A SURVEY ON THE USE OF JUST-IN-TIME (JIT) SYSTEMS IN THE COMPANIES LISTED AT THE NAIROBI STOCK EXCHANGE.

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DECLARATION

This Research Project is my original work and has not been submitted for a degree in this or any other University.

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DEDICATION

This Management Project is dedicated to the Lord God Almighty who provided me with all the resources that I needed during my time of study. I also dedicate it to my wife Alice and my children Branny and Billy, for their encouragement, patience and perseverance throughout this course.

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I give thanks to the Almighty God for making the whole program a success. Special thanks go to my supervisor Mr. Onserio Nyamwange for his invaluable guidance, support and advice. My colleagues throughout the MBA program also made significant contributions and I am deeply indebted to them.

TABLE OF CONTENTS

LIST OF ABREVIATIONS

BM	Benchmarking
BPR	Business process re-engineering
CI	Continuous Improvement
DOPS	Daily overhead and perfect supply
EDI	Electronic Data Interchange
EPZ	Export processing Zones
ERP	Enterprise Resource planning
FGI	Finished Goods Inventory
GE	General Electric
IBM	International Business Machine
ISO	International Organization for standardization
ISO 9001:2000	ISO Quality Management System
IV	Intravenous Solutions
JIT	Just –in- time
JIT 1	Just-in-time (Preparatory)
JIT 2	Just-in-time (Waste elimination)
MAN	Materials -as -needed.
MNCs	Multinational corporations
MRP	Materials Requirements Planning
MRPII	Manufacturing Resource planning
NPDS	New products development strategies
NSE	Nairobi stock exchange
ROI	Return on investments
SCM	Supply Chain Management
SGIA	Small group improvement activities
SPC	Statistical Process Control
Std	Standard Deviation
TOC	Total Quality Control
TPM	Total Preventive maintenance
TQM	Total Quality Management
US	United States
USA	United States Of America
WIP	Work in process
ZIPS	Zero Inventory production systems.

ABSTRACT

This Research Project sought to survey the use of JIT practices by the companies listed at the Nairobi Stock Exchange. The study set to achieve three objectives. The first objective was to document just-in-time practices among firms operating in Kenya. Secondly, the study aimed at finding out the benefits emanating from implementing just-in-time systems in organizations in Kenya. Thirdly, the study set out to unfold obstacles hindering successful implementation of Just- in –time systems by Kenyan firms. Primary data was collected by use of a questionnaire with both closed and open- ended questions. The closed-ended questions enabled the collection of quantitative data for analysis using a likert-scale of 5; while the open-ended questions enabled the researcher collect qualitative data on the respondents' view of just-in-time systems in organizations in Kenya. The quantitative data was then analyzed by use of descriptive statistics.

The study found that most Kenyan firms believe that JIT practices enhance long-term business performance and success. The study established that reduction in inventory, work-in-progress (WIP), production space and lead time were the most substantial benefits emanating from JIT implementation. The study established the following hindrances to JIT implementation starting with the most significant obstacle; Poor infrastructure, Government policies, interfacing JIT with existing systems, poor information/data accuracy, power outages/blackouts and lack of internal expertise. These findings should help in encouraging the widespread adoption of JIT practices in other organizations in Kenya.

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

1.1.1 Just-In-Time (JIT) Concept

Organizations in manufacturing, service and public sectors are implementing a wide variety of innovative managerial tools and philosophies to help them deal with the highly competitive and customer- driven environments in which they must operate. The adoption of philosophies such as Just-in-time (JIT), Total quality management (TQM), Benchmarking (BM), Business process reengineering (BPR) and continuous improvement (CI) has, in most cases, led to operational and strategic gains for manufacturing and service organizations (Wafa and Small, 2001). With increasing regional and global competition many organizations worldwide have looked to new production systems and technologies to help improve their operations effectiveness. Just- in- time systems represents one such approach that have been widely adopted by several organizations.

JIT implementation, as argued by Piper and Radford (1985) and also Abegglen and Stallk (1985) helps lay the foundation for successful transition towards operations automation. In light of this, the adoption of JIT practices becomes of strategic significance to most organizations. When JIT is used in the context of services, the focus is mainly on the time needed to deliver the service. Examples of fast delivery are Domino's Pizza and Federal Express in the US; Nation Courier services, Akamba courier services, Express Mail, in-flight catering companies and 911 emergency services in Kenya. Service environments with repetitive operations, with high volumes and tangible items, such as mail, checks or bills are expected to benefit more from application of JIT principles.

1.1.2 Evolution of Just-In -Time Concept

Just-in-time concept started at Toyota in the 1950s and over a period of time have come to be synonymous with Japanese industry (Ohno, 1988). Few people, however, are aware that the idea of JIT came not from other automobile industries, which Toyota studied, but from the American supermarkets. When Taiichi Ohno, the creator of this system, went on a trip to USA, he was struck by the efficiency of these supermarkets. What appealed to him was that here was a system, which made required items available in the right quantities, and at the right time. Applying this to the factory, he realized, would have tremendous benefits in terms of time and low inventories. Ohno studied how the supermarkets operate, and in 1953, for the first time applied this system to the Toyota machine shop in the main plant (Vokurka et al, 1996).

Toyota, led by Taiichi Ohno as Manufacturing Director, was a pioneer of kanban. Its performance after the sudden oil price rises of 1973-74 excited the interest of rivals both in Japan and elsewhere. Toyo-Kogyo, whose brand is Mazda, was almost bankrupted by the same oil shock. Its recovery had much to do with its introduction of the Toyota production system that was already regarded as good practice throughout the country. Ford's close connection with Toyo-Kogyo began when it bought a 25% stake in 1976. Then followed an intensive programme of training of Ford managers in Japanese techniques. Through the use of a "pull system", where production of a part was driven by the needs of the following lines rather than the preceding line as was the norm then, just-in-time allows manufacturers to build only what the customer orders in the shortest time possible, eliminating the need to hold large inventories and reducing storage costs (Reuters Sep 09, 2003).

Lyson (1989) also traces origin of JIT concept in Japan in the 1950s when the Toyota Motor Company developed a system known as Kanban to meet

customer demand for various vehicle models with minimum delivery delays. Kanban in Japanese means 'ticket' and refers to an information system in which instructions relating to the type and quality of items to be withdrawn from the preceding manufacturing process is conveyed by a card. JIT is a 'demand pull' system in which manufacturing planning begins with the final assembly line and works backwards, not only through the various manufacturing processes, but also to the vendors and subcontractors supplying materials and components. The exact quantity to replace the items withdrawn to meet the requirements of one manufacturing stage are provided by the preceding process. The aim is that by limiting a production and assembly to what is actually needed, both materials and work-in-progress inventories can be eliminated or significantly reduced.

1.1.3 Definition of Just-In-time(JIT) system

Most people in industry know about the Just-in-time, or the stock-less production system. JIT can be defined as a planning concept designed to eliminate waste. Waste being anything other than the minimum amount of equipment, materials, parts, space, and workers' time, which are absolutely essential to add value to the product or service (Schonberger, 1982).

According to Naylor (1996), beyond the general statements of principle and the declaration of war on waste, JIT consists of a family of techniques that can be assembled and integrated. These fall into two groups: JIT1 is preparatory, making the facility ready for high flow, short lead-time production; JIT2 techniques are the tactics used to cut waste. A summary list appears in Appendix II.

Lyson (1989) adopted defination of (JIT) purchasing as 'an inventory control philosophy whose goal is to maintain just enough material in just the right place at just the right time to make just the right amount of product'. More concisely JIT is ' the exact adjustment of production to quantity and time held'.

JIT has several versions known by such names as ZIPS (Zero Inventory Production Systems), MAN (Materials-as-Needed), DOPS (Daily Overhead and Perfect Supply) and Nick-of-Time. In all such cases the essential requirement is that supplies must be delivered frequently in relatively small quantities 'Just-in-time' for use.

According to Dennis et al (1995), JIT is often thought to be a technique for reducing inventories. That is partly correct. JIT can be considered in two ways: As a philosophy of waste reduction and as a set of techniques for reduction of inventory and waste. As a philosophy, JIT's primary goal is elimination of waste in the production system. Anything that doesn't add value to the product in the system is waste. Rework and scrap should be eliminated. JIT has as its basics that the right part should be at the right place at the right time.

Chase et al (1999) highlights that JIT requires the production of precisely the necessary units in the necessary quantities at the necessary time with the objective of achieving plus or minus zero performance to schedule. It means that producing one extra piece is just as bad as being one piece short. JIT concept applies to a repetitive manufacturing process. It does not necessarily require large volumes but is restricted to those operations that produce the same parts over and over again. Every piece is expected to be correct when received, every machine is expected to be available when needed to produce parts and every delivery commitment is expected to be honored at the precise time it is scheduled.

Suzaki (1987) refers to Just-in-time as a management philosophy and not a technique. It is originally referred to the production of goods to meet customer demand in time, quality and quantity, whether the 'customer' is the final purchaser of the product or there is another process further along the production line. It has now come to mean producing with minimum waste. "Waste" is taken in its most general sense and includes time and resources as well as materials.

1.1.4 Emerging issues

One may however wish to ask whether the need for organizations to implement just-in-time systems is justified. The researcher could mention just a few of the incidences that qualify the need for such a study. Uchumi Supermarket has streamlined its distribution system expected to free billion of shillings tied up in stocks to restructure other operations. The Supermarket chain has entered into a product distribution partnership with Bidco Oil Refineries Ltd to restock specific branches from its Thika plant without necessarily passing through Uchumi's central distribution warehouse in Nairobi.The joint lean operation venture is aimed at reducing inventory and transferring storage costs to manufactures (The Standard Business and Daily Nation of 20th May 2005).

Shortly after the September 11th 2001 terrorist attack in USA, many manufactures experienced disruptions to the flow of raw material and parts into manufacturing plants. For example, Ford had to idle several of its assembly lines intermittently in the days following the attack, as trucks loaded with parts destined to these production plants were delayed at the Canadian and Mexican borders. As a result, Ford lost 12,000 units of production. The reason Ford and other leading manufactures were vulnerable to transportation disruptions is that they operate a "Just-In-Time" (JIT) inventory discipline, keeping just enough material on hand for only a few days and sometimes only a few hours of operation (Wall Street Journal Ip, 2001).

The recent implementation of computerized clearing system at the Port of Mombasa by Kenya Revenue Authority has led to some delays in firms in Kenya ordering materials just-in-time. We have since seen firms in the Export processing Zones (EPZ) close their business and send workers on compulsory leave because of this Government policy.

Stock-outs of raw materials and production parts would shut down an operation and be extremely costly in terms of lost production, escalation of operation costs due to fixed costs, and inability to satisfy delivery promises to customers. For example, an automobile producer cannot complete the car without the purchased tyres; an airline cannot keep its planes flying on schedule without purchased fuel; and a hospital cannot perform surgery without purchased IV (intravenous) solutions. If purchasing and other functions of an organization by adopting JIT concepts can support operations with an inventory investment of kshs.10 million instead of khs.20 million, at the annual inventory carrying cost of 30 percent, the 10 million reductions in inventory represents a saving of 3 million (Baily et al, 1998).

To produce the desired product or service a certain quality level is required for each material input; otherwise the end product or service will not meet expectations or will result in higher-than acceptable production costs. The internal cost to correct a substandard-quality material input can be huge. For example, an unsatisfactory spring assembled in to the braking system of a diesel locomotive costs only 90 shillings, but if the defective spring shows up when the locomotive is in service, the replacement cost is in thousands of dollars, caused by teardown required to replace the spring, the lost revenue to railroad because the locomotive is not in service and the possible loss of locomotive reorders. The need to improve quality to compete effectively on a worldwide basis has caused renewed attentions to organizations to adopt quality objectives by enhancing world-class concepts like JIT (Baily et al, 1998).

The just-in-time (JIT) systems have received considerable attention since their beginning in Japan in the early 1950's. Some of the main benefits of JIT, such as inventory reduction, quality improvement, and quick delivery, are well known (Cook and Rogowski, 1996; Hobbs, 1994; Billesbach, 1991; Payne, 1993; Temponi and Pandya, 1995). However, in a competitive global market, price, quality, and quick delivery are not sufficient to stay ahead of competition once the product reaches the maturity stage of its life cycle. To stay competitive in the market, in addition to price, quality, and speed,

organizations need to develop agility to innovate, design, and introduce new products to the market quickly (Eppinger, 2001; Krishnan and Ulrich, 2001). Introducing new products to the market early has several strategic and operational advantages. It often means charging premium price, building name recognition, controlling a large market share, and enjoying the bottom line profit. Better competitive position in the market also makes it difficult for competition to enter the market (Blackburn, 1991; Cooper and Kleinschmidt, 1994; Zahra and Ellor, 1993). During the last two decades, through their JIT systems, world class manufacturers have dominated their competitors not only in the areas of price, quality, and speed, but also in the areas of innovation, design, and quick new product development (Bebb, 1989; Dumaine, 1989; Blackburn, 1991; Clark and Fujimoto, 1991; Ulrich and Eppinger, 2000).

1.2 THE RESEARCH PROBLEM

An expanding global competition, emerging new technologies and improved communications have increased customers' expectations for full satisfaction with the products and services they purchase. At the rapid rate that technology is increasing, it is not uncommon to be left in the dust of aggressive competitors. Consequently, in recent years, many manufacturing and service companies have been challenged to increase their focus on customer satisfaction and quality of products and services. Confronting the challenges of global competition, companies world-wide are forced to find ways to reduce costs, improve quality, and meet the ever-changing needs of their customers. One successful solution has been the adoption of just-in-time (JIT) systems, which involve many functional areas of a company such as manufacturing, engineering, marketing, and purchasing (Carlos, 2003).

Many studies on JIT have been done outside Kenya. Crawford et al (1988) represents one of the earliest published works on JIT (Hum and Ng, 1995). Their study involved a survey of 39 JIT companies, which the authors had identified as the early adopters of JIT in the USA. They reported on the reasons for adopting JIT, the associated benefits and also the implementation

and operational problems experienced by these early JIT companies. They concluded from their research that future adoption of JIT should emphasize education and training, quality control measures and preventive maintenance in the early phases of JIT implementation.

Im and Lee (1989) and Gilbert (1990) conducted similar studies of JIT implementation among companies in the USA. They focused on how companies can be successful in their JIT implementation efforts.

Hum and Ng (1995) did a comprehensive study of JIT practices in Singapore. Their study showed that foreign companies (MNCs) were the main practitioners of JIT in Singapore.

Vakurka and Davis (1996), Kelein and Devens (1990) mainly focused on how JIT organizational strategic philosophy has the potential of increasing organizational efficiency and effectiveness. Their studies concluded that JIT tends to eliminate waste in production and material, improves communication internally and externally, reduce purchasing costs, and finally tends to foster organizational discipline and managerial involvement.

Several other similar studies of JIT implementation have also been reported for companies operating in Germany, Italy, Austalia, HongKong, Korea and Taiwan (Wildemann, 1988;Bartezzaghi etal,1992;Clark and Mia, 1993;Cheng, 1988;Lee, 1992 and Yang, 1989). Cheng, (1988) for example, focused his survey within the electronics industry in HongKong. The results from the study showed that the electronics manufacturers were fully aware of JIT and its benefits; however, the lack of an overall coordinating effort hindered its extensive implementation in the industry.

Related Studies carried out in Kenya have focused on areas such as; aspects of strategy formulation and implementation within large private manufacturing companies in Kenya (Aosa, 1992), Advanced Manufacturing Technologies in Kenya (Mwangi, 2002), Operations strategies applied for the competitiveness

of Kenyan large manufacturing firms (Nyamwange, 2001) and obstacles in the implementation of Total quality Management in the banking sector (Oloko,1999). Nyamwange (2001) concluded that operations strategies, on which the companies compete, in their order of rank, are high quality, low cost and time/speed, innovativeness, and flexibility, which are ranked equally. Oloko (1999) concluded that the three major obstacles faced in TQM implementation, include, resistance to change, differences in people's attitudes and poor understanding of the concept by the lower level staff.

So far no study has addressed the use of just-in-time systems in organizations in Kenya. Given the benefits of just-in-time (JIT) systems elsewhere this exploratory study seeks to identify how the use of Just-in time philosophies in Kenyan organizations impacts on their operations. Therefore, the questions that the study sought to answer were: "To what extend have organizations operating in Kenya adopted Just-in-time practices?; What are the benefits derived from implementing just-in-time systems in organizations in Kenya?; What are the problems and/or barriers encountered in implementing Just-in-time systems in firms operating in Kenyan?; what are some of the possible strategies that can be used to overcome the obstacles mentioned above?"

1.3 OBJECTIVES OF THE STUDY

i) To document just –in- time (JIT) practices among firms operating in Kenya.

ii) To determine benefits emanating from implementing just-in-time systems (JIT) in organisations in Kenya.

iii) To determine obstacles hindering implementation of just-in-time system in Kenyan firms.

1.4 IMPORTANCE OF THE STUDY

Below are possible beneficiaries to whom the results of the study will be of importance;

i) The results of the study will provide corporate and operations decision-makers with a basis from which they can make informed strategy and investment decisions in the light of increasing competition in the market.

ii) It will also help to identify opportunities derived from implementing JIT practices that enhance acquisition of capabilities that could result in competitive advantage.

iii) The study has also practical significance to the manufactures and distributors in the supply chain. It will lead to improvement of costing and pricing strategies.

iv) The study may be of immediate benefit to customers and society at large from favorable prices and prompt deliveries.

CHAPTER TWO: LITERATURE REVIEW

2.1 ROLE OF PURCHASING AND SUPPLY IN JIT IMPLEMENTATION

The JIT philosophy also extends to adopting JIT purchasing techniques, whereby the delivery of materials immediately proceeds their use. By arranging with suppliers for more frequent deliveries, stock can be cut to a minimum. Requiring suppliers to inspect materials before their delivery and guaranteeing their quality can obtain considerable savings in material handling expenses. This improved service is obtained by giving more business to fewer suppliers and placing longer-term purchasing orders (Baily et al, 1998).

According to Dobler & Burt (1996) purchasing and supply plays a key role in any JIT operation. Whether a JIT production system works or not depends on how well purchasing does its job in selecting and managing suppliers. Obviously, it is not practical to procure all materials on a JIT basis. Most successful JIT firms buy from 5 to 10 percent of their individual materials-those that account for 60 to 75 percent of the firm's materials expenditures and those that are space – intensive – in a JIT mode. This keeps the administrative parts of the job manageable. As noted earlier, the basic objective of the 'partnering' relationship is to reduce costs, improve efficiency, and increase profitability for both organizations. The development of scheduling guidelines and parameters, the implementation of SPC quality systems, and the conduct of value analysis work on the purchased items must be done jointly in a team – type environment. To assist in all of these activities, the buyer often makes greater use of performance specifications to encourage the supplier to exercise as much creativity possible.

Reducing the delivering carrier's transportation time is also an important objective. Consequently, supplier's location near the buyer's operation offers a distinct advantage. The most important strategy in this element of the equation, however, is to work out a longer-term contractual JIT arrangement with a small number of selected carriers. This type of transportation service can be purchased in the same manner material is purchased from a JIT supplier.

A final impact of JIT is seen in the form of a shift in the workload within the purchasing and supply department. The buyer's job now involves the responsibility for contract administration and supplier management than obviously the tight delivery schedules, the emphasis on control of quality performance, and the joint resolution of problems with supplier requirement. At the same time, the nature of the JIT buying operation now requires less time, nitty-gritty buying work. In effect, the JIT buyer's job tends to require broader range of professional and managerial skills than typically was previously. Dobler & Burt (1996) notes that, the very nature of JIT purchasing operation requires and usually creates, a closer, more co-operative relationship between buying and supplying firms. Hence, from a practical point of view, a reduced supplier base is a necessity and a long-term contract is the primary incentive that attracts a supplier to consider the arrangement. Only with the knowledge of the buyer's long-term requirement schedule can a supplier schedule production and size inventories so that replenishment lead time can be reduced while simultaneously providing both flexible and reliable service.

Naylor (1996) indicates that, quality control, delivery scheduling and inventory levels should be spelled out clearly in the terms. An explicit written notice should be given to the supplier and the supplier should be given a reasonable period of time to gear up to meet the new delivery requirements.

Chase et al (1999) postulated that, JIT manufacturing requires dependable sources of defect-free materials, which arrive within a very tight time frame.

Suppliers of JIT customers meet their requirements in three ways: They are locating closer to their customer. Suppliers are implementing responsive manufacturing systems. They are taking aggressive action to control the transportation of their materials to their customers.

2.2 JIT RELATIONSHIP WITH SUPPLY CHAIN MANAGEMENT

A study of just- in- time concepts cannot be complete without mentioning the term supply 'chain management'. A supply chain is a network that includes vendors of raw materials, plants that transform those materials into useful products, and distribution centres to get those products and services to customers. Without any specific effort to coordinate the overall supply chain system, each organization in the network has its own agenda and operates independently from the others. However, such an unmanaged network results in inefficiencies. For example, a plant may have the goal of maximizing throughput in order to lower unit costs. If the end demand seen by the distribution system does not consume this throughput, there will be an accumulation of inventory. Clearly, there is much to be gained by managing the supply chain network to improve its performance and efficiency (Baily et al, 1998).

2.2.1 Decision Variables in Supply Chain Management

In managing the supply chain, the following are decision variables: Location - of facilities and sourcing points,Production - what to produce in which facilities,Inventory - how much to order, when to order, and safety stocks,Transportation - mode of transport, shipment size, routing, and scheduling (Christopher, 2005).

2.2.2 The Bullwhip Effect

A problem frequently observed in unmanaged supply chains is the bullwhip effect. This effect is an oscillation in the supply chain caused by demand variability. This problem must be addressed in order to avoid the poorer

service and higher costs that stem from it. An unmanaged supply chain is not inherently stable. Demand variability increase as one move up the supply chain away from the retail customer, and small changes in consumer demand can result in large variations in orders placed upstream. Eventually, the network can oscillate in very large swings as each organization in the supply chain seeks to solve the problem from its own perspective. This phenomenon has been observed across most industries, resulting in increased cost and poorer service (Hau et al, 1997).

2.2.3 Causes of the Bullwhip Effect

Sources of variability can be demand variability, quality problems, strikes, and plant fires. Variability coupled with time delays in the transmission of information up the supply chain and time delays in manufacturing and shipping goods down the supply chain create the bullwhip effect. The following can contribute to the bullwhip effect: Overreaction to backlogs, neglecting to order in an attempt to reduce inventory, no communication up and down the supply chain, no co-ordination up and down the supply chain, delay times for information and material flow, Order batching - larger orders result in more variance. Order batching occur in an effort to reduce ordering costs, to take advantage of transportation economics such as full truck load economies, and to benefit from sales incentives, promotions often result in forward buying to benefit more from the lower prices, Shortage gaming: customers order more than they need during a period of short supply hoping that the partial shipments they receive will be sufficient, demand forecast inaccuracies: everybody in the chain adds a certain percentage to the demand estimates. The result is no visibility of true customer demand (Charles et al, 2003).

2.2.4 Supply Chain Structure

The performance of a supply chain is measured in terms of profit, average product fill rate, response time, and capacity utilization. Profit projections may improve if another parameter is relaxed, but one must consider the impact of

all aspects of the relaxed parameter on profits. For example, if customers are lost because response time is too slow, then the profit projections may be artificially high. Average fill rate can be improved by carrying more inventory in order to reduce stock-outs. The optimal balance must be achieved between inventory cost and lost profits due to stock-outs. Response time often can be improved at the expense of higher overall costs. As with fill rate, the optimal trade-off should be found. If response time is sacrificed in order to achieve higher profits, sales forecasts may have to be modified if the elasticity of demand with respect to service is significant at the chosen service levels.

Capacity utilization should be high enough to reduce overhead sufficiently, but not so high that there is no room to grow or to handle fluctuations in demand. Problems often are encountered when capacity utilization exceeds 85%. Lower capacity utilization in effect buys an option for increased output in the future. Higher capacity utilization decreases downside risk since costs are reduced, but also limits the upside gains if future demand should outstrip supply (Chopra and Meindl, 2005).

2.2.5 JIT enablers; (MRP, MRPII, ERP AND EDI)

Many companies have moved from functional mainframe legacy systems to cross-functional client/server network applications. This typically has involved installing Enterprise Resource planning (ERP) or Supply Chain Management (SCM) software. Instead of focusing on information processing requirements of business functions, ERP software focuses on supporting the supply chain processes involved in the operations of a business (O'Brien, 2001).

Jessop & Morrison (1996) highlights that, Material requirements planning (MRP) system monitor stocks and automatically generate order proposals for purchasing and production. They also give a higher version of MRP referred to as MRPII (Manufacturing Resource Planning Systems), which combine production forecasting, production scheduling, material requirement planning, capacity planning, production cost control and quality control.

Companies worldwide are also making use of Electronic Data Interchange (EDI) systems that link the computers of a company with those of its suppliers and customers for the electronic exchange of business documents. Data representing a variety of business transaction documents (such as purchase orders, invoices, requests for quotations and shipping notices) are electronically exchanged between computers using standard documents message formats. Electronic commerce like EDI, MRP, MRP11, ERP and other supply chain and financial systems and databases, seek to reengineer and streamline traditional supply chain processes thus supporting just-in-time (JIT) inventory policies and reduction of inventory levels (O'Brien, 2001).

2.3 PURPOSE OF IMPLEMENTING JIT IN ORGANIZATION

According to Naylor (1996), the basic purpose behind JIT is to minimize stocks of work in progress and to keep all materials in motion through the production system. This means that firms must be able to: Supply goods just in time for them to be used, create subassemblies just as they are needed in the final assembly shop, make components just in time for fitting to sub-assemblies, receive bought-in items at the time they are needed.

JIT is different from conventional production planning with its push philosophy. JIT pulls work through the system. Having deliveries at least once a day implies small batches and little stock. Yet, in many people's minds, it goes beyond stock minimization to continuous improvement and incorporation into other business functions. To operate flow systems with such little stock implies, for instance, that each item must be of the correct quality, hence Total Quality Management; that machines are highly reliable, hence Total Productive Maintenance; and that all staff are well trained and motivated. In other words, JIT is as much a philosophy of the way the whole business should operate as a technical approach to the problem of scheduling.

2.3.1 Waste elimination

The advantages of JIT come from the elimination of waste at all stages. According to Mondem (1993) waste arises in many ways in the production system:

i) In the process itself: Some processes add no value. Fitting and other adjustments, or removing scale or burrs, are only required because of defects in upstream processes. If a machine cannot produce to defined tolerances, it should be replaced or the tolerances themselves reviewed and the design changed.

ii) Running the process too fast or too early: Overproduction leads to the build up of inventory which not only wastes investment but wastes space and transport resources as the stock often has to be moved several times to keep it out of the way.

iii) Waiting time between processes is wasteful because the inability to deliver quickly loses the firm market opportunities.

iv) Stock: Just-in-Time replaces the idea of 'Just-in-Case'. This meant that inventory was held only because there were problems in the production system. These made it impossible to supply within a period when customers wanted orders.

v) Material movement: The effect of excessive distances between processes is often disguised in a production system. Such movements, and the associated stock that has to be in transit, add no value.

vi) People movement: Excessive movement of people may arise from poor job layouts but also from their having to go and look for materials for the next task. Shops crowded with inventory lengthen this search.

vii) Defects: An example of the interaction between the scheduling and quality systems defects cost more than the value of the lost item. Habitual defects rate mean that schedulers set batch sizes to allow for loss; correction delays waste time; customers become annoyed.

Dobler & Burt (1996) highlighted that although JIT was originally pioneered by Henry Ford, the just-in-time manufacturing concept has been refined and

developed over the past several decades in Japanese industry. The purpose of this recent concerted effort was to improve quality and reduce costs to help Japanese business become more competitive in world markets for selected product lines. The resounding success of the Japanese effort prompted a growing number of U.S firms to develop and implement modified versions of the JIT systems.

2.4 ESSENTIALS FOR JIT OPERATION

It has been found that JIT benefits do not just happen (Prasad,1995; Zhu and Merdith 1995; Kristensen et al, 1999). For an organization to realize the benefit of JIT, it must accept JIT as an organization philosophy. This may require changing or modifying operating procedures, production systems and in most cases changing organizational culture. In many cases, plant layouts have to be adjusted, relation with suppliers and customers have to be modified, quality circles have to be implemented, and accurate demand forecasts have to be achieved and maintained (Bowman, 1991; Cook, 1996; Hobbs, 1997; Storhagen, 1995; Vokurka and Davis,1996).

Several factors that could break or make the JIT implementation process have also been identified. Top management involvement and proper employee training is essential for successful implementation of JIT (Minahan, 1996; Prasad, 1995; Vora and Saraph,1990). The importance of the logistical planning system was stressed as a prerequisite to the successful implementation of JIT by Vickry (1989), Prasad (1995), and Lee (1996). In addition, Billesbach and Schniederjans(1989) and Zhu and Merdith (1995) advocate training administrative as well as production workers to ensure the successful implementation of JIT. Francis (1989) underscored the importance of accurate data, especially, demand forecasts to the successful JIT effort. The literature indicates that JIT does promote the efficient, effective and flexible utilization of productive resources. Its is also believed that strong working relationships with vendors are critically linked to the successful utilization of JIT (Monden, 1981, 1983; Schonberger,

1982, 1986; Black, 1991; Hobbs, 1997; Lee, 1996; Huson and Nanda, 1995;Wafa *et al*, 1996)

Most authors have agreed that successful JIT implementation requires five key elements to be considered (Ramarapu, 1995). Waste reduction: this element is aimed to eliminate all non-value-added tasks (Bowen, 1998). The main problem with traditional production method is due to the focus on producing large number of items. With level of competitiveness and flexibility requirements, this is no longer an appropriate method to be performed. Value-adding production oriented: This element brings the terminology of "pull-system" which allow customer order to trigger the production process. Pull system requires immediate respond in order to satisfy customer requirement therefore avoiding "the goal of producing large batches" (Bowen, 1998). By grouping products based on their production process similarity, manufacturer may also add-value to the products by lessening production complexity, shortening travel and idle time. Customer participation in quality improvement: In every business, customer will have the final say therefore the success of the business can be determined based on customer satisfaction. This element heavily emphasis the needs of customer involvement in product development and delivery (Bowen, 1998). Customer may also be included in development team to direct them to the right manufacturing plan.

Employee empowerment: Empowering employees mean dividing problem solving and decision making responsibilities from management level to its individual team directly related with the task. With careful planning and adequate team work, this element will increase quality, productivity and flexibility of the manufacturing process (Bowen, 1998).Vendor/supplier integration: Undoubtedly, specialised suppliers will normally produce a better product since they can concentrate in a particular thing. By outsourcing to those suppliers, a company will be able to put all its time and resources in its core function which in turn will improve the quality of the final products (Ramarapu, 1995). JIT, in its basic principles, encourages the involvement of

shop floor staff in detailed scheduling and control. This is a move towards decentralisation, although constrained by the strict rules without which JIT would not work. There are moves towards autonomy and pressures for more discipline in the following areas:

i) Discipline - 'the critical essence of a manufacturing company
ii) Flexibility - growth in the long term through training
iii) Equality - removal of divisions
iv) Autonomy - having authority to stop the line, solve problems, control materials
v) Quality of Working Life - developing security and a sense of involvement and enjoyment
vi) Creativity - harnessing the 'natural curiosity of company members to make improvements which affect the work they do.'

Whether these factors can live happily together both defines, and depends upon, the culture of the organisation. Whether this can in turn stand apart from the culture of a nation, either permanently differentiated from it, or as an instrument of change, is a further difficulty.

In summary, the following elements tend to characterize most successful JIT operations (Dobler & Burt ,1996). The JIT concept is most applicable to manufacturing operation that produce a relatively small number of different products in at least a quasi-continuous environment. Product demand must be reasonably predictable, and requirements must be generated accurately. A close loop MRP system can be used to do this, but typically the master production schedule must be smoothed on a daily basis. Statistical process control typical is used in both the buyer's and suppliers' organizations to ensure tight control of material and production quality. This is vital to the functioning of the low-floats, small-volume, relatively smooth-flowing operation. Production operation setup requirements must be able to be reduced to relatively short times. Most firms target for tool changes and equipment setups of less than ten minutes. Without this capacity, small-bath and smooth-flow production of different models or different products cannot

be accomplished efficiently. Purchasing must be able to reduce materials replenishment leads times. This usually is accomplished by reducing the four major elements of lead time; internal paperwork and ordering time, supplier queue and manufacturing time, transportation time requirements, incoming receiving and inspection requirements. Successful JIT operation suppliers must be able to be flexible to meet the buying firm's stringent, short-fused material requirements and must be reliable to the nth degree. A flow diagram of the major production operations in an electronic instrument manufacturing plant, both before and after the firm implements a JIT system (Dobler & Burt,1996) is highlighted in Appendix II.

According to Lyson (1989), for JIT to work, two things must happen: All parts must arrive where they are needed, and in the exact quantity needed; All parts that arrive must be usable parts. Where these are not achieved, JIT may easily become 'just-too-late'. To achieve these requirements, purchasing has the responsibility to: Liais with the design function. The emphasis should be on performance rather than design specifications. Looser specifications enable suppliers to be more cost effective by being more innovative with regard to the quality/function aspect of supplies. In JIT purchasing value analysis is an integral part of the system and should include suppliers.Liais with suppliers to ensure that they understand thoroughly the importance of consistently maintaining lead times and a high level of quality.Investigate the potential of suppliers with reasonable proximity to the purchaser to increase certainty of delivery and reduction of lead time.Establish strong, longterm relationships with suppliers in a mutual effort to reduce costs and share savings. Establish an effective supplier certification programme which ensures that quality specifications are met before components leave the supplier so that receiving inspections are eliminated. Evaluate supplier performance and the solving of difficulties as an exercise in cooperation.

2.5 BENEFITS OF IMPLEMENTING JIT IN ORGANIZATIONS.

Research has shown that a JIT organizational strategic philosophy has the potential of increasing organizational efficiency and effectiveness (Vokurka and Davis,1996; Klein and Devens,1999). Specifically, the following potential benefits of JIT are cited in the literature. First, JIT tends to eliminate waste in production and material (Tesfay, 1990). Second, JIT improves communication internally (within the organization) and externally (between the organization and its customers and vendors) (Inman and Merhra,1990). Third, JIT has the potential of reducing purchasing costs which is a major cost to most organization (Ansari and Modarress, 1990; Gargeya and Thompson,1994). Fourth, JIT is instrumental in reducing lead-time, decreasing throughput time, improving production quality, increasing productivity and enhancing customer responsiveness (Green et al 1991; Crawford and Cox, 1991;Arogyaswamy and Simmons, 1991; Cook, 1996). Fifth, JIT tend to foster organizational discipline and managerial involvement (Ptak, 1991; Bolander *et al,* 1999). Last but not least, JIT tend to integrate the different functional area of the organization. It especially tends to bridge the gap between production and accounting (Sand well and Molyneux, 1989; Johansson, 1990; Bhimani and Bromwich, 1991; Green et al, 1991).

The potential benefits of JIT to an organization, and its purchasing function in particular, have been summarised by (Schonberger, 1986) as follows:
Part costs - low scrap costs; low inventory carrying costs.Quality - fast detection and correction of unsatisfactory quality and ultimately higher quality in purchased parts. Design - fast response to engineering change requirements. Administrative efficiency - fewer supplier; minimal expediting and order release work; simplified communications and receiving activities. Productivity - reduced rework; reduced inspection; reduced parts related delays. Capital requirements - reduced inventories of purchased parts, raw materials, work-in-progress and finished goods. Acording to Drury (2000) Companies that have implemented JIT purchasing techniques claim to have substantially reduced their investment in raw materials and work in progress stocks. Other advantages include a substantial saving in factory space, large

quantity discounts, savings in time from negotiating with fewer suppliers and a reduction in paperwork arising from issuing blanket long-term orders to a few suppliers rather than individual purchase orders to many suppliers.

2.6 JIT COMPONENTS.

Some JIT components logically presuppose the implementation of other components for their successful operation. This section describes the big picture of a JIT system by setting out the network of dependencies among JIT components that must be considered in JIT implementation. The dependencies as summarized in table 2.1 can be described by picking smooth production as the starting point since it is the primary goal. Smooth production means finished products are produced in a continuous flow at customer demand rate with minimum resources and material. To achieve this, a company must implement production leveling and a pull system. Both of these need a small-lot production system. In addition, the pull system requires good housekeeping, while production leveling requires a stable demand from customers and a line balancing process. Small lot production calls for Total Quality Control (TQC) to ensure that every component involved in production is in good condition. Reduced setup time and total preventive maintenance must be applied to all machinery and equipment. In addition, small lot production needs supplier cooperation to realise JIT purchasing. Line balancing requires flexible manufacturing, which consists of standard operations, group technology and a flexible workforce. Besides these elements, JIT demands commitment from all employees to improve the system in Small Group Improvement Activities (SGIA). SGIA is employed to increase quality, improve the production line, and achieve smaller lot size production by reducing setup time and by effective maintenance (Niko et al, 1997).

Table 2.1: JIT Components. Source: Niko et al, (1997)

JIT Components	Definition
Production Levelling	To produce the same quantity and mix of items every day
Pull System	Materials are drawn by the users from the "downstream" stage as needed
Good Housekeeping	Workers are encouraged to keep their own work spaces tidy
Small Lot Production	To produce in small batches and to reduce buffer
Setup Time Reduction	To eliminate external setup times and to reduce internal setup times
Total Preventive Maintenance (TPM)	To avoid any breakdown from the outset by maintaining the machinery
Total Quality Control (TQC)	To make the output right the first time by employing quality at source, line stop and foolproof devices.
JIT Purchasing	Comprises of JIT deliveries, information sharing, quality at the suppliers and long-term partnerships.
Line Balancing	To adjust the output of a series of cells to the same rate.
Flexible Manufacturing	Facilities and workforce can be rearranged according to customer demand. It comprises Standard Operations, Group Technology and Flexible Workforce.
Small Group Improvement Activities (SGIA)	To empower employees to improve the operations.

Source: Niko et al, (1997)

Suzaki, (1987) highlights the following components of JIT: Continuous improvement, attacking fundamental problems, devising systems to identify problems, striving for simplicity- simpler systems may be easier to understand, to manage and is less likely to go wrong, a product oriented layout, quality control at source, poka yoke –prevent mistakes, preventive maintenance, eliminate waste, set up time reduction, good house keeping, mixed production, Kanbans – simple tools to "pull" products and components through the factory, Jidoka –providing the machines with autonomous capability to use judgment so that workers can do more useful things, and Andon (trouble lights) to signal problems to initiate corrective action.

2.7 HOW TO ACCOMPLISH JIT PRODUCTION

According to Chase et al (1999), JIT production can be accomplished by: Design flow process, Link operation, Balance workstation capacities, Relay out for flow, Emphasize preventive maintenance, and reduction of lot sizes. Plant layout should be designed to ensure balance workflow with a minimum of work-in-process (WIP). Preventive maintenance is meant to ensure that the workflow is not interrupted. The ultimate goal of JIT is to achieve economic lot size of one. Stephen (2001) also notes that work-in-process inventory is reduced to a bare minimum. The amount of WIP inventory allowed is a measure of how tightly the JIT system is tuned. The less WIP designed in the system, the better balanced the various steps in the process need to be.

JIT approach requires a serious commitment from the Top Management and workers alike. Workers need to maintain an awareness of their systems, products, and need to be empowered to stop the flow of production if they see something wrong. Total quality control refers to the "building in" quality and not "inspecting it in". James (1992) adds that high quality is required for JIT to work well. It is possible to have high quality without JIT but it is difficult to have JIT without high quality. JIT methods help a firm maintain good quality levels. With low WIP inventory, items flow to subsequent operations more quickly so defective items will be discovered at subsequent work stations soon and the process will be stopped and corrected before many defectives items have been produced.

A level schedule is one that requires to be pulled into final assembly in pattern uniform enough to allow the various elements of production to respond to pull signals. It does not necessarily mean that the usage of every part on an assembly line is identical hour by hour for days on end.

There is an indication of need for more parts. Back flush is a term used to designate how component parts are accounted for in a pull system.
Steven (2001) notes that, JIT is a pull system. Production at each stage is initiated only when requested. The flow of information in a JIT system

proceeds sequentially from level to level. This will mean making the frequent requisitions that meet the quality expectations. The benefits of JIT extend beyond savings of inventory related costs. Plants can be run efficiently without the clutter of inventory of raw materials and partially finished goods clogging the system.

2.8 HOW JIT THEMES FIT THE SERVICE SECTOR

According to Cheng (1993), the JIT approach requires a good deal of cooperation, planning and strategy. As stipulated in the background, when JIT is used in the context of services, the focus is mainly on the time needed to deliver the service. Service environments with repetitive operations, with high volumes and tangible items are expected to benefit more from application of JIT principles (Fitzsimmons & Fitzsimmons, 2001).

Services are much like manufacturing, in the sense that both employ processes that add value to the basic inputs used to create the final product. JIT focuses on the process, not the product. It can therefore be applied (in theory) to any group of processes, whether manufacturing or service. The philosophy behind JIT is to continuously seek ways to make processes more efficient. The ultimate goal of JIT is to produce a good or a service without waste. This goal is approached by testing each step in a process to determine if it adds value to the product or service. If the step does not add value, then it is examined closely to determine possible alternatives. It helps make, each process gradually and continually improve. Thus, one of the key requirements of JIT is the constant and continual testing of processes, whether they are in manufacturing or in services (Fitzsimmons & Fitzsimmons, 2001).

The service sector has demonstrated a remarkable capacity to improve productivity. As regards services, the greatest productivity gains will come from defining the critical or value-added service activities and eliminating what does not need to be done. The definitions and descriptions found in the literature for the term "service operations" are somewhat ambiguous. Typically, it is actually easier to describe service operations by what they are

not. For instance, Lovelock (1984) defines services as "all those economic activities in which the primary output is neither a product nor a construction". This definition may appear to be straightforward, however it is not particularly helpful when one attempts to classify a restaurant or a company such as IBM, for that matter. IBM manufactures equipment but also provides customer service, education, maintenance, etc. We think about service in humanistic terms; we think about manufacturing in technocratic terms. That is the reason why manufacturing industries are considered to be progressive and efficient while service industries are, by comparison, primitive and inefficient.

Lovelock (1984), postulates that any discussion of service systems must look at how they differ from manufacturing systems as follows:

i) Inseparability of production and consumption: This involves the simultaneous production and consumption, which characterizes many services. Simultaneous production and consumption also eliminates many opportunities for quality control intervention. Unlike manufacturing, where the product can be inspected before delivery, services must rely on a sequence of measures in order to ensure the consistency of output. This emphasizes the importance of process control in services even more so than in manufacturing, since services at times do not deal with a physical product to inspect.

ii) Intangibility: Because services are performances, ideas or concepts, rather than tangible objects, they often cannot be seen, felt, etc., in the same manner in which goods can be sensed. When buying a product, the consumer may be able to see, feel and test its performance before purchase. With services, the consumer must often rely on the reputation of the service firm. These less measurable considerations have the potential to greatly influence consumers' perceptions and expectations of quality.

iii) Perishability: This refers to the concept that a service cannot be saved or inventoried. The inability to store services is a critical feature of most service operations. Vacant hotel rooms, empty airline seats and

unfilled appointment times for a doctor are all examples of opportunity losses. Perishability leads to the problem of synchronizing supply and demand, potentially causing customers to wait or not to be served at all.

It is readily apparent that there are many potential differences between manufacturing and service operations. Until recently, services have been sheltered from competition and have had little incentive to drive out inefficiency. Service companies should not make the same mistakes as their manufacturing counterparts did: cutting costs at the expense of securing enduring competitive strength. Overzealous cost-cutting may make the companies more efficient over the short run, but unable to motivate, respond to customers or provide quality services over the long run.

Service systems design is similar to that of manufacturing, which indicates that service industries could benefit from the application of materials requirements planning (MRP) and other inventory control techniques in the same way as have manufacturing operations. Manufacturing and service organizations both produce a product, whether that product is a good or a service. The JIT concepts and techniques are equally applicable to both manufacturing and service operations because they are process rather than product-oriented (Fitzsimmons & Fitzsimmons, 2001).

Applying JIT to the Service Industry involves: Synchronization, balance of information and workflow, total visibility, continuous improvement of the process, holistic approach to waste elimination, flexibility in the use of resources and respect for people.

It is important to integrate these basic themes with the main characteristics of the service industry in order to have a complete view and approach to JIT. Visibility; With a simultaneous offering of marketing and operations functions in services, the customer is very well aware of not only the tangible aspects of the service, but also of the service delivery system. Customers often notice

variance in the system and this may affect the perceived level of quality. Synchronization; this is critical for services. Service organizations must be able to successfully balance supply and demand for the service otherwise, customers will use a competitor's service.

Flexibility: The customer being part of the process, service operations must be able to respond to sudden demand changes made on them by the customers. The service firm must adjust to these demands by being flexible in staffing, scheduling and production. Continuous improvement; this is of the utmost importance in order to achieve continued profitability and success. In addition, service organizations operate with a wide variety of personnel that may be totally interchangeable at any time. Thus, they must strive to improve all employees and systems throughout the lifetime of the company. As regards services, the emphasis should be placed on labour and processes rather than capital.

Holistic approach: JIT is a total organizational approach to improvement and waste elimination, a factor that becomes even more important in services because of the issue of inseparability. The more each employee knows and understands the company as a whole, the less variance in the service delivery there will be. Respect for people; Due to the labour-intensive nature of services and the need for employee scheduling to provide services, each worker should be allowed to participate in the production/service process. Thus, the worker will get a chance to make suggestions, suggest improvements and receive awards.

As stated by (Lovelock, 1984), the following activities would most likely demonstrate the greatest potential for improving performance in services and achieving a successful implementation of the JIT themes stated earlier: Training of employees; as expectations from the customers of service business increase, companies have started to value investments in people as much as investments in machines. Companies need to make recruitment and training as important for service employees as for managers. Service employees who are well trained and fairly compensated provide better

service, need less supervision and are much more likely to stay on the job. Training provides service employees the ability to identify and resolve problems and operational weaknesses hindering organizational effectiveness and efficiency. Training service employees to perform a variety of service activities will also provide an organization with a great deal of flexibility. Proper training and empowerment will allow the staff members to resolve any perceived conflicts before they become a negative service encounter for the customer.

Technology: the advances in technology should be used to support the service employees' activities, not to monitor or replace them. Because customers participate directly in some service processes, the success of technological innovations will depend to some extent on customer acceptance. To enhance productivity of various services, the customer is able to interact directly with the system without the intervention of an employee.

Layout: service employees whose tasks are interrelated should be physically close together, thus creating better information flows and reducing throughput time. Layout changes should be allowed in order to improve operations. Service companies must strive to remove communication barriers and facilitate effective communication by proper layouts. If physical proximity cannot be achieved, then effective communication means must be developed. Bottlenecks during service delivery can be devastating to the quality and success of a service firm.

Quality: One of the basic requirements for a successful implementation of JIT is the existence of total quality management (TQM) principles. Employees must perform their tasks correctly the first time, which requires adequate education of employees as to the proper way to perform their tasks. The use of the "quality circle" concept can be helpful in service companies. The employees' ideas for improving the quality of services and increasing the satisfaction of customers should be carefully analyzed and implemented.

Standardization: the emphasis on the standardization of activities arises from balancing between processes, which is expected to improve operational effectiveness and efficiency. By standardizing job activities, resources can be focused on only a few areas. The resulting impact on productivity can be significantly higher if one standardizes activities and concentrates organizational efforts and resources on those limited activities. Standardization of activities also reduces the time and cost of cross-training employees, but the flexibility has to be maintained in order to serve those customers with different needs. Service delivery: one of the desired outcomes of JIT is reduced lead-time for delivering the product or the service. The effort for lead-time reduction begins with order entry and setting due dates. Simplifying the procedures for any other paperwork relating to this transaction will help reduce considerably the order processing time.

The basic philosophy behind JIT in manufacturing and service operations represents a uniquely organized set of activities, which can be utilized to produce both low-cost and high-quality products and services. Global competition is forcing companies to improve the quality of their products and their customer service while reducing the cost of their operations. This is a key requirement for maintaining competitiveness. It is postulated that the implementation of JIT concepts in the service sector will facilitate the achievement of benefits long-recorded by the manufacturing sector. The philosophy of JIT can bring impressive advances in productivity and quality to the increasingly service-dominated economies of the future (Fitzsimmons & Fitzsimmons, 2001).

2.9 BARRIERS TO JIT IMPLEMENTATION

The JIT production philosophies continued to gain acceptance through the late 1980's and throughout the 1990's. According to a St. Louis logistics consulting firm, in 1990, 18% of all US products were delivered JIT and in 1992, 23% and, at that time, a 39% JIT delivery rate was projected for the year 2000 (Johnson, 1994). Major manufacturers are ahead of this curve;

according to Intel's global customer service manager, 98% of its customers expected JIT treatment, and their tolerances have progressively tightened (Wise, 1990).

Concurrently, however, just-in-time is now being seriously questioned or even reversed by academics and by other practitioners. The slow demand and simultaneous surge in inventories during the second quarter of 1994 was interpreted by the *Wall Street Journal* as an end to the "wishful nature" of the JIT theory of production management, rather than the traditional view of reactive response to slowing sales (Norris, 1994). Ranaganath Nayak, head of global operations management services at Arthur D Little, finds "paltry gains" amidst the $950 billion of capital and training expenditures by US manufacturers to mimic Japanese concepts such as JIT.

Naj (1993); Karmarkar (1989), at UCLA's Anderson School, suggests that JIT practitioners during the late 1980's "just didn't know when to stop." Both Shapiro (Bleakley, 1994) at Harvard Business School and Cusumano (1994) at MIT's Sloan School of Management note the irony of Japanese managers and policy makers now recognizing that continuous improvement and just-in-time are encountering a new set of problems in the present global environment and that these concepts have real practical limits. So, while much has been written to applaud the merits of just-in-time philosophies, there seems to be sufficient cause to research, identify and validate legitimate reservations regarding the just-in-time philosophies as well.

i) External Obstacles

Just-in-time faces difficulties under certain economic environments. Both Karmarkar (1989) and Aggarwal (1985) identify that just-in-time systems cannot cope with increasing rates in demand. JIT assumes the production rate at final assembly is even; Aggarwal (1985) specifies that a JIT master production schedule cannot tolerate load fluctuations of more than 10% and that it breaks down under larger deviations from average conditions. Economists such as Maury Harris, who heads PaineWebber's economics

unit, speaks for many in stating that for this reason, JIT may not be fully appropriate for management in all economic environments (Bleakley, 1994).

JIT is also credited with motivating inflationary behaviors. According to Norris (1994), just-in-time assumes that additional inventory is always available for quick delivery at the same price as old inventories, and that the fourth quarter 1993 upturn served as a counterexample to this assumption. Shortages in certain commodities and a spectrum of consumer products motivated supply-based price hikes negatively impacting JIT companies; inflation in that quarter doubled from the prior quarter. Some economists had argued that JIT would tame the amplification of the business cycle effected by the reactionary moves in inventories; the argument was not borne out during the 1990-1991 recessionary period, with firms cutting their inventories to near the average of past recessions (*The Economist*, 1993). Higher costs for capital in that period further detracted from JIT practices. Japanese new product development was traditionally headed by empowered project managers who expedited NPDs from start to finish in JIT fashion; such development was constrained by a lack of ready capital and Japanese executives exerted higher controls on the process (Cusumano, 1994).

The current marketplace dictates ever-higher levels of customer responsiveness and mass customization, demands not generally tolerated under JIT. Despite reduction of setups, Japanese managers are finding that ever-increasing levels of product variety is pushing kanban towards a practical limit (Cusumano, 1994). The implementation of just-in-time tends to be a pull system which does not anticipate customer demand; in the words of Karmarkar (1989), JIT doesn't plan well. Karmarkar (1989) suggests that in a highly variable environment, JIT is even less likely than a planning system, eg, MRP, to operate in a stockless manner. GE Appliances, finding that low inventories of some critical parts prevented it from responding to customer demands quickly, recently increased long lead-time inventories by 25%; management believes that the benefits of higher cycle times greatly outweigh the incremental inventory costs (Naj, 1993). Bollinger Industries, a sports and

fitness equipment manufacturer, after its successful just-in-time implementation, recently reverted to an increase of 30% in certain finished goods inventories after experiencing the inflexibility of JIT to customer demand (Bleakley, 1994).

ii) Global and Logistical Issues

As could be expected, serious logistical issues impede the success of just-in-time. The brief 1992 railroad strike is often cited as a major example of the most obvious inherent risk within JIT (Seideman, 1992). General Motors was forced to shut down certain factories involving 75,000 workers on the first day of the strike, and would have experienced a total shutdown without immediate resolution; as a practical matter, some safety stock is required even in the purest of JIT environments.

In its initial implementation of JIT, Japanese managers did not have to seriously consider logistical issues in its localized, non-industrial state (Cusumano, 1994). US manufacturers, however, generally contend with much greater distances, and so enter the JIT philosophy with disadvantage. Japan, however, are now experiencing the opposing geographical obstacle to JIT. Nissan began to experience difficulties with JIT deliveries in congested, urban areas as early as the 1970's when they adopted the Toyota style, difficulties not then experienced by suppliers enjoying the proximities of Toyoda City. In recent years, increasing congestion effected by rising rates of JIT deliveries forced the Japanese government to launch a media campaign encouraging companies to actually reduce the frequency of their material deliveries (Cusumano, 1994).

In theory, traditionally underestimated inventory carry costs heavily outweigh the increase in transportation costs, however many suppliers claim the opposite (Bleakley, 1994; Wise, 1989). For example, the apparel industry, due to its trendy nature, already practiced a high level of delivery delay. Further tightened delivery schedules under just-in-time are forcing a dramatic change in practice; air shipments, and their incremental costs, are becoming

standard operating procedure, and some in the industry believe the change to be sub-optimal (Armbruster, 1992). Newman (1993), economist and senior staff member of the Conference Board, notes that increments in transportation costs are not linear, that such costs rise sharply at the delineations such as truckload/less-than-truckload and rail/truck that JIT may require. Manufacturers forced under cost competition to choose between such higher transportation and inventory costs are frequently opting for the latter (Bleakley, 1994; Wise, 1989).

Logistical issues are further complicated by the new global marketplace. According to Cusumano (1994) "the days when even Toyota can operate in a highly predictable and geographically small area within Japan are now over". Global sourcing affects longer pipelines and so, even under JIT tenets, forces higher inventories; one GE manager suggests a minimum of four to six weeks of incremental pipeline inventory when sourcing from South America, Europe, or Africa for US manufacture (McClenahen, 1990).

The global market places other constraints on just-in-time practice. It means a greater sum risk of political or natural disaster (McClenahen, 1990), and may require significant financial and human resource commitment from the manufacturer to the supplier to establish a partnership strong enough to tolerate JIT discipline (McClenahen, 1990). Just-in-time requires high raw material quality to avoid stoppages (Wise, 1990), a requirement that can be impacted by global sourcing; one practicing manager advises that even the filtering of the operational definitions of quality through culture and language effects significant rework costs (McClenahen, 1990).

Japanese managers are experiencing cultural barriers to JIT as they globalize operations; e.g., globalization does not automatically export the trust requisite to JIT into foreign suppliers (Cusumano, 1994). Historically, Japanese practitioners of just-in-time relied on well-trained workers capable of broad responsibility to eliminate waste and JIT productivity gains (Aggarwal, 1985; Cusumano, 1994). Recent shortages of Japanese blue-collar labor, an

employment category resisted by Japan's current generation, forced the importation of less-skilled foreign labor, in turn negatively impacting quality and productivity advantages, and requiring inspected-in quality tactics (Cusumano, 1994). In general, the foundational culture on which Japanese production methods rely does not translate well; consider the difficulty Toyota managers encountered in persuading adoption of their traditional familial references, ie, where direct laborers are referred to as "children" of the company.

iii) Behavioral Constraints

Prerequisite to the success of just-in-time is adequate human capital. Just-in-time assumes employees are motivated and perform at best when entrusted with increasing responsibility and authority; ie, JIT generally requires implementation of the Theory Z organization (Keys, 1991). Theory Z, developed during the early 1980's by William Ouchi, a professor at UCLA's Anderson School of Management, advocates an organization where workers are involved in all aspects of the decision-making processes versus McGregor's delineation, generally known as Theory X and Theory Y. The ideal goals of JIT are impractical under the wasteful, lazy, unmotivated worker under Theory X; Theory Y workers are motivated to reach only achievable goals. Further, Theories X and Y focus on managerial solutions to the associated problems; only Theory Z focuses on labor-oriented solutions (Keys, 1991).

Consider Allen-Edmonds, a high-end shoe manufacturer, which took a 1990 write-off of $1,000,000 to abandon its unsuccessful JIT implementation, crediting much of the failure to its hasty decision to substitute hourly wages for piecework (Marsh, 1993). Management believed that the move was necessary to create a JIT culture by abandoning a local, quantity focus, and creating a global, quality focus. Productivity subsequently declined and peers adopted adversarial roles; these workers needed the structure and discipline that piecework system imposed and the assumption of Theory Z apparently unwarranted. The key JIT requirement for a multi-skilled, educated, and

trained workforce was constrained; highly skilled labor was neither substitutable nor trainable. JIT may require other undesirable hire/fire decisions; the president of a company with a highly successful implementation recommends replacing expediters with engineers capable of the demands of JIT decisions.

iv) Intractable Accounting Systems

Traditional accounting and financial measures generally tend to defeat just-in-time objectives. Goldratt & Fox (1986) provides an intuitive example in *The Race*; as diminishing static returns are reflected by standard cost accounting, it will eventually reject a capital expenditure to implement perpetual zero inventory (Zangwill, 1992). Cost accounting identifies variances for managerial inspection, but does not attempt to identify causal factors (Wise, 1990) nor communicate them in a worker orientation, both key JIT tenets. Such measures are cycled monthly or quarterly; however, quicker feedback loops, eg, hourly or daily are far more supportive of just-in-time (Keys, 1991; Wise, 1990).

Standard costs and allocations are usually based on direct labor costs, a measure of individual efficiency that defeats the teamwork orientation of JIT. Traditional measures also ignore the time utility that is central to just-in-time philosophy (Wise, 1994). Measures of efficiency continue to drive US companies to schedule and attempt to run at full capacity, as opposed to Japanese companies that routinely schedule excess capacity to address the difficulties of continual improvement, e.g., line stoppages (Keys, 1991).

The short term focus of financial measures such as ROI often deter executive commitment to the longer term goals of JIT. According to Aggarwal (1985), kanban systems take at least two years to be considered operational, and do not normally achieve optimum results until five to ten years. The early commitments to JIT have negative impact on short-term results, so its abandonment is encouraged in potential takeover scenarios, external pressures for immediate performance, under increasing training costs, etc.

(Keys, 1991). Successful JIT implementers often report no less than a total abandonment of standard cost accounting, a dramatic move considered infeasible by many companies, setting the stage for resistance within the accounting units (Wise, 1990).

Drury (2000) points out that modern management accounting systems are now placing greater emphasis on providing information on supplier reliability, set-up times, throughput cycle times, percentage of deliveries that are on time and defect rates. All these measures are critical to supporting a just-in-time manufacturing philosophy.

v) Small Supplier Difficulties

Small supplier companies report tremendous difficulties and resistance to JIT. A survey of such suppliers says that only half believe they can ever hope to take advantage of the efficiencies attributed to just-in-time (Sheridan, 1989). Small companies cannot reap the same scale of benefits from JIT since they lack the economies of scale that their high volume, repetitive manufacturing customers possess (Sheridan, 1989). They are forced to purchase in much smaller quantities, and hold far less influence over their suppliers to reciprocate just-in-time policies, and so view themselves as the "whipping boys (Sheridan, 1989)" for JIT. In the case of Allen-Edmonds, its hide supplier refused to cooperate with JIT efforts, requiring the company to tolerate $1,000,000 of raw material inventory (Marsh, 1993).

These small suppliers are often forced into JIT policies and higher costs at the behest of the major accounts (Inman and Mehra, 1990; Sheridan, 1989). John Cassidy, director of research at United Technologies, says that to implement JIT, manufacturers focused on material handling aspects and forced suppliers to take extraordinary measures, rather than examining their own manufacturing processes (Naj, 1993). Historical sales-to-inventory ratios clearly bear out that, during the late 1980's, JIT manufacturers have essentially transferred inventories to suppliers through purchasing power and to retailers encouraged by quantity discounts (*The Economist*, 1991;

Sheridan, 1989). Over a third of small JIT suppliers must tolerate higher FGI, and 40% report higher WIP and higher raw material inventories (Sheridan, 1989). In addition, three quarters report some increase in both transportation and manufacturing costs (Sheridan, 1989).

Further, JIT, by nature, pushes quality upstream, an especially attractive option in scenarios where such costs are high, according to Kwok Lau, purchasing manager for Apple in Fremont, California (Wise, 1990). Suppliers also report JIT adds to cost of paperwork and packaging (Wise, 1990), requiring further pricing adjustments. Newman (1993) questions the higher costs associated with the trend to satellite plants. Small suppliers lacking the financial strength to endure such constraints (Inman and Mehra, 1990) are also the suppliers least capable of affording the external talent that successful JIT implementation requires (Inman and Mehra, 1990), nor can they provide such support to their suppliers. In contrast, Jacobs Brake's recent successful JIT implementation was accomplished with the help of Arthur Andersen (Sheridan, 1989).In sum, such arguments suggest that JIT actually raises global product costs. According to Newman (1993), some suppliers charge a 5% premium for JIT (an inventory carry cost by any other name) and argues such a premium charges the purchaser $2 for every $1 saved by JIT. Other suppliers endure the costs if possible, avoiding the risk of lost business.

CHAPTER THREE: METHODOLOGY

3.1 RESEARCH DESIGN

This study was a cross-sectional survey that explored just-in-time practices in companies listed at the Nairobi Stock Exchange (NSE). The responses from the questionnaires were analysed and explanations of the research questions derived from them.

3.2 POPULATION

The population of the study was firms listed at the Nairobi Stock Exchange as at 30th August 2005. The firms listed at the Nairobi Stock Exchange total to 48 firms (see appendix iv for the list). These firms were spread out in Nairobi, Thika, Mombasa, Mumias, and Kericho. The firms were drawn from five segments viz: Agricultural, Commercial & Services, Finance & Investment, Industrial & Allied and Alternative Investment Market Segment. The study was a census of the 48 firms listed at the Nairobi Stock Exchange as at 30th August 2005. Sampling was not necessary.

3.3 DATA COLLECTION METHODS AND INSTRUMENTS

The study made use of primary data collected through a questionnaire (appendix I), with both open and closed ended questions. The closed-ended questions enabled the collection of quantitative data for analysis using a likert-scale; while the open-ended questions enabled the researcher collect qualitative data on the respondent's view of just-in-time systems in organisations in Kenya.The questionnaire was self-administered. Eight-page questionnaire for a cross-sectional field survey was designed after reviewing the JIT literature and related empirical survey studies conducted in Kenya and other countries. The questionnaire comprised two parts; Part I

Was designed to collect data which describe company profile and Part II was designed to gather data pertaining to JIT implementation experiences in firms listed at the Nairobi Stock exchange. A 5-point likert scale was used to determine reasons for JIT implementation, benefits of JIT implementation, barriers to JIT implementation and future plans for successful implementation of JIT.

The questionnaires were administered to individuals who were reasonably assumed to be subject matter experts in Just-in-time practices specifically operations managers, procurement managers and their equivalent who were best placed to provide details regarding the operations of the companies. A majority of the firms in the proposed population were in Nairobi. Others were spread out in Mumias, Mombasa, Thika, Kericho and Athi River. The "drop and pick later" method backed by telephone follow up was used for these firms. The few firms in Mumias, Kericho and Mombasa were served by mailing the questionnaire.

3.4 PROPOSED DATA ANALYSIS METHODS

The data collected was edited for accuracy, uniformity, consistency and completeness and arranged to enable coding and tabulation before final analysis. Data was analysed through descriptive statistics that are indications of Just-in-time practices in companies listed at the Nairobi Stock Exchange. The descriptive statistics included use of tables, percentages, proportions and frequency distribution. Frequency distributions and percentages were used to analyse data in Part 1.Mean scores and standard deviations were used to analyse the extend of the use of JIT practices in companies listed at the NSE. Frequency distribution and percentages were also used to measure barriers to JIT implementation.

CHAPTER FOUR: DATA ANALYSIS AND FINDINGS

4.1 INTRODUCTION

As this was primarily an exploratory study, the researcher made no attempt at formally testing any hypothesis. As such, only descriptive statistics were presented throughout. The results were based mainly on the aggregate data obtained from 29 sets of responses. Where relevant within this section, the researcher highlighted the implications from the empirical data with regard to the three research objectives described earlier.

4.2 YEARS OF OPERATION

The years of operation are the number of years the firm has been in operation. Most of the companies surveyed have been in operation for more than 20 years, for example 22 companies (76%) have been in operation for more than 20 years. The oldest company was 130 years in operation while the youngest had operated for 18 years. The mean years of operation for the 29 companies were 50 years. Table 4.1 below shows distribution of companies according to years operation:

Table 4.1 : Year of operation

Years of operation	Frequency	Percentage	Cumulative Percentage
Below 10	0	0	0
10-20	7	24	24
Above 20	22	76	100
Total	29	100	

Source : Research data

4.3 COMPANY OWNERSHIP

Respondents were required to indicate the ownership of their companies from a choice of four alternatives. The purpose of this was to determine if there was any relationship between the ownership of the firm and the extent to which it applied JIT practices. Of the 29 companies, which responded, 24% were owned by locals, 42% were jointly owned by foreigners and locals and 34 % by foreigners only. Table 4.2 below presents the distribution of the companies according to Nationality.

Table 4.2 : Ownership

Ownership	Frequency	Percentage	Cumulative Percentage
Both local & foreign	12	42	42
Foreign	10	34	76
Local	7	24	100
Total	29		

Source : Research Data

4.4 COMPANY CLASSIFICATION

Table 4.3 : Classification of Company

Classification	Frequency	%	Cumulative Percentage
Food,beverage, beer tobacco	5	17	17
Wood, paper printing and publ	1	4	21
Chemicals, petro, rubber & plustics	5	17	38
Non-metalic,minerals except petro	0	0	38
Metals, Machinery & Equipment	6	21	59
Service provider	12	41	100
Total	29	100	

Source : Research Data

The biggest number of respondents was from service industry representing 41% of the respondents. Metals, machinery and equipment represented 21 % while food; beverage, beer and tobacco represented 17%. Chemicals, petrol, rubber and plastics also represented 17% of the respondents. Wood, paper

printing and publication had the smallest representation of 4%. No firm responded from Non-metalic, minerals except petrol sector. Table 4.3 above presents distribution of the companies according to the type of products.

4.5 NUMBER OF PRODUCTS AND PRODUCT MARKET

Majority of firms were producing up to 5 products/services as represented by 48% of the total number of respondents. Of the 29 companies, which respondent, 35% were producing between 6 and 10 products/services while 17% were producing above 10 products/services. Of the 29 firms surveyed, 66% were producing both for the foreign and local market. The rest 34% were producing for the local market alone. Majority of firms producing for the export market had tried to implement JIT practices. Table 4.4 and 4.5 below presents distribution of the companies according to number of products and product market.

Table 4.4 : Range of Products/Services

Ownership	Frequency	Percentage	Cumulative Percentage
1 to 5	14	48	48
6 to 10	10	35	83
Above 10	5	17	100
Total	29	100	

Source : Research Data

Table 4.5 : Product market

Product market	Frequency	Percentage	Cumulative Percentage
Both local & foreign	19	66	66
Foreign	0	0	66
Local	10	34	100
Total	29		

Source : Research Data

4.6 ANNUAL COMPANY TURNOVER

The annual company turnover was measured in million Kenya shillings. Majority of firms surveyed were having an annual turnover of above 1 billion as represented by 52% of the total 29 firms. 35% were having annual turnover of between 501million and 1 Billion, 10% had turnover between 51million and 500 million and the rest (3%) had turnover of up to 50 million. Table 4.6 below presents distribution of the companies according to annual turnover.

Table 4.6 : Annual Turnover

Annual Turnover	Frequency	Percentage	Cumulative Percentage
Up to 50 million	1	3	3
51 to 500 million	3	10	13
501 to 1 billion	10	35	48
Above 1 billion	15	52	100
Total	29	100	

Source : Research Data

4.7 COMPANY MISSION, JIT AWARENESS AND PERCEIVED IMPORTANCE OF JIT.

All the 29 respondents indicated they had a company mission statement. All 29 respondents said they had heard of JIT systems and considered JIT systems as important in enhancing their competitiveness.

4.8 ISO 9001:2000 CERTIFICATION

Of the total 29 firms surveyed 16 of them (55%) were ISO 9001:2000 certified. The rest 13 firms (45%) were not ISO 9001:2000 certified. The main reason for certification among the certified firms was because of the perceived advantage of certification in the global market.

4.9 EXTENT OF JIT IMPLEMENTATION AND USE OF E-PROCUREMENT

Of the 29 firms surveyed only 11 of them (40%) indicated that they had implemented JIT practices. Of the firms, which have implemented JIT

practices, 5 of them (45%) are from the service sector. The rest (55%) were from the manufacturing sector.82% of firms, which have implemented JIT practices, indicated that their organizations have embraced JIT practices for the last 6 years. The entire firms, which have implemented JIT practices, are using e-procurement in sourcing and selling their products/services. Table 4.7 below presents distribution of the companies according to period they have practiced JIT.

Table 4.7 : Period practicing JIT philosophies

Period	Frequency	Percentage	Cumulative Percentage
Below 3 years	3	27	27
3 to 6 years	6	55	82
6 to 10 years	1	9	91
Above 10 years	1	9	100
Total	11	100	

Source : Research Data

4.10 REASONS FOR JIT IMPLEMENTATION

This is where the researcher explicitly designed the study to explore the strategic aspect of JIT by asking the respondents for their degree of agreement to a list of 14 possible reasons for implementing JIT. The respondents were requested to indicate on a likert scale of 1-5 where 5 represented very significant and 1 represented negative significant, the extent to which the reasons for JIT implementation were considered important. Reasons with mean score of above 3.6897 were considered to be very significant (Strongest) while those with mean score of below 3.6897 were considered to be less significant.

A list of these reasons, ranked according to the calculated mean scores, is presented in Table 4.8 below. Reduction of inventory is ranked as the strongest reasons for practicing JIT with a mean score of (4.2069). This represents what is referred to as the fundamental operational motivation for implementing JIT. While reduction in production space and reduction in lead-

time were ranked second and third respectively. As can be seen, the more clearly defined, specific aspects of JIT, namely: Strive for manufacturing excellence, increase in profit margin, Service/product quality improvement and improve worker motivation, are all in the bottom half of the ranking. Table 4.8 below presents reasons for JIT implementation:

Table. 4.8 : Reasons for JIT implementation.

	Mean	Std deviation
Reduce Inventory	4.2069	0.9171
Reduce production/warehouse space	4.0345	0.5482
Reduce lead-time	4.0000	0.7357
Reduce manufacturing costs	3.6897	0.4420
Suit client's JIT implementation	3.3103	0.3743
Improve efficiency of operations	3.1379	0.3605
Increase long term competition	2.8621	0.3605
Regain and maintain market share	2.7931	0.3648
Improve product/service quality	2.7586	0.3675
Improve worker motivation	2.7241	0.3707
Overhaul organisational culture and attitude	2.5517	1.1930
Reduce labor requirement	2.5517	0.9930
Strive for manufacturing excellence	2.2759	0.8508
Increase profit margin	2.2759	1.0504

Source: Research data

Even though the table shows that reduction in inventory is ranked highest among the reasons for JIT implementation, this is purely a mathematical rank order, which is derived from the mean rank score of priorities.

The respondents were also asked, by way of open-ended questions to give other reasons for JIT implementation. Other reasons for JIT implementation indicated by majority of the respondents include; Achieve continuous organizational learning; serve as means towards automation, and improvement of cash position/liquidity levels.

4.11 BENEFITS OF JIT

The study was explicitly designed to explore the strategic aspect of JIT by asking the respondents for their degree of agreement to a list of 15 possible benefits of implementing JIT practices. The respondents were requested to indicate on a likert scale of 1-5 where 5 represented very significant and 1 represented negative significant, the extent to which the benefits of JIT implementation were considered important. Benefits with mean score above 3.8621 were considered to be very significant (Strongest) while those with mean score of below 3.8621 were considered to be less significant.

A list of these benefits, ranked according to the calculated mean scores is presented in Table 4.9 below:

Table 4.9 : Benefits of JIT implementation

	Mean	Std deviation
Inventory reduction	4.4138	0.9141
Work-in-process reduction	4.0690	1.0012
Production space reduction	4.0690	0.5612
Lead time reduction	4.0000	0.5357
Warehouse space reduction	3.9310	0.5119
Wastage reduction	3.8621	0.8099
Set-up time reduction	3.3448	0.4430
Labor requirement reduction	2.8621	0.7605
Improved material flow and throughput	2.7241	1.0007
Profitability improvement	2.6897	0.3743
Product and service quality improvement	2.6552	0.3784
Rework reduction	2.5517	0.3930
Productivity improvement	2.4483	0.4115
Manufacturing cost reduction	2.3793	0.3718
Sales volume improvement	2.0690	0.9019

Source : Research data

The most significant benefits realized by the companies are in the reductions of Inventory, work-in-process (WIP), production space, and lead time with mean scores of (4.4138), (4.0690), (4.0690) and (4.000) respectively. Other benefits such as the reduction in warehouse space and waste reduction are also quite significant with mean scores of (3.9310) and (3.8621) respectively. Sales volume improvement, manufacturing cost reduction and productivity improvement are all in the bottom half of the ranking.

This ranking is only mathematical. Other benefits of JIT implementation as indicated by majority of respondents on the open-ended questions include increase in productivity, and profitability.

4.12 BARRIERS TO JIT IMPLEMENTATION

The respondents were asked to give their degree of agreement to a list of 14 possible barriers to JIT implementation. The respondents were requested to indicate on a likert scale of 1-5 where 5 represented very significant and 1 represented negative significant, the extent to which the barriers to JIT implementation were considered strongest. The barriers to JIT implementation with mean score above 3.5172 were considered to be very significant (Strongest) while those with mean score of below 3.5172 were considered to be less significant.

A list of these barriers, ranked according to the calculated mean scores, is presented in Table 4.10 below. Most companies indicated the problem of poor infrastructure as the most significant barrier to JIT implementation with a mean score of 4.4828.Government policies, interfacing JIT practices with existing systems and poor information/data accuracy were ranked second, third and fourth respectively. Other common problems encountered in JIT implementation include power outages/blackouts, lack of internal expertise and lack of vendor support with mean scores of (3.8276), (3.5172), and (3.3448) respectively. Lack of continuing education/training, lack of top management support and problem with accounting practices are all in the

bottom half of the ranking. Table 4.10 below presents barriers to JIT implementation:

Table 4.10: Barriers to JIT implementation

	Mean	Std deviation
Poor Infrastructure like roads	4.4828	0.8498
Government Policies	4.1034	0.7746
Lack of Interface with existing systems	4.0690	0.9012
Poor information/data accuracy	3.9310	0.5075
Power outages/black outs	3.8276	0.4795
Lack of internal expertise	3.5172	0.4050
Lack of Vendor support	3.3448	0.3784
Employees' resistance to change	3.1724	0.3625
High cost of electricity	2.3448	0.4338
Lack of Political will	2.2759	0.7504
Lack of appreciation of resulting Benefits	2.2759	1.0508
Problem with accounting practice	2.1724	0.4794
Lack of top management commitment	2.1034	0.5007
Lack of continuing education/training	2.0690	0.7119

Source :Research data

This ranking is only mathematical. Other specific barriers to JIT implementation as indicated by majority of respondents include; Delays by custom departments in clearing materials and spare parts at the port of Mombassa, Cumbersome importation and export procedures and the need to hold critical but slow moving spare parts for safety reasons.

4.13 FUTURE IMPLEMENTATION PLAN

To identify their future plans for successful implementation of JIT practices, respondents were asked to select from a list of 13 possible JIT practices that they plan to implement in the near future. The respondents were requested to indicate on a likert scale of 1-5 where 5 represented very significant and 1 represented negative significant, the extent to which the future plans for

successful implementation of JIT were considered important. Future plans for successful JIT implementation with mean score of above 3.5862 were considered to be very significant (strongest) while those with mean score of below 3.5862 were considered to be less significant.

Table 4.11 below presents the survey results, which ranked the types of JIT practices according to their popularity for future implementation:

Table 4.11: Future plans for successful implementation of JIT

	Mean	Std deviation
JIT education and training	4.5517	0.7871
Investment in latest technology	4.4828	0.9498
Quality circles and quality control programs	4.3448	0.8801
Good housekeeping	4.2759	0.6478
Supplier quality assurance	4.0345	0.5482
Multi-functions workforce	3.8966	0.5007
Top management support	3.7931	0.4695
Lot size reduction	3.5862	0.4185
Staff motivation	3.5172	0.4049
Continuous improvement	3.2414	1.1075
Preventive maintenance	2.9655	0.3574
Set-up time reduction	2.7586	0.4675
Management of change	2.0690	1.1119

Source : Research data

Of the 13 JIT practices listed, the most popular practice earmarked for future implementation is JIT education and training with a mean score of 4.5517. Investment in latest technology, quality circles and quality control programs and good housekeeping were ranked second, third and fourth with mean scores of (4.4828), (4.3448) and (4.2759) respectively. Other more popular practices include supplier quality assurance with a mean score of 4.0345, multi-functions workforce with a mean score of 3.8966 and top management support with a mean score of 3.7931. The survey data show that the

emphasis in future implementation of JIT seems to be on the quality-related concepts and techniques. Management of change, set-up time reduction, continuous improvement and preventive maintenance are all in the bottom half of the ranking.

This ranking is only mathematical. Other future plans for successful implementation of just-in-time systems as indicated by majority of respondents include; ISO 9001:2000 certification and implementation of Total Quality Management Systems.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMARRY AND CONCLUSIONS

The aim of this study was to document JIT practices among firms in Kenya.The study targeted 48 firms listed at the Nairobi stock Exchange as at 30th August 2005. Responses were received from 29 firms. This represents a response rate of 60%.

Primary data was collected through a questionnaire with both open and closed-ended questions. The closed-ended questions enabled the collection of quantitative data while the open-ended questions were used in collecting qualitative data on the respondent's view of JIT practices in Kenya.

5.1.1 JIT practices in Kenya

The study found out that most Kenyan firms believe that JIT practices enhance long- term business performance and success. These findings are in agreement with those of Dobler & Burt (1996) in the literature review. Overall, the study showed that companies producing for both local and export market were the main practitioners of JIT practices in Kenya. While the majority of these companies came from the manufacturing industry. JIT practices appeared to have spread to the service industries as well.This relates to the literature that traces JIT origin from the American Supper markets which is in the service sector (Ohno,1988). Most of the sample Companies started JIT only in recent years thus the need for firms to send their employees to attend the JIT-related courses and seminors and also conduct their own JIT-related in-house training and education programmes.

The survey revealed that reduction in inventory was the strongest reason for practicing JIT. This represents what is referred to as the fundamental operational motivation for implementing JIT. Other important reasons of JIT implementation emerging from the study include reduction in production space, and reduction in lead-time. These findings also relate to those of Naylor (1996) and Schonberger (1986) who did their studies in Europe. The study indicated that, the more clearly defined, specific aspects of JIT, namely: Strive for manufacturing excellence, increase in profit margin, Service/product quality improvement and improve worker motivation, are not very important reasons for JIT implementation.

Most of the respendents involved in this study indicated that substantial benefit have been realized from the implementation of JIT practices. The greatest benefits realized were in the reduction of inventory, work-in-progress (WIP), production space and lead time. Other substantial benefits were in the reduction of warehouse space, waste and set-up time. These relate well to the fidings of Schonberger (1986) and Drury (2000) who underscored that, Companies that have implemented JIT techniques, have substantially reduced their investment in raw materials and work in progress stocks. Data pertaining to the reasons for JIT implementation, showed that most of the sample companies were concerned primarily with the operational benefits of JIT such as the reduction of inventories, floor space requirements, and warehouse space requirements. Most companies do not seem to recognize or appreciate the more concrete strategic motivations for JIT implementation as highlighted in the literature review by Green et al (1991), Crawford and Cox (1991), Cook (1996) and Arogyaswamy & Simons (1991) such as continuous organizational learning, improve product/service quality, strive for manufacturing excellence, reduction in cycle time and JIT as means towards automation. This means that firms should be able to motivate JIT adoption at the more strategic level rather than merely at the more commonly recognized operational level.

However, there were also several problems the respondents encountered in their JIT implementation process. The problem of poor infratructure was the most commonly reported.This relates to the findings of Seideman (1992) in the literature review, who underscored how Nissan began to experience dificulties with JIT deliveries in congested urban areas as early as the 1970s when they adopted the Toyota Style. Other common implementation problems includes Government policies, interfacing JIT practices with existing systems, poor information/data accuracy, power outages/blackouts, lack of internal JIT expertise and lack of vendor support. This is in agreement with the findings of Sheridan (1989), Karmarkar (1988), Aggarwal (1985), Mcclennahen (1990), Keys (1991) and Goldratt & fox (1986) in the literature review, who also underscored resistance to JIT by small companies, difficults in coppying up with increasing rates in demand, influence of political or natural disaster to JIT implementation and the problem of traditional accounting and financial systems.The lack of continuing education/training and top management support were reported as the least of problems to JIT implementation.

The survey also revealed that out of the 13 JIT practices listed, the most popular practice earmarked for future implementation was JIT education and training. Other equally important plans revealed by the survey includes investment in latest technology, quality circles and quality control programs, good housekeeping, and supplier quality assurance. This relates to the findings of Minahan (1996), Prasad (1995) and Vora & Saraph (1990) in the literature review. The survey data showed that the emphasis in future implementation of JIT seems to be on the quality-related concepts and techniques. Management of change, set-up time reduction, continuous improvement and preventive maintenance were regarded as least important future plans for successful JIT implementation.

In conclusion this study has shown that companies can benefit substantially through the implementation of JIT. It has also provided empirical data, which indicate that companies could be further motivated through the strategic benefits associated with JIT. Further, this study has also reported data, which

indicate the future plans for successful implementation of JIT practices . All these should help in encouraging the widespread adoption of JIT practices in other organizations in Kenya.

5.2 RECOMMENDATIONS

From the results of the study we realize that implementation of JIT practices plays an important role in the competiveness of companies. It is therefore important that companies accord the implementation of JIT practices the necessary support so as to enhance business success.Firms should maintain good relations with their Suppliers and other stakeholders because this is one of the ways of supporting not only high quality products/services but also enhances speed and reliabilty of companies operations.

The study has also indicated that one of the major barriers to JIT implementation is poor infratructure and Government policy.The government should step in and improve our roads and communications networks and eliminate beaurocratic policies to enable as many companies as possible adopt just in time practices and strive for operational excellence.

Since the study revealed JIT training and education as the most popular future plans for successful implementation of JIT systems,firms should send their employees to attend the JIT-related courses and seminars and also conduct their own JIT-related in-house training and education programmes.

5.3 LIMITATIONS OF THE STUDY

One of the limitations was the focus of the study.The study focussed on the firms listed at the Nairobi Stock Exchange. Many of these are large firms, thus limiting the genaralization of results with other small firms in Kenya.

The second limitation is that adequate local research has not been carried out locally. This limited the comparison of findings with other local researchers.

Another limitation is that the findings are based on the responses of 29 firms. This is because many firms were found to be unwilling to participate in the study because of Company policy, lack of time, absence of the right persons to fill the questionaires, among other reasons. This made the response rate to be less than the expected 100%. However, the response rate which was 60% was acceptable given that the questionnaires were self-admistered.

5.4 SUGGESTIONS FOR FURTHER STUDY

There is little literature on JIT issues in Kenya. A lot of research would therefore be necessary in this area. It is hoped that this study will provide a beginning point for potentially valuable JIT practices research in Kenya. More specifically, further research is necessarry to explore the strategic significance of JIT, the speedy and effective implementation of JIT, pre-implementation and post-implementation experiences, and initiators for JIT implementation.

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APPENDIX I: RESEARCH QUESTIONAIRE

This research questionnaire is aimed at getting an understanding of the impact, challenges and benefits of implementing just-in-time systems in companies operating in Kenya. The responses to this questionnaire will be purely used for academic purposes and will be treated with strict confidence.

Thanks in advance for your assistance.

Part I Company Profile

1. Name of Company.....
2. Position of Respondent.....
3. Educational level of the Respondent (optional).....
4. Training of the respondent (optional).....
5. Year of your organisation establishment in Kenya.....
6. How can you describe ownership of your Company? (Please tick (4) appropriately).
   a) Local [ ]
   b) Foreign [ ]

c) Both [ ]

If foreign please indicate the country of origin----------

7. Please indicate by a tick (4) the best classification of your company's operation:

Food, beverage beer and tobacco [ ]
Wood, wood products, paper products printing and publishing [ ]
Chemicals, petroleum, rubber and plastics [ ]
Non-metallic, minerals products except petroleum [ ]
Basic metal industries, metal products, machinery and equipment [ ]
Service provider [ ]

Other (please specify.....) [ ]

8. Which of the following best describes the number of different types of products/services that you deal in?

1 to 5 [ ]
6 to 10 [ ]
Above 10 [ ]

9. Which products and/or services are your company's most significant source of revenue?

.....
.....
.....
.....
.....

10. What is your products/services market

Local [ ]
Export [ ]
Both local and export [ ]

11. Annual company turnover (Kshs)

Up to 50 million	[ ]
51 to 500 million	[ ]
501 to 1 billion	[ ]
Over 1 billion	[ ]

Part II JIT implementation experiences

1. What is your company mission? (Please provide a copy of statement if available)

.....
...
.....
...
.....
...
.....
...

2. Have you heard of just-in-time production systems?

Yes	[ ]
No	[ ]

3. Do you consider the just-in-time systems important in enhancing your company's competitiveness?

Yes	[ ]
No	[ ]

4. Listed below are different views that firms have towards the just-in-time systems. On a scale of 1 to 5 where 5= highly representative, 4=Representative,3=Least representative,2=Not representative and 1= Negative representative, indicate by a tick (4) in the appropriate box

the level to which each of the statements below represent your firms view of the just-in-time systems.

	5	4	3	2	1
Lacks in pro-activity					
Has potentially negative effect if not appropriately managed					
Provides minimum support to the overall business strategy					
Highly important in development of core competencies					
Is a key component of the business strategy					

5. Is your organisation ISO 9001:2000 certified?

   Yes [ ]

   No [ ]

   If yes, what factors led your company to seek certification?

a).....

b).....

c).....

d).....

6. Has your organisation adopted just-in-time systems?

   Yes [ ]

   No [ ]

   If no why?.....

.....

.....

.....

7. For how long has your organisation embraced just-in-time philosophies?

   Below 3 years [ ]

3 to 6 years [ ]

6 to 10 years [ ]

Over 10 years [ ]

8. On a scale of 1 to 5 (where 5= highly used, 4=Used,3= Occasionally used, 2=Least used, and 1= not used), indicate the extent of use by your organisation for each of the following strategies;

Waste Reduction through:	5	4	3	2	1
i) Input changes					
ii) Operational improvement					
iii) Efficient use of energy					
iv) Production process changes					
v) Inventory control					

9. Does your organisation use e-procurement in sourcing and selling its products/services?

Yes [ ]

No [ ]

10. Listed below are some of the reasons firms may want to implement JIT systems. Please rank by a tick (4) in the appropriate box the nature and extent to which you consider these reasons significant using the following rating;

5=Very significant,4=Signficant,3= Moderately significant, 2=Not significant and 1=Negative significant.

Reasons for JIT implementation.	5	4	3	2	1
Increase long term competition					
Reduce Inventory					
Strive for manufacturing excellence					
Reduce lead-time					
Reduce manufacturing costs					
Reduce production/warehouse space					
Improve product/service quality					
Improve efficiency of operations					
Increase profit margin					
Improve worker motivation					
Regain and maintain market share					
Overhaul organisational culture and attitude					
Reduce labor requirement					
Suit client's JIT implementation					

Indicate other reasons of implementing just-in-time systems in your organisation.

a) .....

b) .....

c) .....

d) .....

11. Listed below are competitive priorities for firms in Kenya. Please rank by a tick (4) in the appropriate box the nature and extent to which implementation of just-in-time systems has impacted on these priorities using the following ratings;

5=Very Positive impact,4= Positive impact, 3=Low impact 2=No impact,1=Negative impact.

Benefits of JIT implementation	5	4	3	2	1
Work-in-process reduction					
Inventory reduction					
Lead time reduction					
Production space reduction					
Product and service quality improvement					
Productivity improvement					
Warehouse space reduction					
Rework reduction					
Wastage reduction					
Manufacturing cost reduction					
Set-up time reduction					
Profitability improvement					
Sales volume improvement					
Labor requirement reduction					
Improved material flow and throughput					

Indicate other benefits of adopting just-in-time systems in your organisation.

a) .....

b) .....

c) .....

d) .....

e) .....

f) .....

12. Listed below are some of the challenges/barriers, which prevent firms from adopting just-in-time systems. Please rank by a tick (4) in the appropriate box the extent to which you consider these challenges significant using the following rating:
5=Very significant, 4=Signficant,3= Moderately significant, 2=Not significant and 1=Negative significant

Challenges/Barriers to JIT implementation	5	4	3	2	1
Lack of Interface with existing systems					
Lack of internal expertise					
Government Policies					
Lack of Political will					
Poor Infrastructure like roads					
Poor information/data accuracy					
Employees' resistance to change					
Lack of Vendor support					
Lack of appreciation of resulting Benefits					
Power outages/black outs					
High cost of electricity					
Lack of continuing education/training					
Lack of top management commitment					
Problem with accounting practice					

Please list any other challenges faced while implementing just-in-time systems.

a) .....
.....

b) .....
.....

c) .....
.....

d) .....

13. Listed below are some of the future plans/strategies for successful implementation of JIT practices in Kenyan firms. Please rank by a tick

(4) in the appropriate box the extent to which you consider these future plans significant using the following rating:

5=Very significant, 4=Signficant, 3= Moderately significant, 2=Not significant and 1=Negative significant

Future plans for successful implementation of JIT	5	4	3	2	1
Good housekeeping					
Continuous improvement					
Supplier quality assurance					
Quality circles and quality control programs					
Preventive maintenance					
Lot size reduction					
JIT education and training					
Set-up time reduction					
Management of change					
Top management support					
Investment in latest technology					
Staff motivation					
Multi-functions workforce					

Please list any other future plans your firm intent to put in place to facilitate successful implementation of just-in-time systems.

a) .....

b) .....

c) .....

d) .....

I sincerely thank you for the time you have taken to complete this questionnaire.

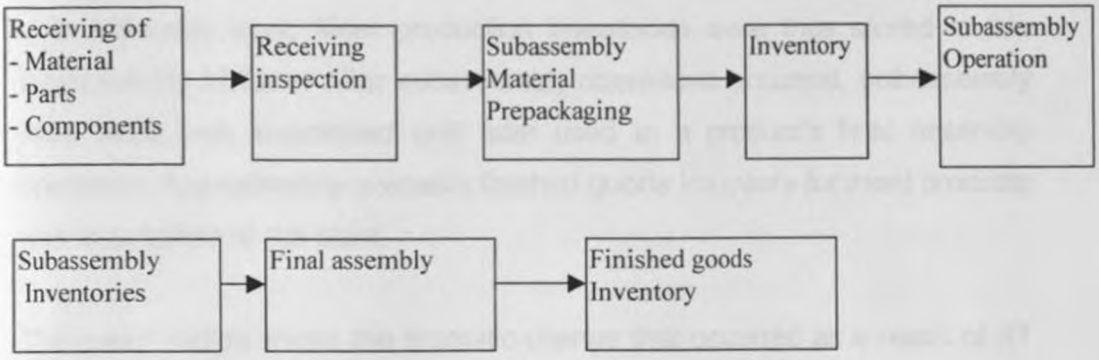
APPENDIX II

JIT1: Preparation	
Design	Design for manufacture to reduce number and range of components. Defining quality to match capability.
Focus	Limit scope of manufacturing task by setting up groups, cells or focused 'plants within plants' each of which concentrates on a limited range.
Small machines	Several single-purpose machine may be superior than a few large multi-purpose ones.
Work flow	Careful attention to layout to control the stock of good in transit cuts waste.
Maintenance	Planned maintenance to avoid wasteful breakdowns and their associated buffer stocks will benefit flow rates.
Set-up times	Reduced set-up times mean that smaller batches can be run more economically
JIT2: Waste reduction	
Scheduling	The kanban system of pulling inventory through the system avoids the futile build-up of stocks of partly finished items.
Inventory	Inventory levels are to be cut by running smaller, regular batch sizes and ensuring that goods move on when they are ready.
Visible controls	Simple, readily seen controls enable staff and supervisors to see the state of any batch of work at any time.
Continuous improvement	In the JIT philosophy, problems are 'jewels to be treasured' rather than embarrassments, the furtherance of the attack on waste.
Scheduling techniques	JIT can be integrated with MRPII, OPT and so on.
Vertical integration	JIT works best if the whole productive system works to the rhythm of the Master Production Schedule. Waste can be cut from all stages.

Box 12.6 The family of JIT technique
Source: Naylor (1996),

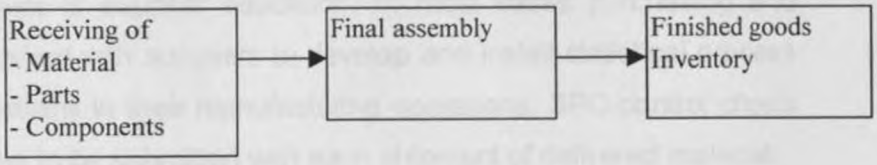
APPENDIX III

Conventional Operation



Production Inventory = 6 weeks
Work-in-process inventory = 3 weeks
Finished goods inventory = 3 – 6 days

JIT Operation



Production Inventory = 6 – 10 days
Work-in-process inventory = 1 day
Finished goods inventory = 3 days

The top portion of the figure shows the original operation. After incoming material was received, counted, and logged into the system, it went through a standard visual receiving inspection operation where potential quantity problems were detected, and perhaps submitted to quality assurance for further detailed inspection.

The next step was to prepackage the materials, parts, and components that would subsequently be used in putting together a given sub-assembly. This was done for each subsequently produced to facilitate stock picking for the later assembly work. Most production inventories were thus stored in this subassembly kit form. After subassembly operations occurred, subassembly units were then inventoried until later used in a product's final assembly operation. Approximately a week's finished goods inventory for most products was maintained at the plant.

The lower portion shows the dramatic change that occurred as a result of JIT implementation. The receiving inspection and quality control technical inspection operations for purchased materials were completely eliminated. The responsibility for incoming quality was placed with the purchasing department and delegated to each supplier organization. This required a reasonable amount of supplier education. In most cases purchasing and quality control worked with suppliers to develop and install statistical process control (SPC) systems in their manufacturing operations. SPC control charts were then required to be submitted with each shipment of delivered material.

The next major change occurred on the shop floor. The facility originally utilized a specialized process-type layout, similar to a large job shop. This was revised to achieve a modified product-type layout. Although the firm produced approximately half a dozen different product lines, enough similarity between products existed to permit the use if several product-flow types of facilities arrangements. The layout permitted the use of an open-type storage system adjacent to the production operations themselves. So incoming materials were delivered directly to the point of use in the shop.

Production scheduling subsequently was based completely on units of finished product, rather than on the production of sub-assemblies. This made it practical to eliminate the subassembly prepackaging and storage activities, as well as the subassembly operations themselves. The firm's closed loop MRP system was still used to generate requirements and overall schedules,

but it was necessary to smooth' the master schedule to facilitate the reasonably continuous, small-lot production. Consequently, the total shop now resembles a continuous manufacturing operation much more than its previous job shop character.

As indicated each of the two flow diagrams, inventory levels were reduced greatly. Production inventory was decreased approximately 70 percent, and in-process inventories were dropped from about a fifteen-day supply to a one-day supply. Finished goods inventory was reduced by about 40 percent. Hence, the total float figure declined from approximately fifty days to twelve days – and the firm reports that quality problems have declined noticeable.

APPENDIX IV: List of firms listed in the Nairobi Stock Exchange

NAIROBI STOCK EXCHANGE		
LISTED COMPANIES		
AGRICULTURAL		
UNILEVER TEA (K) LTD.	REA VIPINGO LTD.	Sasini Tea & Coffee Ltd
Kakuzi Ltd		
COMMERCIAL & SERVICES		
TPS (Serena)	Car & General Ltd	Hutchings Biemer Ltd
CMC Holdings	Kenya Airways	Uchumi Supermarkets Ltd
Marshalls (EA) Ltd	Nation Media Group	
FINANCE & INVESTMENT		
National Industrial Credit Bank Ltd	Pan Africa Insurance Co Ltd	Housing Finance Ltd
Barclays Bank of Kenya Ltd	CFC Bank Ltd	Standard Chartered Bank Ltd
Diamond Trust Bank of Kenya	ICDC Investment Company Ltd.	Jubilee Insurance Co Ltd.
National Bank of Kenya Ltd	Kenya Commercial Bank Ltd	
INDUSTRIAL AND ALLIED		
Athi River Mining	BOC Kenya Ltd	Bamburi Cement Ltd
British American Tobacco (K) Ltd	Crown- Berger (K) Ltd	Dunlop (K) Ltd
E.A Breweries Ltd	E.A Cables Ltd	Carbacid Investments Ltd.
E.A. Portland Cement Co. Ltd	Sameer Africa Ltd	Unga Group Ltd
Mumias Sugar Co.	Kenya Power & Lighting Co. Ltd	Kenya Oil Ltd
Total (K) Ltd		
ALTERNATIVE INVESTMENT MARKET SEGMENT		
A Baumann and Company Ltd.	City Trust	Standard Newspapers Group
Eaagads Ltd	Express (K) Ltd	Williamson Tea Kenya Ltd
Kapchorua Tea Company Ltd.	Kenya Orchards	Limuru Tea Ltd