits and vegetables (FFV) in Kenya. Another study by Kimani et al., (2012) compared shopper's perception of retail service quality between supermarkets and small convenience shops.

Generally the studies conducted in supermarkets in Kenya as seen from the studies above do not address real-time information processing and SC optimization and those conducted on real-time information processing are in developed countries and in industries different from the supermarkets. It is on this basis that the study seeks to determine the role of real time information processing and SC optimization in supermarkets in Nairobi, Kenya. The study seeks to answer the following questions: what are the various types of real-time information processing technologies employed by supermarkets in Nairobi, Kenya? What are the benefits of real-time information processing in SC optimization in supermarkets in Nairobi, Kenya? What is the relationship between real-time information processing and SC optimization?

1.3 Objectives

The study sought to achieve the following three objectives:

i. To find out the forms of real-time information processing technologies used among supermarkets in Nairobi, Kenya.
ii. To determine the benefits of real-time information processing among supermarkets in Nairobi, Kenya.
iii. To establish the relationship between real-time information processing and SC optimization among supermarkets in Nairobi, Kenya

1.4 Value of the Study

The study may be of significance in the following to the following groups:

Consumers:

The study will be of significance to consumers of supermarkets' goods and services in three ways: price, delivery, and quality. Customers pay for value of goods and services and for them to be satisfied there must be some form of utility. The study will offer alternatives that will make firms improve customer service.

Policy makers:

The policy makers would use the findings and recommendations to optimize their supply chains. The different benefits of real-time information processing will be brought out and the different indicators of supply chain optimization measured against performance to

come up with recommendations that will benefit policy makers in optimizing their organizations.

Employees:

The employees of supermarkets in Nairobi, Kenya will recognize the importance of real-time information processing on production efficiency and how to improve on their service delivery to the customers. They will also realize their contribution in the successful implementation of real-time information processing technologies and more importantly learn how to ensure that they work towards achieving the corporate goals of their respective firms.

Research & Academic Institutions:

The study will add to existing stock of literature in the field of procurement and supply chain management. Other scholars may validate the findings and use the study as a reference text. Other researchers and institutions may follow the areas recommended for further research as a means of increasing knowledge on real-time information processing and supply chain optimization.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviewed some of the studies that have been conducted in the area of real-time information technology and supply chains. It sought to discuss: the benefits of real-time technology, the various IT applications that support real-time, and the relationship between real-time and supply chain optimization and conceptual framework.

2.2 Real- time Information Processing

One of the most common forms of data management is batch data processing, where data is collected and held in a mobile device until a user synchronizes the information to a host system or server, via a serial or USB connection or a local area network (LAN). However, with the acceptance and proliferation of the wireless LAN (WLAN), companies are migrating to real-time data processing. In real-time data processing, data is stored on the server and processed at the right time to be instantly available to other business systems (Symbol Group, 2005). According to Dreyer (2004) Planning and control done on the basis of previous demand and event information such as past sales and budgets in combination with control concepts such as MRP and MRPII leads to a time gap between sudden events and corrective actions. To Dreyer, this calls for a paradigm shift in the direction of real-time control and decision making, closing the time gap between when events take place and their corrective actions.

The switch to real-time information processing needs putting up supply chain visibility applications to assist provide a powerful way to support end to end visibility of the supply chain. This will contribute to the overall supply chain strategy. Though many technology applications exist today that assist in the acquisition, assimilation, and integration of data for the purpose of information provision, Supply Chain Visibility solutions to complement current technology applications with the ability to retrieve data from a multiple sources are necessary (Hensley,2010).

Supply Chain Visibility applications can access real-time databases and capture data in real-time directly thus improving tactical decision making whenever exceptions occur and hence reducing or avoiding negative impacts. This improves overall productivity, reduces supply chain costs and enhances customer service (Pisello, 2006).

2.3 Types of Real-time Information Processing Technologies

There are many types of real-time information technologies that companies employ for real-time information processing. These include: ERP, RFID, internet, barcodes, and GPS (Shang et al., 2002; convery, 2003; Harrington, 2013; Siau et al., 2002 and Wheeler, 2012).

2.3.1 Enterprise Resource Planning

An ERP system is a set of software applications with different modules, which are integrated to have an architecture that can be used by firms as the primary engine for integrating data, processes, and information technology in real-time internally and externally in the value chains(Shang et al., 2002). According to Samaranayake (2009), ERP systems are business software packages that enable organizations to: integrate their business functions such as sales, production, human resources, finance and purchasing using integrated application modules based on business processes of best in class. Ajayi eta al., (2010) argues that ERP systems integration among different business functions enables communication and information sharing, leading to increased productivity and processing of transactions in real-time.

Studies have found out that Cisco has managed to be a world leader in the global networking Industry due to the use of ERP that integrate and process information in real-time manner. Its ERP system is the backbone that enables its new business Model Global Networked Business based on the use of electronic communications to build interactive, knowledge-based relationships with its customers, business partners, suppliers, employees (Mendelson, 2000).

According to Rashid et al.,(2002) and Jeremy (2000), the use of ERP make firms to gain competitive advantage through access to cheaper and faster communication, access to

reliable information, avoidance of data and operations redundancy, reduction in delivery and cycle times and facilitation of e-commerce and e-business

2.3.2 Radio Frequency Identification Devices

Radio Frequency Identification (RFID) refers to data collection and identification systems that combine the use of radio and microchip technologies to locate objects (Convery, 2003). RFID technology may enable some organizations to better meet their supply chain optimization goals (Byrnes, 2004).

Studies from the health sector indicate that the use of RFID has varied successes. The studies show that tagging pharmaceutical items to prevent counterfeiting and tagging items in a hospital environment for inventory purposes have been fairly successful. However, certain RFID applications have faced resistance in a hospital setting where their electromagnetic interference could affect normal operation of medical instruments. RFID tags have been found important in real-time tracking and tracing of surgical medical equipment and managing bottled gas in hospital (Meiller et al., 2010).

RFID, when well integrated with ERP systems, enhance real-time information sharing in the entire supply chain, which leads to enhanced supply chain performance. Successful implementation and sharing of information provides the necessary operational, tactical, and strategic information to supply chain partners on a real-time, synchronous basis

utilizing the data capturing capabilities of technologies such as RFID and leading to improved overall productivity (Pamela et al., 2010).

According to Basker (2007), Wal-Mart is at the forefront in integrating RFID technology in which each individual item receives a tag that reads by a radio signal, hence facilitating tracking shipments, inventory, and sales. RFID has made Wal-Mart's operations to be efficient and effective as they are able to send and receive real time data to the networks thus making it edge against its competitors in the retail industry (Slemmons et al., 2011).

2.3.3 Internet

With the advent of E-Business, many firms are using the Internet to integrate with their suppliers, customers and trading partners. This has made ERP vendors to shift focus from internal orientation to external orientation and hence increasing the importance of Business-to-Business as well as front-office applications. The benefit of using the Internet is that it is real-time, inexpensive, ubiquitous, and has readily available security and data mining tools. The internet is equally standards driven, and has the capacity for mass market pricing (Mendelson, 2000).

According to Power (2005), the emergence of the personal computer, optical fiber networks, the explosion of the Internet and the World Wide Web, and the cost and availability of information resources allows easy linkages and eliminates information related time delays in any supply chain network thus allowing access to accurate, timely and affordable information. He further points out that the use of e-mails leads to access

to 24/7, easy to use, cheap, information making companies communicate within and outside their walls. The email for example, is being used to transfer different documents between trading partners serially without interaction and interruption thus bridging the constraint of time and distance

Lichtenthal et al. (2002), seems to be in agreement with Power and Mendelson. He argues that there are a number of Supply chain management goals which included: cost minimization, increased level of service, improved communication, and increased flexibility in delivery and response time. The growth of the Internet has given companies numerous opportunities to improve services and reduce costs as it has made it possible for companies to access fast and accurate information from a wide range of operating areas including transportation, inventory, purchasing, customer service, production scheduling, order processing and vendor operations. This has made firms to quickly react to market changes and to adjust inventory, production, and transportation systems which in return lead to cost reduction and improved utilization of assets thus improving the profitability of the supply chains.

Harrington (2013), says that the Internet can optimize the supply chain in many way: minimize time and distance among trading partners, route information and product along the most effective path to meet market demand, offer fluid, rapid integration of inter-enterprise business processes, leverage volumes and alliances with preferred suppliers while using virtual inventory as market conditions change and reduce cycle time, process cost, and inventory.

2.3.4 Mobile-Phones

The rise of wireless technology and mobile devices has led to the birth of a new kind of e-commerce known as mobile commerce or m-commerce or mobile e-commerce in which transactions are conducted via mobile devices using wireless telecommunication networks and other wired e-commerce technologies. This kind of commerce is characterized by personalization, localization, ubiquity, and convenience. M-commerce extends to current Internet sales channels and moves into the more immediate and personalized mobile environments, thus presenting the business world massive opportunities to offer value-added services to consumers and the corporate world (Siau et al., 2002).

According to the Annual Survey 2008, prepared for Real Time Information Group, there is a wide range of literature on use of mobile phone, for example, the most innovative two European agencies describe use of real-time information with trip planning and providing this capability on mobile devices. The studies suggests that when providing real-time information on mobile devices one should consider factors such as: mobile messaging reliability and usability, handset display dimensions, memory and processing speed, and networks communication access. The studies show that using mobile phone location and social networking has transformed the provision of real-time information on mobile devices.

The ability to access the Internet from any location at any time has made it possible to pinpoint an individual user's location and to access information when needed and therefore consequently reduce administrative overhead, increase efficiency, and distribute information more rapidly throughout organizations (Siau et al., 2009).

M-commerce facilitates information and goods and services exchange, and it is important to all supply chain partners. This kind of commerce has the potential to improve customer service, create new distribution channels, enhance responsiveness, and facilitate inventory management. M-commerce has made it possible for the corporate to communicate to the organization and its partners while on the move. Logisticians and field officers are equally able to communicate with relevant people in and outside the organization in good time and significantly enhance the performance of the supply chain. The mobile phone uses applications such as SMS, WAP, blue tooth, GPS, XML, and GPS to send and receive timely business information (Siau, 2009).

A survey by the National Academy of Science (2011) on the Use and Deployment of Mobile Device Technology for Real-Time Transit Information found the 7 real-time applications were prevalent: real-time arrival prediction software, automatic vehicle location, computer-aided dispatch, two-way messaging capability, alert subscription system, schedule adherence functionality and onboard data communication system. According to the National Academy Science Some of the advantages associated with m-commerce include: improved safety through better coordination of emergency response, enhanced greening of the supply chains and improved customer service.

2.3.5 Barcodes

The ability to take orders and process payment efficiently and reliably is important to the success of any business (Wheeler, 2012). Bar codes are up-to this task. Invented in the 1950s, bar codes accelerate the movement of goods and information in the entire supply chain. The most common type of barcodes is the electronic point of sale (EPOS) which is used when retail sales are recorded by scanning barcodes at the checkout tills. The POS system checks, verifies and charges transaction, provides instant sales, monitors and changes prices and sends intra and inter organizational store message (Lyons et al., 2006).

According to Wheeler (2012), POS technologies lead to more information, easier integration and better cost control. Studies on the deployment of the point of sale technology by BC Ferries Corporation, British Columbia; Crown Corporation that operates ferry service in the Province of British Columbia shows that; the use of POS reported increase sales and increased gross profit as some of the benefits of POS (Dion, 2003).

Some applications for barcodes include: counting raw material and finished goods inventory, automatic sorting of cartons, automatic receiving, put away, picking, and shipping, tracking and access control. The benefits of use of barcodes include: fast entry of data (five to seven times more than a fast typist), greater accuracy, reduced labor costs,

elimination of stock outs and overstocking, better decision making, faster access to information, and better customer service (Lyson et a l., 2006).

2.3.6 Global position systems (GPS)

Global Positioning System (GPS) is a system of 24 satellites orbiting the Earth. Due to the satellites' continuous broadcasting of their own position and direction, GPS receivers can calculate the exact geographic location with great accuracy. Though it was initially made for use of military, GPS is now also used for other purposes. For instance, GPS is used in vehicle navigation systems (Siau, 2009).

According to the US Department of Transportation Federal Highway Administration (2000), the Global Positioning System (GPS)'s satellite carries an operating atomic clock that emits timed signals that include a code telling its location. Users equipped with the right receivers will receive signals from satellites to calculate the user position, time and velocity. The signals which are free have been used in many transport applications which include: creation of geographic databases in emergency 911 systems, highway inventory trucking, automatic vehicle location, navigation snowplows for low visibility situations, trucking of hazardous materials from origin to destination and in accidents data and traffic data.

GPS tracking technology allows users to monitor movements of people, motor vehicles, airplanes, ships, trains, packages, and other products. Tracking enhances efficient

management of goods and services and reduces loss stemming from accidents, theft, malfunctions, or improper operation. GPS tracking also reduces response times and enables more efficient utilization of vehicles used by police departments, fire officials, search and rescue missions, and other emergency services (TFHA, 2000).

2.4 Benefits of Real-time

There are a number of benefits of real-time information processing these: include: increased productivity, costs reduction, improved supply chain visibility, reduction in data latency, reduction of overall inventory requirement, increased customer service and reduced bullwhip effect among others (Symbol Group, 2005;Nishanth et al.,2013).

2.4.1 Increased productivity

In the business environment characterized by relentless and continuing cost pressures, different companies have resulted to focus their attention to innovations that lead to growth, maintenance, or expansion of revenue. Research in USA on productivity in manufacturing firms found out that output in 2010 rose up by 16 % from the previous decade. This is attributed to automation of supply chains which leads to accommodation of the "3vs"- volume, velocity and variety. Automation makes firms to have capacity to deal with large amounts of market information, adapt to dynamic environment and manage variety of information sources leading to increased productivity (Nishant, 2013).

Symbol Group (2005), in their technical white paper argue that real-time information processing leads to increased productivity due to reduction of the need to download and upload files on a daily basis.

Studies show that Cisco through the application of real-time information processing, has managed to cut down on labor cost, mitigating on risks, increased resource utilization, reduction of carrying costs reduction of accounts receivable cycle and prevention of counterfeits into a firm's supply chain (Dong et al., 2009).

Real-time information also Maximizes the ROI through reduced production-related exceptions such as reworks order and fulfillment errors, support calls, customer returns, backorders, change orders, production stops, production expediting/changeovers, transportation errors and recalls, reduced incidents and handling costs in annual error handling labor and cost avoidance and reduces accounts receivable disputes which in turn lead to annual write-down cost avoidance (Pisello,2006; Hugh, et al., 2006).

2.4.2 Improved Supply Chain Visibility

According to Hensley (2010) firms that have adopted Supply Chain Visibility solutions are already reaping huge benefits that real-time visibility provides, and re incorporating the solutions in their daily operations in a variety of ways including: text message, email, or phone call which proves to be an effective way of responding rapidly to happenings or to prevent situations before they arise.

There also seems to be a strong synergy between real-time visibility and performance improvements through the proactive prevention, or quick reaction to the ever- changing environmental demand. Access to real-time data is vital in mitigating risk factors, isolation of potential risks and making of timely decisions to lessen or prevent negative performance downstream. Visibility applications provide a common framework in which to view discrete, real-time data to support educated decision making. By isolating potential issues as they occur, timely decisions can be made to lessen or prevent negative performance impacts from occurring downstream (Hensley, 2010).

Real-time tracking solutions too, ensures production coordination and avoidance of delays as RFID tags track everything from work in progress to raw material and routes and tracks sub-assembly parts throughout work stations along the assembly line and the entire production process. This reduces quality issues errors, shipping delays, improves right shipment and reduces shipment of counterfeits. Additionally, uses of real-time visibility solutions improves distribution and retail channels to more accurately and in real time track delivered goods and match supply with demand, reduce shortage, and shrinkage costs (Pisello, 2006).

2.4.3 Cost Reduction

Pisello (2006) argues that automating supply chains with RFID one of the key technologies that enhance real-time information processing not only improves productivity but also reduces labor costs. Research by Symbol group (2005) concludes that inability to see information in real-time leads to huge costs along the whole supply chains in form of stock-outs, carrying costs of overstocking, incorrect payments of invoices, slow acknowledgement and reporting of shipment and lost sales which in the affects productivity.

The costs of hidden data and those of lost data can be high. The cost of hidden data include: holding costs, stock-out costs and incorrect invoice payments while those of lost data include: cost of time and lost productivity. The solution to such costs is the application of real-time visibility applications able to mitigate risks and assist in making of informed decisions (Hensley, 2010; Hugh, et al., 2006).

2.4.4 Reduction of Overall Inventory

According to Johanna et al. (2003), unavailability of demand visibility is one of the biggest challenges for supply chain management. This is given that order information often gives delayed and distorted information of end customer demand and the actual happenings in the market; with the distortion increasing upstream and making demand look variable when the end customer demand is level. Inventory management based on

this distorted information leads to operating under capacity, poor product availability, and overstocking (Lee et al. 1997).

End to end supply chains which have integrated information is therefore good in inventory replenishment, increase in inventory turnover, reduction of order cycle, and reduction of inventory of entire supply chain since they reflect the actual demand, reduce the pull-whip effect, reduce uncertainties and shortens lead time (Grean et al., 200)

According to Convery (2003), RFID devices brings capability to systems to identify, locate, and track objects and people in real time in the real world becoming a solution to the out of stock problems. Accurate and real-time visibility in the whole supply chain assists to improve inventory forecasting, manage just-in-time workflow and eliminate excess inventory costly and minimize inventory errors (Pisello, 2006).

2.4.5 Increased Customer Service

The era of push economy is long gone and as a result the customers nearly always have their say and if they decide not to purchase from a given firm it will collapse. Supply chains should therefore be structured in such away to add value to the customer (Dlugosz, 2010*).*

The use Of real time information processing technologies like RFID improves overall customer experience by enabling better inventory management, proper deliveries and shipment management, better demand forecasting, better promotions management, better

new product introduction and reduction in out of stock conditions. RFID, for example, enables better management of inventory, ensures proper deliveries and shipments, better forecasts demand, better manages promotions and new product introductions, and reduces out-of-stock conditions. The elimination of supply chain issues in real-time and availing of products at point of demand at the time of demand gives customers an exciting experience (Pisello, 2006).

2.4.6 Reduces Data Latency and increases Value of Data

The value of data keeps decreasing rapidly as it ages such that we have low-latency (fresh data) and high-latency The fact that value of data keeps reducing with time calls for real-time business intelligence (Hackthorn, 2004).

There are three types of latency which include: data latency which is the length of time between when an event occurs and when the associated data is stored in the data warehouse, analysis latency is the time between data storage and data analysis and the time it is available to applications and users and decision latency which is time from availability of data to time action is taken on it. These three sources of latency are additive and result in total latency. Reducing data and analysis latency is dependent upon primarily technical solutions and thus the new developments in real-time data warehousing help in this regard (Hackthorn, 2004). Reducing decision latency needs dramatic changes in business processes and people's use of information in performing (Hugh, 2006).

2.5 Supply Chain Optimization

Supply chains are optimized only when inter-organizational, inter-functional strategic approach is adopted by all partners operating within the supply chain. Strategies that strengthen the competitive position of the supply chain such as the adoption of technologies to enhance information sharing serve to directly impact supply chain Key performances indexes are therefore necessary to align the supply chains meet their objectives. Measures are important as they provide means of assessing supply chain progress and they include customer service, financial performance, business processes performance, innovation and learning among others (Chopra et al.,2004; Lapide, 2013; Kalkar et al., 2010; Brewer and Speh, 2000).

2.5.1 Supply Chain Optimization Measures.

Performance measurement is a way of quantifying action, where measurement means the process of quantification. It is assumed to derive from actions taken by management. It is the degree to which a supply chain fulfills the objectives of speed, quality, dependability, cost and flexibility (Slack, 2007).

One of the ways through which supply chain optimization is measured is through the number of customer contact points. This is a measure of service quality in terms of the number of people that the customer has to contact before he is fully served. The higher the number of contacts the; higher the probability of miscommunication, response delays,

and wastage and hence poor service to the customer (Brewer, 2000). Order response is another optimization measure related to customer service. This measures the time it takes for a supply chain to respond to a customer order in relation to the time taken by a competing supply chain. It seeks to standardize response (Brewer, 2000).

The satisfaction index measure is another method that can be used to measure optimization. It measures how well a supply chain is satisfying its commitment to downstream customers and the customer's perception of the supply chain in terms of quality, flexibility, time in relation to the cost incurred by the customer. Other measures of customer satisfaction include: percentage of on time delivery, number of warranty claims, number of customer complaints and percentage of orders with complaints, Customer satisfaction, and order entry accuracy (Pohlen, 2003; Handfield et al., 2009; Lapide, 2013).

Supply chain optimization can equally be measured through inventory performance or fill rate. This can be measured in terms of: number of Stock-keeping units, percentage of Inbound and Outbound, percentage level of service or order cycle time, percentage of quality rejections, percentage Average safety inventory, percentage fraction of time out of stocks, percentage of seasonal inventory and inventory turn-over. Inventory turn -over is the number of times inventory is used up (Pohlen, 2003; Lapide, 2013).

Transportation performance can be measured through: total transportation costs, number of vehicles operated, percentage of outbound shipments, average outbound shipment size,

percentage of inbound shipments , percentage average inbound shipment size, fraction of transportation mode , percentage on timely delivery, percentage of accidents , average kilometers vehicles running full load or empty per day (Lyson et al., 2006).Warehousing performance on the other hand, is measured in terms of : number of warehouses, average cost of warehousing per SKU, average carpet area covered, average time required to access per SKU, percentage of SKUs placed in automated shelves and average variable cost of material handling equipment (Brewer, 2000).

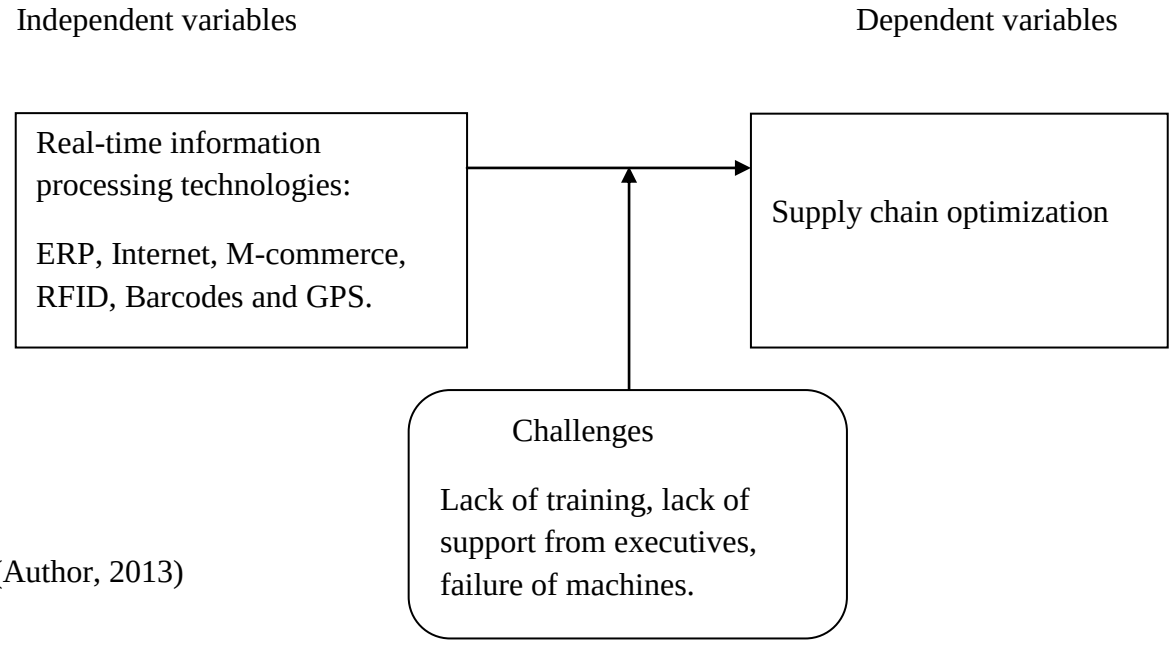
Cash to cash cycle and percentage of internal and external complaints for data unavailability also measure optimization (Lapide, 2013).Cash to cash cycle measures the time it takes from point of purchase of raw material to conversion of raw materials and to sales and final collection of cash from sales. Firms that are integrated and are using real-time information processing have reduced their cash-to-cash cycle (Brewer, 2000).

Customer sales growth and profitability looks at the sale and profits generated each year. The sales are expected to grow each year or remain constant at the worst. The Return on supply chain investment is another parameter that is used to measure supply chain optimization. Every supply chain should make some return from the investment in supply chain facilities. The reason for this is to assess how supply chains utilize their assets. Return on supply chain investment is based on operating profits in excess of capital employed (Pohlen, 2003; Lapide, 2013).

2.6 The Conceptual Framework

The conceptual framework explains the relationship between independent and dependent variables in the study. In this study Supply chain optimization is the independent variable since its success depends on individual outcomes of real-time information processing technologies which are independent variables. The success of technology also faces challenges like support from executive, lack of training and failure of machines.

Figure 2.1 Conceptual Framework



(Author, 2013)

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the methodology that was used in conducting the study. The issues discussed include the research design, the target population, the sampling design, data collection methods and data analysis and data presentation method.

3.2 Research Design

The study adopted a descriptive survey of all the supermarkets operating in Nairobi, Kenya. The survey approach was adopted since it allowed the researcher to collect a large amount of data from a sizable population in a highly economical way. In addition the survey strategy is considered authoritative by people in general and is easy to explain and understand. It also allowed for collection of quantitative data which was analyzed quantitatively using descriptive and inferential statistics (Sauders, 2009).

3.3 Population

There are 105 supermarkets in Nairobi, Kenya as can be seen in the appendix attached at the end of the study. All the 105 supermarkets represent the study population.

3.4 Sample

The size of a sample should neither be excessively large nor too small. It should be optimum such that it fulfills the requirements of efficiency, representativeness, reliability and flexibility Kothari (2004). A sample of 50 supermarkets picked through simple random sampling from a population of 105 supermarkets in Nairobi was used in the study. The use of fifty was based on the central limit theorem which states that the larger the absolute size of the sample, the more closely its distribution will be to normal distribution. A minimum number of 30 or more provides a useful rule of the thumb (Sauders, 2009). Given the number of supermarkets in Nairobi and their expansive geographical locations 50 was representative and economical as it was the rule of the thumb of 30 cases.

3.4 Data collection

Primary data was collected by means of closed ended questionnaires. According to Nachiamis and Nachiamis (1996), answers to closed ended questions can be more elaborate. The questionnaire had four sections, section a, dealt with general information of the organization. Section B, sought information on the forms of real-time processing technology used by supermarkets in Nairobi. Section C; aimed to find information on the benefits of real-time information processing and section D, sought for information on supply chain optimization.

The respondents to the questionnaire were procurement and supply chain managers or their equivalents at the head offices of the supermarkets with more than one branch and from the location of those with one branch. The questionnaire were administered on drop and pick later method.

3.5 Data Analysis

Data was collected and analyzed using Statistical Package for Social Scientists (SPSS). In order, to find out the extent to which real-time information processing technologies had been used and the benefits of use of real-time information processing technology, descriptive statistics analysis such as use of frequency distribution, cumulative frequencies and standard deviation were used to analyze quantitative data. Factor analysis was also used in determining the benefits of real-time information processing. Regression analysis was done to determine the relationship between real-time information processing and supply chain optimization.

CHAPTER FOUR: DATA ANALYSIS, FINDINGS AND DISCUSSIONS

4.1Introduction

This chapter presents data analysis, findings, interpretation and discussions of the study. The data is summarized and presented in form of frequency, percentage and tables interpreted in line with the objectives of the study which included: to find out the forms of real-time information processing technologies used in supermarkets in Nairobi, Kenya, to determine the benefits of real-time information processing in supermarkets in Nairobi, Kenya, to establish the relationship between real-time information processing and SC optimization in supermarkets in Nairobi, Kenya. The respondents were drawn from supermarket in Nairobi, Kenya. All the 50 supply chain managers who were sampled to participate in this study participated giving a response rate of (100%). This response rate indicates that the findings can be used in generalization.

4.2 Organizational Profile

In this section the researcher sought to find out the organizational profile of the supermarkets in Nairobi, Kenya in terms of adoption as well as time they have taken using real-time information processing technologies in conducting their business.

4.2.1 Adoption of Real-time Information Processing Technology

Here the researcher sought to know whether different supermarkets in Nairobi, Kenya use real- time processing technologies in their operations. It was found out that all the supermarkets in Nairobi Kenya have adopted real-time information processing technologies to conduct their day-to-day activities such as data processing and supply chain visibility solutions to assist them cope with the changing business environment as well as reduce operation costs. The adoption of real-time information processing technologies by Nairobi supermarkets support Hugh et al. (2006)'s argument that real-time information processing reduces operations costs and leads to customer satisfaction. The findings are as shown in the table below.

Table 4.1 Adoption of Real-time Information Processing Technologies

Response	Frequency	Percent
Yes	50	100.0

Source: Researcher (2013)

4.2.2 Period of Real-time Information Processing Adoption

The number of years a firm has adopted real-time information processing technology will determine supply chain optimization level of a firm. The respondents were asked to indicate the number of years that have elapsed since their firms adopted real-time information processing technologies in their operations and the results are as seen in table 4.2.

Table 4.2 Years of Real-time Information Processing Technologies

Years	Frequency	Percent
1-2 years	11	22.0
2-4 years	7	14.0
over 4 years	32	64.0
Total	50	100.0

Source: Researcher (2013)

The findings from the table above indicate that majority (64%) of the supermarkets in Nairobi, Kenya adopted real-time information processing technologies for over 4 years; an indication that real-time information processing technology is not so new a concept in the retail industry in Kenya. This is in contrast to Hugh et al., (2006) who argues that real-time information processing in management is a relatively new concept.

4.3 Level of Implementation of Real-Time Technology

There are very many forms of real-time information processing technologies that firms can use in their operations. They include: barcodes, RFID, GPS, Mobile phones, ERP, and internet. The respondents were asked to rate the type of real-time information processing technologies used by their supermarkets to conduct their operations. This was on a five point scale where 1=very small extent 2=small extent 3=moderate extent4=great extent and 5=very great extent. The results are as in table 4.3.

Table 4.3 Types of Real-time Information Processing Technologies (Descriptive Data)

	N	Mean	Std. Deviation
Mobile Phones	50	4.7400	.48697
Barcode	50	4.1800	1.10083
Internet	50	2.5000	1.16496
ERP	50	2.0800	1.36785
GPS	50	1.9000	.88641
RFID	50	1.8800	1.88051
Valid N (listwise)	50		

Source: Researcher (2013)

From the findings in table 4.3; the supermarkets in Nairobi, Kenya, use mobile phones to a very great extent as the real-time information processing technology to conduct their operations (M=4.7, SD=0.4869). Barcodes are used to a great extent (M=4.1800, SD=1.10083) while the internet is used to a moderate extent (M=2.5, SD=1.16496). The GPS and RFID are used to a small extent with a mean of (M=1.9000, MD= 0.88641) and (M=1.8800, MD=1.88051) respectively. This means that barcodes and mobile-commerce are the most common forms of real-time processing technologies in supermarkets in Nairobi, Kenya. This is associated with the fact that mobile phone technology is increasing its presence in the Kenyan markets and is becoming cheaper with each coming year. The mobile phone's flexibility, personalization, localization, ubiquity, and convenience, make it popular in real-time information processing in supermarkets in Nairobi, Kenya. This is in line with Siau (2009),'s argument that mobile phones use

applications such as SMS, WAP, blue tooth, GPS, XML, and GPS to send and receive timely business information. The popularity of barcodes is associated with their role at the point of sale in supermarkets where retail sales are recorded by scanning barcodes at the checkout tills (Lyons et al., 2006).

4. 4 Benefits of Real-time Information Processing Technology

The respondents were given a list of 14 variables of real-time information processing and were asked to rank the extent to which they thought their firms realized supply chain visibility benefits as a result of implementing real-time information processing systems. This was on a five point measurement scale whereby 1= very great extent; 2= to a great extent; 3= moderate extent; 4=small extent and 5= very small extent.

Table 4.4 Benefits of Real-time Information Processing

Benefits	N	Mean	Std. Deviation
Reduces labor costs	50	1.4400	1.07210
Reduced rework due to accuracy of data entry	50	1.4600	1.26507
Real-time information processing mitigates on risks	48	2.2292	1.54699
Made a firm have capacity to deal with large amount market information	46	2.2391	1.64904
Reduces incorrect invoice payment	50	2.4200	1.66709
Reduces stock out costs	50	2.4600	1.70486
Resource utilization is increased	50	2.4800	1.65665

Reduced paperwork	50	2.4800	1.77557
Reduces order cycle	50	2.4800	1.75243
Real-time information processing has led to reduction of the need to download and upload files on a daily basis	50	2.5400	1.52810
Eliminates excess inventory	50	2.5400	1.72863
Reduces data and analysis latency	50	2.5400	1.71678
Leads to making of timely decisions to lessen or prevent negative performance down stream	49	2.5510	1.73279
Increases inventory turn-over	50	2.5600	1.72804
Improves overall customer service	50	2.5800	1.70342
Improves inventory forecasting	50	2.6400	1.74683
Reduces pull-whip effect	50	2.6600	1.68559
Tracks and ensures production coordination and avoids delays in the supply chain	50	2.7000	1.68123
Maximized return on investment	50	2.7200	1.67868
Reduced fulfillment errors, support calls, customer returns backorders, and change orders	50	2.7200	1.73840
Inventory carrying costs are reduced	50	2.7600	1.68499
Improves distribution and retail channels to more accurately track delivered goods and match supply with demand.	48	2.7708	1.76538
Reduces shipping delays	50	2.8600	1.80713
Prevented counterfeits into the supply chain	50	2.9000	1.72910
Valid N (listwise)	42		

Source: Researcher (2013)

From the findings in table 4.4 the supermarkets in Nairobi to a very great extent have reduced labor cost and reduced rework due to accuracy of data entry through the use of real-time information processing (mean=1.45, SD=1.16859). This is in line with Hensley, (2010) and Hugh, et al., (2006) who argue that automating supply chains with RFID; one of the key technologies that enhance real-time information processing not only improves productivity but also reduces labor costs. The supermarkets to a great extent use real-time information processing to mitigates on risks, have capacity to deal with large amount market information, reduces incorrect invoice payment, reduces stock out costs, increases resource utilization and reduces paperwork among other benefits (mean=2.44083, SD=1.67261).

To a moderate extent the real-time information processing has led to increased supply chain visibility through making of timely decisions, lessening or prevention of negative performance downstream, increased inventory turn-over, improved inventory forecasting, reduced pull-whip effect, and avoidance of delays in the supply chain among other benefits (mean 2.65515, SD=1.7832).

The factors in table 4.4 above were far too many and therefore factor analysis using the principal component analysis and rotational component matrix was used to extract the benefits of real-time information processing technology used in supermarkets in Nairobi and the results are as in table 4.5 and figure 4.1.

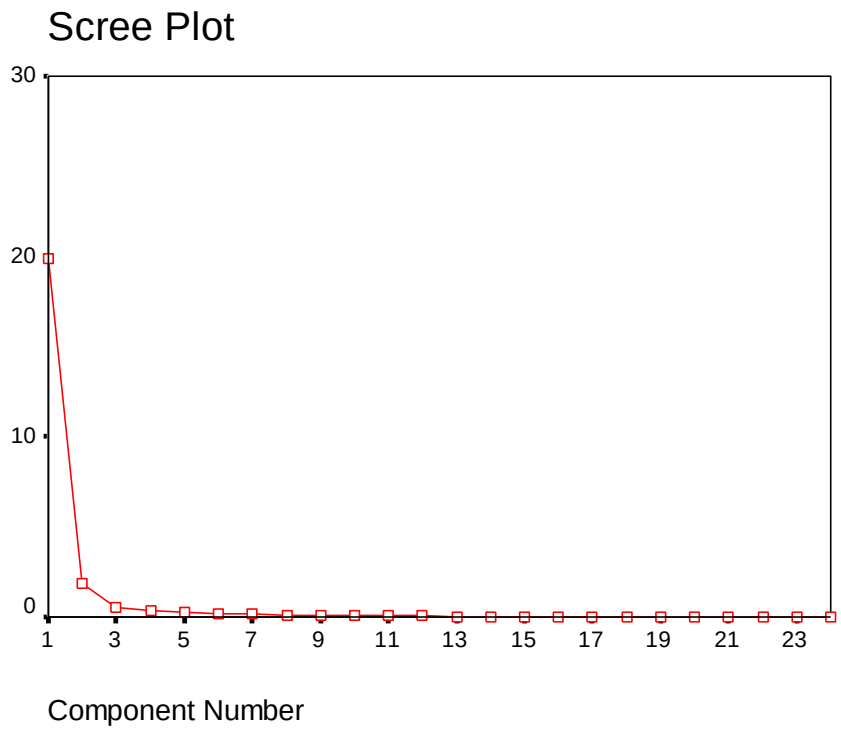
Table 4.5 Befits of Real-time Information Processing (Total Variance Explained)

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	19.889	82.872	82.872	19.889	82.872	82.872
2	1.885	7.853	90.725	1.885	7.853	90.725
3	.562	2.342	93.067			
4	.372	1.551	94.618			
5	.256	1.067	95.684			
6	.204	.850	96.535			
7	.161	.670	97.204			
8	.130	.541	97.745			
9	.120	.502	98.247			
10	.102	.426	98.673			
11	.084	.349	99.022			
12	.067	.279	99.301			
13	.044	.181	99.482			
14	.042	.174	99.656			
15	.028	.117	99.773			
16	.023	.094	99.867			
17	.017	.069	99.936			
18	.006	.024	99.961			
19	.005	.021	99.982			
20	.003	.012	99.994			
21	.001	.005	99.998			
22	.000	.001	99.999			
23	.000	.001	100.000			
24	1.457E-16	6.072E-16	100.000			

Extraction Method: Principal Component Analysis.
Source: Researcher (2013).

Two benefits of real-time information processing were extracted using the principal component analysis method. The extraction criteria was Eigen values > 1 as can be seen from table 4.5. Each of the extracted benefits shares a proportion ≥ 7.5 % of its variance with the rest of the other benefits. This shows that the benefits extracted accounted for highly significant variability in the behavior of the major variable which was in this case the benefits of real-time information processing technology in supermarkets in Nairobi, Kenya. Cumulatively, the extracted benefits account for 90.725 % of the variability in the main construct as summarized in table 4.5

Figure 4.1 Scree Plot



Source: Researcher (2013).

The scree plot from figure 4.1 shows that two benefits extracted had highly significant variability in the behavior of the major variable which was in this case the benefits of

real-time information processing technology in supermarkets in Nairobi, Kenya. Cumulatively, the extracted benefits account for 90.725 % of the variability in the main construct.

Table 4.6 Benefits of Real-time Information Processing Rotated Component Matrix

Component Matrix (a)

	Component	
	1	2
Improves inventory forecasting	**.982**	.026
Eliminates excess inventory	**.978**	.030
Leads to making of timely decisions to lessen or prevent negative performance down stream	**.976**	.046
Reduced fulfillment errors, support calls, customer returns backorders, and change orders	**.975**	-.006
Increases inventory turn-over	**.974**	.039
Improves overall customer service	**.973**	.035
Resource utilization is increased	**.972**	.003
Tracks and ensures production coordination and avoids delays in the supply chain	**.972**	-.022
Maximized return on investment	**.971**	-.052
Reduces order cycle	**.970**	.006
Reduces incorrect invoice payment	**.957**	.021
Reduces pull-whip effect	**.957**	-.033

Reduces data and analysis latency	**.953**	.053
Inventory carrying costs are reduced	**.951**	-.004
Reduces shipping delays	**.948**	-.033
Improves distribution and retail channels to more accurately track delivered goods and match supply with demand.	**.941**	-.078
Prevented counterfeits into the supply chain	**.931**	-.072
Reduced paperwork	**.916**	.083
Reduces stock out costs	**.912**	.084
Real-time information processing has led to reduction of the need to download and upload files on a daily basis	**.845**	-.227
Made a firm have capacity to deal with large amount market information	**.845**	-.328
Real-time information processing mitigates on risks	**.762**	-.540
Reduced rework due to accuracy of data entry	.482	**.814**
Reduces labor costs	.433	**.855**

Source: Researcher (2013).

4.4.1 Benefit No. 1: Improved Inventory Management and Increased Supply Chain Visibility

Improved Inventory Management and Increased Supply Chain Visibility is one of the greatest benefits that supermarkets in Nairobi, Kenya have accrued through the use of

real-time information processing technology in their operations (82.872 %). This means that through the use of real-time information technology in their day-to-day business, the supermarkets were able to improve inventory management and visibility. The supermarkets were able to achieve this through improved forecasting, elimination of stock-outs, reduction of inventory carrying costs, increased inventory turnover and prevention of counterfeits in the supply chain. This is in tandem with Pisello (2006), who posits that accurate and real-time visibility in the whole supply chain assists to improve inventory forecasting, manage just-in-time workflow and eliminate excess inventory costly and minimize inventory errors.

The supermarkets managed to improve supply chain visibility leading to prevention of negative interference downstream, reduced fulfillment errors, reduced order cycles, reduced bull-whip effect, and hence matching of demand with supply. The findings were in agreement with research by Symbol group (2005), which concluded that inability to see information in real-time leads to huge costs along the whole supply chains in form of stock-outs, carrying costs of overstocking, incorrect payments of invoices, slow acknowledgement and reporting of shipment and lost sales which in the affects productivity. The use of real-time information processing, equally led to mitigation of risks, reduced the need to download large amount of data, reduced paper work and reduced delays in the supply chain. This supports the argument by Hensley (2010), that by isolating potential issues as they occur, timely decisions can be made to lessen or prevent negative performance impacts from occurring downstream.

4.4.2 Benefit No.2: Reduction in Labor Costs

Another important benefit gained through the use of real-time information processing in supermarkets in Nairobi, Kenya, was reduction of labor costs (7.853%). This is achieved through reduced rework and reduction in number of employees. The application of real-time processing technologies led to reduced number of human resource to deal with data and reduction in number of stages in processes. This led to an overall reduction in labor costs thus making a company to save on labor costs and at the same time freeing others for other productive activities. The findings are in line with Convery (2003); and Hugh, et al., (2006) who found out that real-time information processing reduces handling labor and cost avoidance and reduces accounts receivable disputes which in turn lead to annual write-down cost avoidance (Pisello,2006; Hugh, et al., 2006).

4.5 Supply Chain Optimization

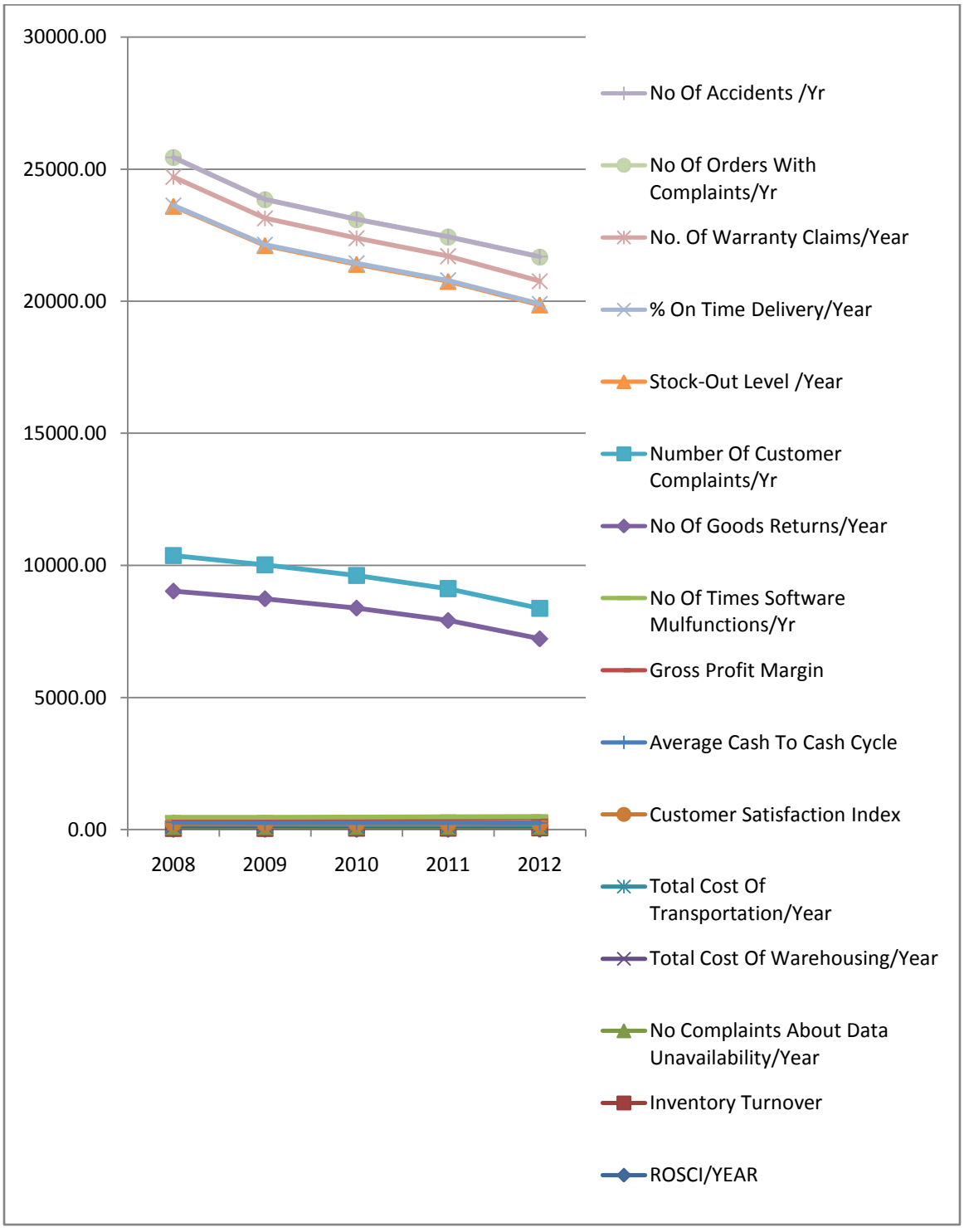
In this section respondents were asked to give some information that could assist in the computation of supply chain optimization of their firms. All the 50 respondents gave information on 16 indicators that were used to measure supply chain optimization in their supermarkets for a period of 5 years. The mean was then calculated by looking for the annual averages. The findings were as in table 4.6.

Table 4.7 Supply Chain Optimization Indicators

	ANNUAL AVERAGE					
SC Optimization Indicators	**2008**	**2009**	**2010**	**2011**	**2012**	**Average**
ROSCI/YEAR	5.06	5.29	5.87	6.51	6.88	5.92
Inventory Turnover	40.28	42.20	45.68	49.92	54.12	46.44
No Complaints About Data Unavailability/Year	65.56	63.02	61.92	59.24	57.04	61.36
Total Cost Of Warehousing/Year	34.96	32.36	29.85	28.57	26.06	30.36
Total Cost Of Transportation/Year	51.18	49.54	47.48	44.92	41.65	46.95
Customer Satisfaction Index	39.40	40.30	41.46	42.12	44.03	41.46
Average Cash To Cash Cycle	34.51	32.61	31.57	30.51	28.92	31.62
Gross Profit Margin	143.52	150.07	161.58	173.61	190.24	163.80
No Of Times Software Malfunctions/Yr	56.76	53.72	52.18	51.60	50.12	52.88
No Of Goods Returns/Year	8560.36	8273.00	7912.32	7432.20	6727.06	7780.99
Number Of Customer Complaints/Yr	1342.24	1281.54	1230.70	1204.26	1150.22	1241.79
Stock-Out Level /Year	13224.00	12085.00	11776.40	11628.00	11484.08	12039.50
% On Time Delivery/Year	36.06	37.15	38.69	39.32	40.83	38.41
No. Of Warranty Claims/Year	1077.02	1000.88	957.62	920.36	862.36	963.65
No Of Orders With Complaints/Yr	725.94	697.84	698.34	722.52	914.48	751.82
No Of Accidents /Yr	18.18	16.20	15.06	14.12	13.40	15.39

Source: Researcher (2013).

Figure 4.2: Supply Chain optimization indicators



Source: Researcher (2013).

Results from figure 4.1 shows that some supply chain optimization indicators had some trend over a period of five years while others did not. The five indicators that had shown a trend include: inventory turnover, ROSCI, number of orders with complaints per year, number of customer complaints per year and number of warranty claims. The remaining 11 indicators did not show a trend and were therefore not regressed. From the findings on figure 4.1, inventory turnover seemed to have increased for the five years. Meaning that the supermarkets increased the number of times inventory was replaced. The return on supply chain investment (ROSCI) also increased. The number of goods returns, number of warranty claims, number of orders with complaints and numbers of customer complaints reduced.

4.5.1 The Relationship between Real-time Information Processing and Supply Chain Optimization

There were only five indicators that could be used to explain SC optimization as per the trend from figure 4.1. They include: inventory turn-over, ROSCI per year, customer complaints per year, and order complaints per year and warranty claims per year. The relationship between real-time information processing and supply chain optimization will be regressed on the above said indicators which were derived from figure 4.1.

4.5.2 Real-time Information Processing and Inventory Turnover

The regression analysis was conducted with the independent variables being Global positioning systems (GPS), Barcodes, Mobile phones, Internet, and Radio Frequency

Identification (RFID). Inventory turn-over was the dependent variable. The results are as indicated in table 4.8

Table 4.8 Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.636(a)	.405	.337	12.17216

Source: Researcher (2013).

From the results of table 4.8, the correlation between the dependent variable was high R (0.636). The effect size estimated by R square (R^2) is 0.405. The model is therefore explaining 40.5 % of change in inventory turnover(Y) using the five independent variables GPS, Barcodes, Mobile phones, Internet, and RFID. The results are significant at 1 %(P =0.00) as shown in table 4.9. This implies that there is a very strong relationship between real-time information processing and inventory turnover.

Table 4.9 Analysis of Variances in the Regression model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4433.220	5	886.644	5.984	.000(a)
	Residual	6519.100	44	148.161		
	Total	10952.320	49			

Source: Researcher (2013).

From test of the statistical significance of the real-time information processing technologies in the model done, the findings indicate that the coefficients of internet (p= 0.03), Mobile-phone (p=0.009), and RFID (p= 0.002) were significant at 1% significance level shown in the results presented in table 4.10. This means internet, mobile phones,

and RFID have a positive effect on inventory turnover whereas GPS (p=580 and Barcodes (p=0.905) were not a significant predictors.

Table 4.10: Test of Statistical Significance of Real-time Information Processing Technologies

Model	variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.200	30.916		.071	.944
	Internet	3.636	1.155	.427	3.147	.003
	Mobile phones	5.241	6.149	.110	.852	.009
	Barcodes	.030	.249	.015	.120	.905
	Radio Frequency Identification (RFID)	3.668	1.559	.436	2.353	.002
	Global positioning systems (GPS)	-.962	1.728	-.116	-.557	.580

Source: Researcher (2013).

Consequently the regression is thus summarized as follows:

Inventory turnover (Y) = FX (real-time information processing technology)

With the standardized beta of internet (B=0.427), mobile phones (B=0.110), Barcodes (B=0.015) RFID (B=0.436), GPS (B= -116) and constant (a=0); the regression equation is thus:

Y = 0.427 internet + 0.110 mobile phones +0.015 barcodes + 0.436RFID – 0.116GPS

From the equation, internet, mobile phones, barcodes and RFID have a positive effect on inventory turnover while GPS has a negative impact meaning increasing use of internet, mobile phones, barcodes and RFID will lead to increase in inventory turn while increasing use of GPS will reduce inventory turnover.

There is a strong positive relationship between inventory turnover and real-time information processing technologies (R=0.636, R^2 =0.405, P=0.00).The use of real-time information technology leads to an increase in inventory turnover by 40.5%. This means that with the use of real-time information processing technology the supermarkets in Nairobi, Kenya increased the number of times that inventory was replaced by 40.5%. These findings are consonant with studies by Harrington (2013) and Siau, (2009) that found out that the use of real-time technology improves inventory management.

The results, however, shows that not all real-time information processing technologies are significant predictors in determining this relationship. Whereas internet (p= 0.03), Mobile-phone (p=0.009), and RFID (p= 0.002) were found to be significant at 1% significance level and therefore have a positive influence on inventory turnover, GPS (p=580 and Barcodes (p=0.905) were not significant predictors of the relationship. The findings about the internet and mobile phones point to the rise in popularity of the two technologies and is in agreement with Mendelson, (2000) who says that with the advent of E-Business, many firms are using the Internet to integrate with their suppliers, customers and trading partners and Siau, (2009), who argues that mobile-commerce has the potential to improve customer service, create new distribution channels, enhance responsiveness, and facilitate inventory management.

The findings about the GPS and barcodes, however, are not in agreement with most studies that show the two enhance inventory management TFHA, (2000) and Lyson et al., (2006). The equation, Y = 0.427 internet + 0.110 mobile phones +0.015 barcodes + 0.436RFID – 0.116GPS, summarizes the kind of relationship that there is between inventory turnover and the five independent variables (internet, mobile phones, barcodes, RFID and GPS). The equation shows that GPS will reduce number of times inventory is turned since it has a negative value.

4.5.3 Real-time Information processing and ROSCI

Regression was conducted with return on supply chain investment (ROSCI) as the dependent variable with independent variable being: GPS, Barcodes, Mobile phones, Internet and RFID. The results are as indicated in table 4.11

Table 4.11 Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.580(a)	.336	.261	5.33263

Source: Researcher (2013).

From the results of table 4.10, the correlation between the dependent variable was relatively high R (0.580). The R square (R^2) is 0.336 which is the proportion of the variance in the dependent variable that is associated with variance in the independent variables. The model is therefore explaining 33.6 % of change in ROSCI(Y) using the five independent variables GPS, Barcodes, Mobile phones, Internet, and RFID. The

results are significant at 2 % level (significance =0.02) as shown in table 4.8. This implies that there is a relatively strong relationship between real-time information processing and ROSCI. Meaning that the use real-time information processing technology increased return on supply chain investment by 33.6%.

Table 4.12 Analysis of Variances in the Regression model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	633.937	5	126.787	4.459	.002(a)
	Residual	1251.224	44	28.437		
	Total	1885.162	49			

Source: Researcher (2013).

The test of the statistical significance of the independent variables in the model was done using the t-test. The results are presented in table 4.11 which indicates that the coefficients of internet (p= 0.05) and Mobile-phones (p=0.002) were found to be significant at 0.002 significance level.GPS (p=0.452), RFID (0.119) and Barcodes (p=0.967) were not a significant predictors of ROSCI.

Table 4.13: Test of Statistical Significance of Real-time Information Processing Technologies

Model	variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-21.429	13.544		-1.582	.121
	Internet	.698	.506	.408	1.379	.005
	Mobile phones	4.266	2.694	.416	1.584	.002
	Barcodes	.005	.109	.005	.041	.967
	Radio Frequency Identification (RFID)	1.085	.683	.311	1.589	.119
	Global positioning systems (GPS)	.575	.757	.167	.760	.452

Source: Researcher (2013).

The regression equation can therefore be summarized as follows:

ROSCI (Y) = FX (real-time information processing technology)

With standardized B coefficients as follows: internet (B=0.408), Mobile phones (B=0.416), Barcodes (B=0.005), RFID (B=0.311) GPS (B=0.167) and constant (a=0); the regression equation is thus:

Y = 0.408 internet $_+$ 0.416 mobile phones +0.005 barcodes + 0.311RFID +0.167GPS

All the real-time information processing technologies indicate positive effect on return on supply chain investment as seen from the equation.

There is a strong relationship between ROSCI and real-time information processing technologies(R=0.580, R^2 =0.336, F=4.459, p= 0.005). Real-time information processing technologies accounts for 33.9% of increase in return on supply chain investment. The internet (p=0.002 and the mobile phone (0.002) are very significant predictors of return on supply chain investment in the model at the level of significance (p=0.002). RFID (0.119) and Barcodes (p=0.967) were not a significant predictors of ROSCI. This means that the internet and mobile phone increased ROSCI in supermarkets in Nairobi, Kenya more than the other predictors in the model. All the predictors, however, had some positive influence on ROSCI as can be seen from the equation:

$Y = 0.408\text{internet} + 0.416$ mobile phones $+0.005$barcodes $+ 0.311$RFID $+0.167$GPS.

The findings are in agreement with many studies that have shown a correlation between real-time information processing technologies and supply chain performance. The studies are in line with Pisello, (2006) and Hugh, et al., (2006). Who argue that real-time information processing maximizes the ROI through reduced production-related exceptions such as reworks order and fulfillment errors, support calls, customer returns, backorders and change orders among other factors. The results are also in agreement with Samaranayake, (2009) and Siau et al., (2009) whose studies show that use of RFID, Mobile Commerce, ERP, internet, barcodes and other technologies synchronize and integrate activities that help to optimize the entire supply chain.

4.5.4 Real-time Information Processing and Number of Customer Complaints

Regression on the number of customer complaints as the dependent variable and independent variables being GPS, Barcodes, Mobile phones, Internet and RFID. The results were as indicated in table 4.13

Table 4.14 Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.393(a)	.155	.058	1023.21329

Source: Researcher (2013).

From the results of table 4.13, the correlation between the dependent variable slightly low R (0.393). The effect size estimated by R^2 is 0.155(15.5%). The model is therefore explaining 15.5 % of change in Number of Customer Complaints using the five independent variables GPS, Barcodes, Mobile phones, Internet, and RFID. The results are not significant (p=0.178) as shown in table 4.15. This implies that there is no relationship between real-time information processing and number of customer complaints.

Table 4.15 Analysis of Variances in the Regression model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8421694.056	5	1684338.811	1.609	.178(a)
	Residual	46066478.981	44	1046965.431		
	Total	54488173.037	49			

Source: Researcher (2013).

The test of the statistical significance of the independent variables in the model using the t-test found the following outcome presented in table 4.16. The results indicate that the coefficients of the independent variables were as follows: internet (p= 0.619) and Mobile-phones (p=0.141), GPS (p=0.766), RFID (0.123) and Barcodes (p=0.292). This means that all the independent variables were not significant predictors of customer complaints and thus there is no relationship between real-time information processing and number of customer complaints.

Table 4.16: Test of Statistical Significance of Real-time Information Processing Technologies

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2992.763	2598.842		-1.152	.256
	Internet	48.639	97.114	.081	.501	.619
	Mobile phones	774.159	516.856	.230	1.498	.141
	Barcodes	-22.337	20.958	-.155	-1.066	.292
	Radio Frequency Identification (RFID)	206.065	131.026	.347	1.573	.123
	Global positioning systems (GPS)	-43.470	145.222	-.074	-.299	.766

Source: Researcher (2013).

The regression equation from the findings can thus be expressed as follows.

Number of customer complaints (Y) = FX (real-time information processing technology)

$Y = 0.081\text{internet} + 0.230\text{mobile phones} - 0.155\text{barcodes} + 0.347\text{RFID} - 074\text{GPS}$

The equation indicates that barcodes and GPS have a negative effect on number of customer complaints while internet and mobile phones will reduce number of customer complaints.

The study did not find any significant relationship between real-time and number of customer complaints per year (R =0.393). The effect size estimated by R^2 is 0.155(15.5%). The model is therefore explaining 15.5 % of change in Number of Customer Complaints using the five independent variables (GPS, Barcodes, Mobile phones, Internet, and RFID). The results are not significant (p=0.178). The results indicate that the coefficients of the independent variables were as follows: internet (p= 0.619) and Mobile-phones (p=0.141), GPS (p=0.766), RFID (0.123) and Barcodes (p=0.292). This means that all the independent variables were not significant predictors of customer complaints and thus there is no relationship between real-time information processing and number of customer complaints. This means that real-time information processing technologies do not lead to decrease in number of customer complaints. This is contrary to the expectations that real-time information processing leads to elimination of supply chain issues in real-time and availing of products at point of demand at the time of demand and gives customers an exciting experience (Pisello, 2006). The fact that real-time information processing has no relationship with customer complaints is an indication that there are other factor not studied that could be reducing number of customer complaints.

4.5.5 Real-time information Processing and Number of Orders with Complaints.

When the number of orders with complaints was regressed as the dependent variable and independent variables being GPS, Barcodes, Mobile phones, Internet, RFID, the results are as indicated in table 4.16

Table 4.17 Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.315(a)	.100	-.003	499.66643

Source: Researcher (2013).

The results of table 4.17 indicate the correlation between the dependent variable were 0.315. The R square (R^2) is 0.100. The model therefore explains 10 % of change in Number of orders with Complaints using the five independent variables GPS, Barcodes, Mobile phones, Internet, and RFID. The results are not significant (p =0.445) as shown in table 4.17. This implies that there real-time information processing does not necessarily translate to decline in number of customer complaints.

Table 4.18 Analysis of Variances in the Regression model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1214000.970	5	242800.194	.972	.445(a)
	Residual	10985327.721	44	249666.539		
	Total	12199328.691	49			

Source: Researcher (2013).

The test of the statistical significance of the independent variables in the model gave the results presented in table 4.15 which indicate that the coefficients of the independent variables were as follows: internet (p= 0.524) and Mobile-phones (p=0.212), GPS (p=0.263), RFID (0.496) and Barcodes (p=0.900). This shows that all the independent variables were not significant predictors of orders with complaints and thus there is no reduction in number of orders with complaints due to real-time information processing.

Table 4.19: Test of Statistical Significance of Real-time Information Processing Technologies

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-824.642	1269.094		-.650	.519
	Internet	30.471	47.424	.107	.643	.524
	Mobile phones	319.823	252.397	.201	1.267	.212
	Barcodes	-1.296	10.234	-.019	-.127	.900
	Radio Frequency Identification (RFID)	43.929	63.984	.156	.687	.496
	Global positioning systems (GPS)	-80.403	70.916	-.290	-1.134	.263

Source: Researcher (2013).

The linear model can thus be expressed as follows:

Y = 0.107internet + 0.201 mobile phones -019barcodes+ 0.156 RFID -0.290GPS

The equation shows that internet, mobile phones and RFID reduces number of orders with complaints while barcodes and GPS have do not.

The R square (R^2) is 0.100. The model therefore explains 10 % of change in Number of orders with Complaints using the five independent variables (GPS, Barcodes, Mobile phones, Internet, and RFID). The results are not significant (p =0.445). This implies that there real-time information processing does not necessarily translate to decline in number of customer complaints. The coefficients of the independent variables were as follows: internet (p= 0.524) and Mobile-phones (p=0.212), GPS (p=0.263), RFID (0.496) and Barcodes (p=0.900). This shows that all the independent variables were not significant predictors of orders with complaints and thus there is no reduction in number of orders with complaints due to real-time information processing. This is contrary to assertion that real-time information processing leads to elimination of supply chain issues in real-time and availing of products at point of demand at the time of demand giving customers an exciting experience (Pisello, 2006)

4.5.6 Relationship between Real-time and Number of Warranty Claims

Regression was conducted with number of orders with warranty claims as the dependent variable. The independent variables remained the same (GPS, X_1), Barcodes(X_2), Mobile phones, Internet, RFID, The results were as indicated in table 4.

Table 4.20 Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.555[a]	.308	.229	1033.53691

Source: Researcher (2013).

From the results of table 4.19, the correlation between the dependent variable was high R (0.555). The R square (R^2) is 0.308 meaning that the model explains 30.8 % of change in

number of warranty claims(Y) using the five independent variables GPS, Barcodes, Mobile phones, Internet, and RFID. The results are significant at (p =0.005) as shown in table 4.20. This implies that there is a relatively strong relationship between real-time information processing and number of warranty claim. This means that real-time information processing leads to a drop in number of warranty claims.

Table 4.21 Analysis of Variances in the Regression model

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.087E7	5	4174595.708	3.908	.005[a]
	Residual	4.700E7	44	1068198.543		
	Total	6.787E7	49			

Source: Researcher (2013).

Through the test of the statistical significance of the independent variables in the model using the t-test, the results found are presented in table 4.21 which indicates that the coefficients of internet (p= 0.002), and RFID (p= 0.001) were found to be significant at 0.05 significance level. This means internet, and RFID have a positive effect on number of warranty claims whereas GPS (p=0.11), Barcodes (p=0.347) and mobile phones (0.972) were not a significant predictors of number of warranty claims. The implication is therefore that real-time information processing leads to a significant decline in warranty claims per year.

Table 4.22: Test of Statistical Significance of Real-time Information Processing Technologies.

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-434.172	2625.063		-.165	.869
	Internet	192.155	98.094	.427	1.959	.002
	Mobile phones	138.824	522.071	.037	.266	.792
	Barcodes	-20.107	21.169	-.125	-.950	.347
	Radio Frequency Identification (RFID)	495.360	132.348	.747	3.743	.001
	Global positioning systems (GPS)	-388.116	146.687	-.593	- 2.646	.011

Source: Researcher (2013).

Consequently the regression is thus summarized:

Number of Warranty claims (Y) = FX (real-time information processing technology)

The regression equation is thus:

Y= 427 internet + 037mobile phones- 125barcodes +744RFID -593GPS

The equation shows that internet, mobile phones and RFID have a positive effect on number of warranty claims while barcodes and GPS have negative effect on number of warranty claims.

The results indicate that there is a strong relationship between real-time information processing technologies and number of warranty claims(R=0.555, R^2 =0.308**,** P=0.005). The coefficients of internet (p= 0.002), and RFID (p= 0.001) were found to

be significant at 0.05 significance level. This means internet, and RFID had a positive effect on number of warranty claims whereas GPS (p=0.11), Barcodes (p=0.347) and mobile phones (0.972) were not a significant predictors of number of warranty claims.

The findings therefore show that real-time information processing reduces number of warranty claims. This may be associated with the reduction of errors in service delivery and is in consonant with Pisello,(2006) and Hugh, et al., (2006) who found out that real-time processing technologies reduced production-related exceptions such as reworks order and fulfillment errors, support calls, customer returns, backorders, change orders, production stops, production expediting and changeovers, transportation errors and recalls, reduced incidents and handling costs in annual error handling labor and cost avoidance and reduces accounts receivable disputes which in turn lead to annual write-down cost avoidance.

CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the findings, conclusions based on the findings, the recommendations based on the findings and suggestions for further research. The study had three main objectives**:** to find out the forms of real-time information processing technologies used in supermarkets in Nairobi, Kenya, to determine the benefits of real-time information processing in supermarkets in Nairobi, Kenya and to establish the relationship between real-time and SC optimization in supermarkets in Nairobi, Kenya

5.2 Summary of the Findings

The study found out that all the supermarkets in Nairobi, Kenya use real-time information processing technology with most of them having used the technology for a period of over four years. The most commonly used forms of real-time information processing technology emerged out as the use of mobile phones that are used to a very great extent. This is attributed to the flexibility of the mobile phones .The use of barcodes came second as their use was rated as to a great extent. This could be attributed to the fact that bar codes are used very much at the point of sale. These are followed by the internet that are used to moderate extent. The GPS and RFIDs are used only to a small extent.

The results indicate that two major benefits are accrued from the use of real-time information processing by supermarkets in Nairobi, Kenya. The greatest benefit of real-time information processing was found to be Improved Inventory Management and Increased Supply Chain visibility. The second benefit was found to be reduction in operational labor costs. The supermarkets managed to improve inventory management and supply chain visibility through: prevention of negative interference downstream reduced fulfillment errors, reduced order cycles, reduced bull-whip effect, improved and reduced shipping delays, better tracking of goods in transit and hence matching of demand with supply. Labor costs were found to be reduced by the supermarkets through: reduced rework and reduction in number of employees.

The overall results also showed varied findings concerning the relationship between real-time information processing and the different supply chain optimization indicators. The study found out that there is a significant relationship between real-time information processing and inventory turnover and ROSCI. The results show that real-time information processing increases both inventory turnover and return on supply chain investment (ROSCI) while reducing number of warranty claims. The study also found out that real-time information processing reduced the number of warranty claims.

The study however found no significant relationship between teal-time information processing technologies and thirteen other supply chain optimization indicators including: total cost of warehousing, transportation costs, number of orders with complaints, number of customer complaints, percentage of on time delivery, gross profit margin, number of goods returns, average cash-to cash cycle and number of times

software malfunctioned. This indicates that the said factors are more influenced by other factors not studied than real-time information processing.

5.3 Conclusions

Following the study findings it is possible to conclude that all supermarkets in Nairobi, Kenya use real-time information processing technologies to conduct their operations. This is true from the number of respondents who said they use real-time information processing technology.

The study also concludes that a more than half of the supermarkets in Nairobi use barcodes and mobile phones. This may be associated with the lower costs of these gadgets and the flexibility of use of mobile phones with relation to other technologies.

It is also apt to conclude that in as much as real-time information processing may impact positively on supply chain optimization, other factors do affect optimization. This true from the fact that thirteen out of the sixteen supply chain indicators analyzed did not show any trend. This include: warehousing costs per year, transport costs per year, on time delivery and gross profit among others.

Another conclusion is that GPS is not a significant independent variable in real-time information processing given that in all regressions analyzed it was not significant from the t-test of real-time information technologies.

It will also be concluded that the supermarkets in Nairobi, Kenya use real-time information processing majorly on inventory management and supply chain visibility

solutions. This is given that the factor analysis this accounted for over 80% of all the components analyzed.

5.4 Recommendations

The supermarkets in Nairobi, Kenya need should consider training their staff on use of the real-time information processing to be able to reap maximum benefits of real-time information processing. This is due to the fact that most supply chain indicators did not show relationship with real-time information processing. The study also recommends the increase in the use of mobile phones, RFID and internet since they had significant relationship with inventory turnover, ROSCI and number of warranty claims.

5.5 Suggestions for Further Research

The study indicates that there GPS is not a significant independent variable in real-time information processing among the supermarkets in Nairobi, Kenya. It will be important to conduct a study to find out why? Study should also be conducted in other sectors to see whether the same trend holds water.

A study should also be conducted to find the relationship between training of employees and supply chain optimization. This will bring out the relationship between technological training and supply chain optimization.

5.6 Limitations of the Study

The study had the following limitations:

The findings of the study may not be generalized to other organizations since they may be working under different environmental conditions

Equally, respondents may have not disclosed important information or could have given false information on sensitive areas like finances for fear of victimization or that their competitors may copy their strategy.

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APPENDICES

Appendix I: Questionnaire

SECTION A: Organizational profile

1. Has your company adopted real-time information processing technologies and systems to support its operations?

   Yes ☐

   No ☐

2. For how long has your organization used real-time information processing technology?

1-2 years	
2-4 years	
over 4 years	

SECTION B: Level of implementation of real-time technology

Kindly indicate the extent to which you agree with the following statements concerning the extent to which your firm has implemented real-time information technology for supply chain optimization.

Use the scale of: 1=very small extent; 2 = small extent; 3 = moderate extent; 4 = great extent; and 5= very great extent.

technology	1	2	3	4	5
Enterprise Resource planning (ERP)					
Internet					
Mobile phones					
Barcodes					
Radio Frequency Identification (RFID)					
Global positioning systems (GPS)					

SECTION C: Benefits of Real-time Information Processing Technology

To what extent has your supermarket realized the following supply chain visibility benefits as a result of implementing real-time information processing systems?

Use a scale of: 1= very great extent; 2= to a great extent; 3= moderate extent; 4=small extent and 5= very small extent.

Benefit	1	2	3	4	5
Real-time information processing has led to reduction of the need to download and upload files on a daily basis					
Reduce rework due to accuracy of data entry					
Made a firm have capacity to deal with large amount market information					
Reduces labor costs					
Real-time information processing mitigates on risks					
Resource utilization is increased					
Inventory carrying costs are reduced					
Prevented counterfeits into the supply chain					
Maximized return on investment					
Reduced fulfillment errors, support calls, customer returns backorders, and change orders					
Reduced paperwork					
Leads to making of timely decisions to lessen or prevent negative performance down stream					
Tracks and ensures production coordination and avoids delays in the supply chain					
Reduces shipping delays					

Improves distribution and retail channels to more accurately track delivered goods and match supply with demand.					
Reduces stock out costs					
Reduces incorrect invoice payment					
Reduces pull-whip effect					
Reduces order cycle					
Eliminates excess inventory					
Increases inventory turn-over					
Improves inventory forecasting					
Improves overall customer service					
Reduces data and analysis latency					

SECTION D: Supply Chain Optimization

Kindly provide the following information about your supply chain to assist compute the supply chain optimization level among supermarkets in Nairobi, Kenya.

Supply chain optimization measure	**Unit of measure**	**2008**	**2009**	**2010**	**2011**	**2012**
Inventory turn over	days					
No. of complaints about data unavailability	No.					
Total cost of warehousing	k.sh					
Total cost of transportation	K.sh					
No. of customer satisfied with service/year	No.					
Av. Cash to cash cycle	days					
Gross profit margin						
Return on supply chain investment	k.sh					
No of times software malfunctions	No.					
Number of goods returns	No.					
Number of customer complaints in a year	No.					
Stock-out level	No.					
Number of on time delivery in a year	No.					
No. of warranty claims	No.					
No. of orders with complaint in a year	No.					
Number of accidents/year	No.					
Total manufacturing cost /year	k.sh					

Appendix II: Supermarkets in Nairobi, Kenya

NO.	Supermarket	Br. NO	Location
1	Acacia Supermarket	1	Factory Street
2	Aflose Supermarket Lt.	1	Rabai/Gaturo Rd Junction ,Buruburu ph 5
3	African Grocers Ltd.	1	Pan African Insurance Arcade Gr. Flr, Arwing Kodeck Road
4	Amal Supermarket Lt	1	12th street
5	Anal Supermarket Limited	1	
6	Banshi Supermarket	1	Jambo Plaza 3st floor, 3rd Parkland Av.
7	Betccam Savers Supermarket	1	Kahawa West
8	Broadway supermarket	1	Thika Road
9	Buru Buru Mini Market	1	Wab Hotel building, Mumias Road
10	Cash and carry limited	1	Off Mombasa Road
11	Centaline Supermarket	1	2nd Avenue , 2nd Street Eastleigh
12	Centaling Supermarket	1	
	Chandarana Supermarket Lt	2	
13			Mobile Plaza Building, Thika H. W.
14			Ngala Road
15	Clean Way Limited	1	Valley Arcade, Gitanga Road
16	Continental Supermarket Lt.	1	ABC Place, Waiyaki Way
17	Country Mattresses Limited	1	Manan Building, Gr. Flr., Tom Mboya St.
18	Deepak Cash and Carry Lt.	1	Ole Shaparava Avenue
19	Defence Forces Canteen Organization Limited	1	Juja Road Eastleigh
20	Eagles Supermarket	1	Wab Hotel Complex, Mumias South Road
21	Eastleigh Mattresses Lt.	1	Lokitaung Road

22	Munshira	1	Munshra Mansions, Mufangano St.
23	Ebrahim and Company Lt.	1	Wazir House Moi Avenue
24	Esajo Supermarket	1	Githurai off Thika Road
25	Fairdeal Shop and Save lt.	1	Rahmutulia Trust BL.Tom Mboya St
26	Fairlane Supermarkets Lt.	1	Fairlane Hs, Gr Flr, Mbaghathi Rd
27	Foodies Supermarket	1	Ngong road
28	Galmart Supermarket	1	Behind New Garissa lodge,1st Eastleigh Av
29	Goodfare Store	1	City Market Muindi Mbingu St
30	Guestcare Ideal Homes lt.	1	Section III
31	Happy Valley Supermarket	1	Neghbors Bld, Kahawa Sukari, off Thika Rd
32	Home Choice Supermarket	1	Bhavesh Building, after Fig Tree Ht
33	Jack and Jill Extravaganza	1	Haile Selassie Avenue
34	Jack and Jill Supermarket lt	1	Race Cource Road
35	Janamu Supermarket	1	
36	Jawa's Supermarket Lt	1	Park Place Magadi Road
37	Jeska Supermarket Limited	1	Benrose House, Kangundo Rd
38	Jey Supermarket	1	
39	Jopampa Provision Stores	1	Muhini House,Grd Flr, Muchumbi Road
40	Joster Mini Market	1	General Warungi Street
41	Juja Road Fancy Store Lt.	1	Pangani
42	K and A Self Selection Store lt.	1	Caxton house, Koinange street
43	Kaaga Mini Market	1	
44	Kaka Self Service Limited	1	
45	Karen Supermarket	1	
46	Kalumos Trading Company	1	Wanja Hs, Moi Drv off Kangundo
47	Kaymamunguba supermarket	1	
48	Kenton Supermarket	1	Kawangware Shopping Centre

59	Marketways Limited	1	Gitanga Road
50	Master supermarket	1	
51	Mathai supermarket	1	
52	Mensora supermarket	1	Mumias South Road
53	Metro Cash and Carry	1	Corner of Mbsa Rd, off Airp. N. Rd
54	Midas Touch Supermarket Limited	1	Vumira Hs, South B Shopping Centre, Daidi/Shirazi Road
55	Mulika Mini Market Lt.	1	Off Thika Road
56	Mustard Supermarket	1	Mj. Kinyanjui St off 1st Eastleigh Av
57	Muthaiga Mini Market	1	Limuru Road
	Naivas Supermarkets Lt.	4	
58			Kasarani/Mwiki Road
59			Komarock/ Kayore Road
60			Mombasa Road
61			Ronald Ngara Street
62	Nakumatt Holdings Limited	1	Behind Panari Sky Center, Rd c, off Enterprise road
63	Neibas supermarket	1	
64	New Westlands Store Lt.	1	Waiyaki Way
65	Parklands Price Rite Lt.	1	Parkland Road
66	Portway Store Limited	1	Uhuru Highway
67	Rikana Supermarkets	1	Off Outering Road
68	Safeway Hypermarkets	1	Buru Buru Shop.Centre, Safeway Hs Mumias Rd
69	Satellite Supermarket Lt.	1	
70	South C. Supermarket	1	
71	Stagen Enterprise Limited	1	Umoja East
72	Superbgains Cash and Carry	1	
73	Tesco Corporation Limited		
74	Trolleys and Baskets	1	Kasuku Centre

75	Tumaini Supermarket	1	Airport View Estate, Airport N. Rd
	Tursker Mattresses Limited	11	
76			Accra Road
77			Adams Arcade, Ngong Road
78			Dagaruando Bld,Gr Flr,Tom Mboya St
79			Mombasa Road
80			Muindi Mbingu Street
81			Mumias South Road
82			Opposite KBS,Mfangano/Hakati Rd
83			OTC Building, Ronald Ngala Street
84			Pioneer
85			Ronald Ngala Street
86			Tmall Lan'gata Road
	Uchumi Supermarkets Lt	14	
87			Adams Arcade, Ngong Road
88			Buru Buru
89			City Square
90			Jipange, Thika Road
91			Jogoo Road
92			Koinange/Monravia Street
93			Lan'gata Hyper
94			Mombasa Road
95			Nairobi West
96			Ngong Hyper Ngong Road
97			Sarit Hyper Westlands
98			Taj Mall, North Airport Road
99			Westlands
100			Yarrow Rd, off Nanyuki Rd ind. A.
	Ukwala Supermarkets Lt	3	
101			City Stad., Lusaka Rd/ Factory St.

102			Ronald Ngala Sreet
103			Tom mboya street
104	Uncle jim’s supermarket	1	Huruma shopping centre
104	Vantage Supermarket Lt.	1	Ruaraka/Garden Estate Road
105	Westlands General store Lt.	1	Mpaka Road