

**LEAN SUPPLY CHAIN PRACTICES IN URBAN ROAD
CONSTRUCTION PROJECTS: A CASE OF CLASS 'A' ROAD
CONSTRUCTION COMPANIES IN NAIROBI COUNTY, KENYA**

BY

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**A Research Project Submitted in Partial Fulfillment for the Requirement of
the Award of Degree of Master of Business Administration, School of
Business, University of Nairobi**

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DECLARATION

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

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DEDICATION

This project is dedicated to my parents Mr. Wilfred Kamaru and Mrs. Liberatta N. Kamaru, my brothers and sister Clement, the late Don Bosco, Vincent and Angela, my fiance Duncan, my son Mark and niece Imani.

Thank you so much for your endless encouragement and support and for believing in me. God bless you so much.

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May the Almighty God bless the work of their hands.

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ABSTRACT

A study was carried out to establish the lean supply chain practices in urban road construction projects among class "A" road construction companies in Nairobi County. The study aimed at achieving two objectives: To determine the lean supply chain practices adopted in urban road construction projects in Nairobi County, Kenya and to establish the challenges in implementing lean supply chain practices in urban road construction projects in Nairobi County, Kenya.

The researcher adopted a case study design with a descriptive approach. Data was collected from Class "A" road construction companies in Nairobi and from the Kenya urban roads board through questionnaires. The data collected was subjected to SPSS for analysis. Descriptive statistics were used to explain the lean supply chain practices whereas factor analysis was used to establish the main challenges the companies encounter when implementing lean supply chain practices.

The findings indicate that Class "A" road construction companies in Nairobi have adopted various lean supply chain management practices. These practices include: emphasizing on proper customer focus; developing avenues for waste reduction in their activities; practicing continuous improvement in their processes and adopting Just in Time technique of inventory management.

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

The adoption of innovative management practices, such as supply chain management and lean thinking, from a manufacturing context is based on continuous processes and relationships. Some aspects of lean production may not be equally applicable in construction, for which reason lean construction has to be developed and modified to fit the project-based context. In order to learn more about how various aspects work in a construction context, case studies involving lean construction implementation therefore appear relevant (Stehn, 2008).

More than any other time in history, today's business environment is in a constant state of change. Changing customer requirements, product portfolios, market place demographics and geographies are in constant evolution and are impacting the way business is conducted. Lean thinking, which is linked to the Toyota Production Systems (Womack et al., 1990), has been widely recognized and adopted by many other companies in the automotive sector (Towill et al., 2000; Wee and Wu, 2009) and in other manufacturing sectors with the purpose of improving supply chain performance (Naylor et al., 1999). Recently it has been adopted by the construction industry as lean construction for supply chain improvement (Green and May, 2005; Jorgensen and Emmitt, 2009).

Most leading edge companies have realized that by transferring costs either upstream or downstream, they are actually not increasing their competitiveness, since all costs ultimately make their way to consumers. Supply chain management guides firms to co-operate with a common goal to increase the overall channel sales and profitability, rather than competing for a bigger share of a fixed profit (Cigolini, Cozzi & Perona, 2004). Lean management is one of the

best known strategies of coordinating within and between firms with a focus on achieving efficiency, eliminating waste or overburden and creating value in products. (Womack & Jones, 1996).

Research in lean supply chain concept has traditionally been focused on manufacturing but in recent times it has been adopted in other non manufacturing aspects. Arbulu and Ballard (2004) link lean management to lean construction which they define as the on-time delivery of materials and information to project sites at least cost and maximum value for the customer. They argue that the main objectives of lean construction are to simplify the configuration of construction supply systems, to reduce variability coming from these systems such as variability from site and to improve visibility across systems.

Unique challenges exist as firms extend their Lean initiatives beyond the plant or factory floor. The philosophy and culture of Lean had its roots on the shop floor, and so it comes as no surprise that separate and unique challenges arise when enterprises venture outward with their Lean initiatives. The main challenges include: lack of senior management commitment, difficulty in identifying areas of focus, poor communication, resistance to change, shortage of skilled employees, risk of supplier failure, failure of lean information technology applications

1.1.1 Lean Supply Chain Practices

In recent years, there have been several efforts to implement lean management philosophy in the construction supply chains efficiently and effectively (Vrijhoef and Koskela, 2000). The importance of improved construction supply chain performance cannot be overemphasized as the actors' achievement of both short-term business objectives and long-term competitive advantage is necessary (Dubois and Gadde. 2000; Riley and Clare-Brown, 2001).

The main tool that is used by organizations to adapt to changes is the Lean management philosophy. It has been defined by (Lassalle. 2005) as a systematic approach to enhancing value to the customer by identifying and eliminating waste of time, effort and materials through continuous improvement, by following the product at the pull of the customer, in pursuit of perfection.

According to Lassalle (2005), the best practices in lean supply chain management include: demand management that involves providing products and services when requested by the customer, cost and waste reduction which sometimes appears to be the singular focus of lean management. Process standardization which enables continuous flow to occur in the company and is considered a major tenet of Lean management, industry standardization, cultural change and cross enterprise collaboration.

Lean supply chain practices in construction can be grouped into six categories namely; waste reduction, continuous improvement, production planning and control, customer focus, systems perspective and cooperative relationships. The most important core element of lean in construction is waste reduction (Green, 1999). A central aspect of waste reduction is housekeeping, that is, keeping the construction site well organized, clean and tidy (Salem et al., 2006). Workers should therefore be encouraged to clean the job site once an activity has been completed (Salem et al., 2006). A related aspect, crucial for waste reduction in lean construction, is efficient transportation and stockholding of material, often termed just-in-time delivery, (Fearne and Fowler. 2006). A long-term perspective on continuous improvements referred to as Kaizen was first introduced in the Toyota Production System. Kaizen is important in lean construction in order to reduce waste and increase the efficiency of the construction process over time (Green and May, 2005). Long-term contracts are therefore an important aspect, reducing the

traditional short-term focus on cost reduction (Green and May. 2005) and promote lasting improvements. By working together on a series of projects the transfer of knowledge and experiences among supply chain actors and from one project to another is facilitated.

I.1.2 Urban Road Construction in Nairobi County, Kenya

There are 160.886 km of public roads in the country of which 61.945km is classified while 98.941 km is unclassified. These are roads with width greater than 9 meters and whose management currently falls under agencies in the Ministry of Roads. However, there are about 60.000 kms of other roads which have width of less than 9 meters. Classified roads are in 6 categories i.e. International Trunk roads (Class "A"), National roads (class B), Primary roads (class C), Secondary roads (class D). Minor roads (class E) and Special Purpose roads. Class "A" roads are large road construction projects that are handled by big companies (Kenya roads board. 2012).

Out of the 160.886 km of Kenya's public roads. 2.772km are international trunk roads which are classified as Class "A" roads. National trunk roads constitute 1.489km. The total numbers of roads that are classified add up to 8.879km. The total number of roads that are paved are 11,197km compared to 149, 689km that are unpaved (Kenya roads board, 2012).

Roads on urban spaces are fundamental means of communication and transaction. Thus the roads need to be well-functioning and efficient to serve the demand. For better management of urban road construction, there is need for proper planning and implementation of urban road construction projects. The Kenya Urban Roads Authority (KURA). a state Corporation under the Ministry of Roads established by the Kenya Roads Act. 2007 has the core mandate of management development, rehabilitation and maintenance of all public roads in the Cities and

Municipalities in Kenya except where those roads are national Roads. The national and international roads are managed by the Ministry of roads (Ministry of roads, 2012).

The urban road construction project in Nairobi County involves the upgrading of the existing roads in order to provide better and quality road transport services in Kenya's main administrative and commercial hub. The urban road construction project will also help in decongesting the city of Nairobi which frequently suffers from traffic snarl ups during peak hours. The urban road construction projected in Nairobi aims at removing all the roundabouts and replacing them with flyovers to facilitate quick movement of traffic. The project also involves construction of two major bypass roads that will provide alternative passage for motorists who are passing through Nairobi but have no need of going through the central business district (Kenyaweb, 2006).

1.2 Statement of the Problem

The construction industry plays a significant role in economic growth, both directly through its activities, and indirectly through the provision of buildings and infrastructures for the smooth functioning of businesses. However, the construction industry in Kenya is confronted with a number of challenges. According to Kenyaweb (2006), the major challenges of urban road construction in Nairobi County are lack of enough land for expansion, huge financing, and the congestion that is caused due to diversions during the construction of these roads among many others.

A number of studies have been done on lean supply chain management. In a study by Per (2010) on improving construction supply chain collaboration and performance for a lean construction pilot project, it was found out that many of the lean-related aspects identified in the literature

were utilized in the pilot project. These aspects have mostly focused on increasing the cooperation among supply chain actors, for which reason the pilot project is very similar to a partnering project. Hence, much work remains in order to obtain full-fledged lean construction, but the pilot project may serve as a starting point for continuous improvements and development of lean construction in future projects.

Arbulu and Ballard (2004) conducted a study on lean supply systems in construction. The major focus of the study was to assure on-time delivery of information and materials to project sites at the least cost and maximum value for the final customer. It was established that reduction of demand variability by stabilizing workflow on site was important in lean supply systems.

Another study was conducted by Bertelsen (2001) on lean construction as an integrated production. The study based its argument on the fact that the general approach within lean construction is to make the construction process, as it is normally undertaken on the construction site, leaner by reducing non-value-generating activities. This is usually done respecting the traditional division of work into trades. It was concluded that a number of advantages can be realized from lean construction such as cost savings and enhanced revenues.

Even though a number of studies have been conducted on lean supply chain, there is no known study featuring lean supply chain practices in urban road construction projects among developing countries, particularly Kenya. This study will therefore seek to bridge this gap by examining the lean supply chain practices in urban road construction projects in Nairobi County. The study seeks to answer the following questions: What are the lean supply chain practices adopted in urban road construction projects in Nairobi County? And what are the challenges faced in urban road construction projects in Nairobi County in implementing lean supply chain practices?

1.3 Objectives

The general objective is to establish the lean supply chain practices in Class "A" urban road construction projects in Nairobi County, Kenya.

The specific objectives of the study are:

- i. To determine the lean supply chain practices adopted in Class "A" urban road construction projects in Nairobi County, Kenya.
- ii. To establish the challenges in implementing lean supply chain practices in Class "A" urban road construction projects in Nairobi County, Kenya.

1.4 Value of the Study

The findings of this study will assist other companies in the construction industry to learn more about lean supply chain in construction. The study will also assist the contractors to better understand the lean supply chain practices that have been employed by other construction projects elsewhere. They will be able to do a comparison of their current practices and those employed by other construction companies.

The government of Kenya will also be able to understand the challenges that the contractors face during implementation of the road construction projects. Since some of these challenges require solutions from the government, it will make it easier to come up with those solutions.

Other firms outside the construction industry will also get to understand the lean supply chain practices that are adopted by various contemporary businesses. This will assist them to benchmark with the best practices in supply chain management.

Researchers in the area of lean supply chain will equally benefit from the findings of this study. They will be able to find material for reference as they conduct their study.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter discusses literature in the area of lean supply chain. Among the issues discussed, include overview of lean supply chain, implementation of lean supply chain, lean supply chain practices, challenges of lean supply chain implementation and the conceptual framework.

2.1 Lean Supply Chain

Macduffie and Helper (1997) define lean as an organized approach to identifying and eliminating waste or non-value-adding activities and processes through continuous improvement by delivering the product at the demand of the customer in pursuit of perfection. Therefore lean involves creating more value for customers with fewer resources. The ultimate goal is to maximize customer value through minimizing waste. Waste is defined as anything that interferes with the smooth flow of production. The eight wastes highlighted in the Toyota Production system as indicated by Monden (1998) and Liker. (2004) are over-production, waiting, conveyance, over processing, excess inventory, movement, defects and unused employee creativity, the biggest one being over-production.

Lean supply chain is a philosophy based on the concepts of lean manufacturing. It is about managing and improving the supply chain process to profitably deliver what the customer needs. Because it is a philosophy, lean supply chain can be pursued through a number of different approaches. According to Koskela (1992, 2000), the theory of lean supply recognizes that three schools of thought have emerged in production management and that these views are orthogonal yet complementary: the transformation view, the flow view and the value view.

The main focus of lean practices is on value, more than on cost, and seeks to remove all non-value adding components especially processes whilst improving those that add value. It aims to define value in customer terms, identifying key points in the development and production process where that value can be added or enhanced. The goal is a seamless integrated process (value stream) wherein products flow from one value adding step to another, all driven by the pull of the customer. The idea of right first time is essential to the lean philosophy. Right in this context means making it so that it can't go wrong. This approach involves an extremely rigorous, questioning analysis of every detail of product development and production, seeking continuously to establish the ultimate source of problems. Only by eliminating the cause at source can the possibility of that fault recurring be removed (Womack and Jones, 2003).

2.2 Implementation of Lean Supply Chain

In order to implement the lean supply chain philosophy an organization must be able to sell and communicate the Lean philosophy. The emphasis should be on the results and the benefits rather than the use of particular tools. Too often the techniques are wrongly identified as the solution. It should also be noted that many of the techniques and tools are identified as 'old' or 'traditional' and this perception can often get in the way of the message. Likewise, references made to organizations applying lean philosophy can act as a "turn off". Senior management commitment is also very important when implementing lean supply chain. The focus of senior management commitment is critical and the only activity worth pursuing is winning the heart and mind of a major sponsor or sponsors from the top team. It is better to work with a firmly committed individual than a team of 'fence sitters'. Winning a strong psychological commitment to implementation is key and must be tied in with deliverables (Atkinson, 2004).

Lean requires people at all levels to commit to performance issues and monitor metrics which they develop themselves. Therefore it is often appropriate to work on a specific project, rather than a global or strategic thrust, which, if implemented along Lean principles, will result in significant improvement for the business. All events and activities associated with Lean have to be closely led and facilitated. Ideally, Lean should occupy a high profile and the project should involve all significant players involved in the project or process. Success in having Lean accepted and applied throughout any business depends on how it is sold and the potential benefits it will deliver. Although the benefits must be applied to organizational metrics, (reduction in failure rates, increase in delivery and customer service, reliability of deliverables new business transacted, resources deployed to best advantage, ROI, increase in value added business transactions, relative increase in positive business activity, lost customers revived, prospecting rates etc) there is need to focus attention on the human side of enterprise (Mao and Zhang, 2008).

2.3 Lean Supply Chain Practices

Koskela et al. (2002) characterize these views as follows: In the transformation view, production is conceptualized as a transformation of inputs to outputs. The principles by which production is managed suggest, for example, decomposing the total transformation hierarchically into smaller transformations, called tasks, and minimizing the cost of each task independently of the others. The conventional template of production has been based on this transformation view, as well as the doctrine of operations management. However, this foundation of production is an idealization, and in complex production settings the associated idealization error becomes unacceptably large. The transformation view is instrumental in discovering which tasks are needed in a production undertaking and in getting them realized, however, it is not especially

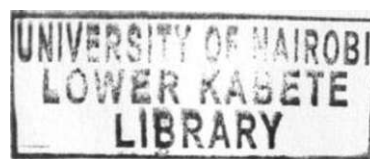
helpful in figuring out how to avoid wasting resources or how to ensure that customer requirements are met in the best possible manner. Production managed in the conventional manner therefore tends to become inefficient and ineffective.

The production as flow view is embodied in lean production; a term coined to characterize Toyota's manufacturing practices. In the flow view, the basic thrust is to eliminate waste from flow processes. Thus, such principles as lead time reduction, variability reduction, and simplification are promoted. In a breakthrough book, Hopp and Spearman (2000) shows that by means of queuing theory, various insights that have been used as heuristics in the framework of JIT can be mathematically proven.

The importance of improved construction supply chain performance in order to enhance the actors' achievement of both short-term business objectives and long-term competitive advantage cannot be underestimated (Egan, 1998). Lean construction has to be developed and modified to fit the project-based context (Hook and Stehn, 2008). According to Per Erik Eriksson (2010), the various best practices of lean supply chain can be grouped into six core elements as follows: waste reduction, process focus in production planning and control, end customer focus, continuous improvements, cooperative relationships and systems perspective, Demand management.

2.3.1 Waste Reduction

Waste reduction is the most important core element of lean construction (Green, 1999). A central aspect of waste reduction is keeping the construction site well organized, clean and tidy (Salem et al., 2006). Workers should therefore be encouraged to clean the job site once an activity has been completed (Salem et al., 2006). A related aspect, crucial for waste reduction in lean



construction, is efficient transportation and stockholding of material, often termed just-in-time (JIT) delivery, (Mao and Zhang, 2008). From a JIT perspective inventories are not valuable and should be regarded as waste (Salem et al., 2006). Through JIT, contractors strive to receive smaller batches of material to the site when they need it in order to reduce stockholding and double-handling of material (Mao and Zhang, 2008).

In the perspectives of waste management, lean performances are important to generate flexibility in order to control organization waste; the focus is to reduce waste; not costs, (APICS, 2004). Anything that delays or impedes supply chain's flow must be analyzed as a potential non-value added activity. Some of the lean performances initiatives can be taken such as engaging and energizing people and supply chain partners to work together and individually to eliminate wasteful processes and excess inventory across the chain. This elimination of waste should have a significant by-product, a reduction in cost for the supply chain.

2.3.2 Better Process Flow

Approaching production management through a focus on processes and flow of processes is another core element of lean construction. The last planner system is a key aspect that enhances efficient production planning and control (Jorgensen and Emmitt, 2008). Last planners are the people accountable for the completion of individual operational assignments (Salem et al., 2006). Each planner prepares weekly work plans to control the workflow, and if assignments are not completed on time, they must determine the root cause and develop an action plan to prevent future failures. It is important that each individual takes immediate action regarding their own work i.e. self-control to prevent defects at the source, hindering them to flow through the process (Ballard et al., 2003; Salem et al., 2006).

Better process flow involves identifying and eliminating non-value-adding activities in design, production, supply chain and dealing with customers. The goal of Lean is to maximize process flow and flexibility. Lean deployment methodology has evolved over the last few decades into a highly capable, well-defined multi-step approach that can be applied to administrative processes as effectively as production processes. Some of the advantages of better process flow include: structured methodology for waste identification and elimination in any process, organization wide training and involves employees at all levels, focused and rapid process improvement and cost reduction structured project management approach and helps communicate customer defined value to all levels of organization and strong analytical tools to map the process and identify root-causes (Kent and Attri, nd).

2.3.3 Customer Focus

Another element of lean supply chain is customer focus. It is very significant maximizing the value of lean construction (Jorgensen and Emmitt, 2008; Mao and Zhang, 2008). Contractors and suppliers must understand the needs of the customer so that they can supply the customer with what he/she needs, not what he/she asks for (Styhre et al., 2004). Customer satisfaction is dependent both on the end product and the process during which it is created, that is service quality (Maloney, 2002). In order to increase end customer focus, it is important to adopt lean principles already in the design stage (Freire and Alarcon, 2002). Early involvement of contractors and integration of design and construction in concurrent engineering are an important aspect in lean construction (Green and May, 2005; Mao and Zhang, 2008; Jorgensen and Emmitt, 2009).

In organizational terms improving customer focus requires firms to integrate market intelligence with design and product development much more closely, so that customer requirements are channeled directly to managers at key decision points. To achieve this traditional functional divisions based on development, design, production and marketing, may need to be eroded with decision making devolved as much as possible. Identifying user requirements and adding value to increase "satisfaction" pre-suppose that customers know what they want and their needs can be captured and translated into realizable products. The objective of a lean system would be to ensure that firms are much better able to respond to customer requirements during the conceptualization phases of a project and accelerate decisions during its realization phases. This has traditionally proved especially difficult in the construction industry (Ahmed and Kangari 1995), although some attempts have also been made to develop tools for capturing customer requirements more effectively. Anumba et al. (1996) argue that more effective ways of processing clients' requirements and designing quality into the product can be developed using new techniques such as 'quality function deployment' (QFD) and 'design function deployment' (DFD).

2.3.4 Continuous Improvement

A long-term perspective on continuous improvements (called Kaizen in the Toyota Production System) is equally important in lean construction (Green and May, 2005; Salem et al., 2006) in order to reduce waste and increase the efficiency of the construction process over time. Long-term contracts are an important aspect, reducing the traditional short-term focus on cost reduction (Green and May, 2005) and promote lasting improvements. By working together on a series of projects the transfer of knowledge and experiences among supply chain actors and from one project to another is facilitated.

For almost three decades now, leading companies have been implementing effective processes in order to plan and execute strategy, to prioritize market and plant improvement opportunities, and to monitor results. Much of Western manufacturing has "gone Lean", using the tools of lean manufacturing and 6 Sigma to drive continuous improvement - reduce defects, cut set up times and order quantities, slash lead times, increase productivity, reduce obsolescence, and cut costs. We believe the widespread adoption of continuous improvement through lean manufacturing and 6 Sigma, and of sales and operations planning, have been the outstanding events in manufacturing in the last twenty years (Salem et al., 2006).

2.3.5 Partnering

Cooperative relationships among the supply chain actors often referred to as partnering are an important element of lean supply chain (Green and May, 2005; Jorgensen and Emmitt, 2008), facilitating the integration of different actors' competences and efforts in joint problem-solving. Since traditional procurement and governance forms are often criticized for producing waste, long lead times, and adversarial relationships, they need to be changed into a lean contracting approach. Since subcontracting can account for most of the project value and because project activities are totally interrelated, a harmonization between main contractors and subcontractors is important for partnering and for lean construction (Miller et al., 2002).

Companies must learn to create reliable partnerships with their suppliers in order to be able to reduce on costs. Meurer (nd) argues that organizations should focus on not only reducing supply chain costs through direct raw materials but also through effective partnerships with suppliers. Organizations that practice adversarial type of relationships with all their suppliers may not be

able to achieve a lot in cost reduction even if they require suppliers to reduce their prices on a yearly basis.

2.3.6 Reliable Workflow

Another core element of lean supply chain is to adopt a systems perspective (Jorgensen and Emmitt, 2009), which is required in order to increase the overall efficiency of lean supply chain and avoid sub-optimizations (Green and May, 2005; Jorgensen and Emmitt, 2008). A reliable workflow in the system as a whole is more critical than individual activity speed or cost (Miller et al., 2002). An important aspect of this is to consider the whole buying process and make coherent procurement decisions that support or complement one another (Eriksson and Pesamaa, 2007). Smith and Fingar (2004) argue that in modern times there are enterprise applications that have made the flow of work in organizations more reliable. Applications such as Enterprise resource planning (ERP) have been very instrumental in the integration of various departments in the organization thus making it possible to achieve reliable workflow.

Smith and Fingar further indicate that today, workflow is far more than an aid to manage documents and forms routing since it has become a systems development platform in its own right and a way to develop new business applications. The proponents of workflow applications believe that 75% of workflow projects succeed while 75% of application development projects fail. This situation is attributed to the fact that defining a business system in terms of work item flow is easier, and more flexible, than trying to develop the same functionality as bespoke software.

2.3.7 Demand Management

In terms of demand management, it is very important that how well firms manage the demand signal, demand collaboration, sales and operation planning and inventory management is also reflected in how a lean supply chain system is viewed as a system (Phelps, 2004). Lean performance is total internal lean optimization process; therefore demand management is vital to play their role to accept the concept of lean performance within their processes and subsets. The strengths of lean approach and leanness are more immediate and practical focus on waste, flow and flexibility therefore, supply chain partners including the upstream suppliers and downstream customers can work together as a team to provide value to the end-user customer (Manrodt et al., 2005).

Seeking a Web-based solution that provides high levels of scalability, economy, usability, availability, synergy and functionality is important for organizations wanting to migrate. It is important to ensure that the solution chosen should be able to support a real-time response that is designed to enable an enterprise to dynamically forecast against a number of variables, such as supply, customer orders, inventory, and financial objectives. Demand management enables an automated bionetwork of the supply chain that simultaneously maps demand forecasting against factors like supply restrictions, customer commitments, inventory counts, financial predictions, as well as patterns of behavior that can affect demand at any given time (Abardeen group, 2010).

2.4 Challenges of Lean Supply Chain Implementation

Implementing lean supply chain management has challenges that must be acknowledged. The following are the challenges relating to lean supply chain implementation that are discussed in this section: lack of senior management commitment, difficulties in identifying areas of focus.

poor communication, resistance to change, shortage of skilled employees, risk of supplier failure and failure of lean information technology applications.

The focus of senior management commitment is critical and the only activity worth pursuing is winning the heart and mind of a major sponsor or sponsors from the top team. Better to work with a firmly committed individual than a team of "fence sitters". Winning a strong psychological commitment to implementation is key and must be tied in with deliverables. In most cases implementation of lean supply chain practices may lack the support from senior management. If this happens, it becomes difficult to implement a project that is not supported by the top management (Atkinson. 2004).

It is an implied assumption that all of the attributes of a lean supply chain deserve equal attention. Yet ideally things never work that way. Companies have to focus on those attributes that best match their organizational strategy, their supply chain capabilities and their competitive positioning. Still if one asks what is that one attribute upon which focus should be there and what is that one improvement that should be brought in a supply chain, it is demand management capability. The entire lean logic works on a pull based system. If firms are able to capture the point of sale (POS) data in real time and synchronize their processes in such a way that they are able to respond to customer requirements in real time, nothing can be better than this. All other benefits would automatically follow (Papatheodorou, 2005).

One of the most challenging jobs for managers in most companies according to Czapke et al. (2008) is effective communication of the vision and plan for lean implementation to the workforce. Understanding the new vision, new order and communicating it at all the organizational levels seems to be a difficult task for the management as well. Sometime even

when the Chief Executive Officer (CEO) of the company is fully committed to the organizational improvement program it appears that the organization experiences some problems with the implementation of the lean supply chain. It happens very often that the implemented programs fell back to their original costly and chaotic mode.

People are resistant to changes on their working place even if the management is dedicated enough efforts in training programs and explaining the values of the new practice. Especially when workers veterans encounter the new challenge of changing their way of working and when they need to be convinced in the benefits of the new technique. Many negative attitudes can be turned into a great resistance (Mefford, 2009). A hard time is the decision to let go some of the employees who cannot accept the adoption of change and wouldn't support the implementation efforts.

Employees' skills, knowledge and experience necessary for working specific tasks throughout the company can be scarce and difficult to copy and hence provide a platform for sustainable competitive advantage. So subsequent problems with staff retention have a major impact on operating performance and "getting into a bidding war"(Lewis, 2000). These skills have a market value for the particular company and if externally visible to other competitors in the same field a risk of staff leaving to leverage this value appears. When key members of staff are being headhunted by other larger organizations willing to offer substantial benefits, to retain these staff becomes time consuming, expensive and can have a major impact on morale in single status firms.

Traditionally companies have been developing multiple sources of supply using lowest price as a major deciding criteria. They seem to have overlooked the inbuilt inefficiencies and higher costs

in such a system due to sub-optimization and low volume per supplier. Managing costs for multiple suppliers is also very high. Some of the best companies in the world, based on the experience of Japanese companies are now gradually shifting to single supplier. However, again there is a disadvantage of such a set up (Admides et al., 2008).

In case of contingencies at the suppliers end, most or all of the supply of material may get disrupted. So it is better to have a key supplier and one or two secondary suppliers. Successful companies have developed long term relationships with the key suppliers, to the extent of helping some of them even get the Deming Award for quality improvement. A long term strategic relationship helps companies to keep the sourcing costs low and synchronize the production planning process to reduce the variability in the sourcing chain. Since commodity prices fluctuate and increase due to inflation, companies entering into long term supply contracts as part of strategic relationships, are able to ensure supply of raw materials and relatively lower and stable rates (Kate et al., 2005).

The role of Information Technology (IT) in streamlining business processes cannot be negated or neglected. Same is the case with lean implementation, where real time transfer of Point of Sale (POS) data is needed. This can be best done through the use of IT tools and techniques. Many companies have gone ahead with introduction of latest computer packages and systems for improving the overall efficiency of the supply chain: but the number of failures has outnumbered the number of success. However, it is important for companies to first improve its business processes through Value Chain Mapping or Value Stream Mapping (VSM) and then implement a suitable IT solution. Electronic Data Interchange and use of RFID technology are some of the suitable solutions for lean implementation. Expert assistance can be very helpful to reach optimum levels for any organization to improve its supply chain performance (Arya, 2011).

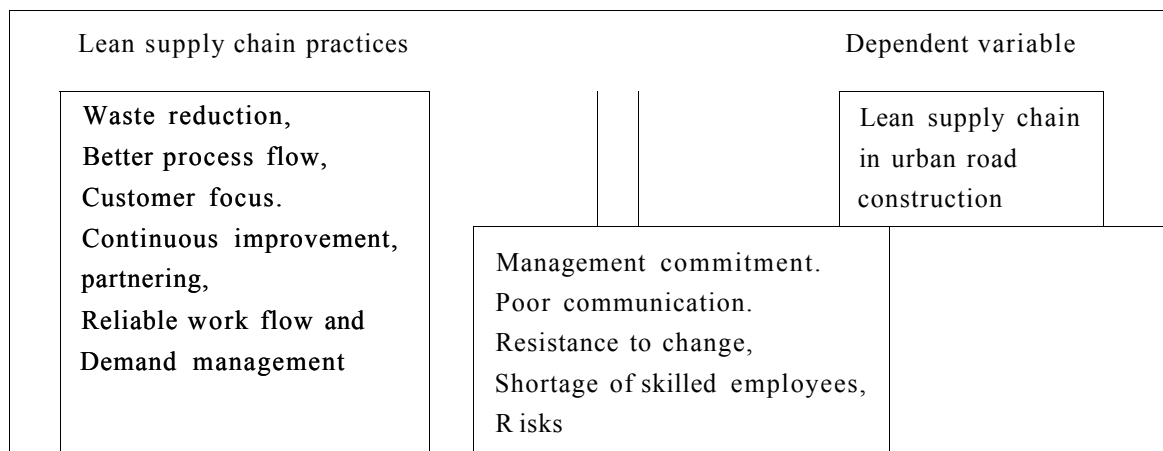
Stream Mapping (VSM) and then implement a suitable IT solution. Electronic Data Interchange and use of RFID technology are some of the suitable solutions for lean implementation.

2.5 Summary and Knowledge gap

This chapter has discussed the lean supply chain in detail together with the lean supply chain practices such as waste reduction, better process flow, customer focus, continuous improvement, partnering, reliable work flow and demand management. The challenges of lean supply chain were also reviewed. They include: risk of supplier failure, shortage of skilled employees, resistance to change and poor communication among others. From the literature reviewed it is clear that there is a gap that exists on lean supply chain practices among urban road construction projects.

2.6 Conceptual framework

In order to achieve lean supply chain in urban road construction, there is need to successfully adopt the lean supply chain practices. Once these practices are carefully adopted then they can lead to lean supply chain. But there is also need to know how to overcome the challenges related to lean supply chain implementation in order to succeed in adoption of the same.



Source: Researcher 2012

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Research design

This research involved a case study of road construction in Nairobi County. The study adopted a descriptive approach in studying lean supply chain management in large construction projects in Nairobi County. There are other designs but the researcher chose descriptive since it enabled her to come up with descriptive statistics that assisted in better understanding the problem under investigation. It also enabled the researcher to evaluate the elements in their natural environment without manipulating them.

3.2 Target Population

The population of the study consisted of all class "A" registered road construction companies in Nairobi. Class "A" road construction companies are large companies comprising both international and local companies that are involved in the construction of Class "A" roads in Kenya. According to the ministry of roads classification, class "A" roads are part of the international highways that link Kenya to other African countries. As at June 2012, there are a total of 40 class "A" road construction companies registered with the ministry of roads. These 40 companies were the target population for the study.

3.4 Sampling procedures

The researcher conducted a census survey of all class "A" registered road construction companies in Nairobi. There are 40 registered companies in this category presently. A total of 2 respondents from the supply chain department were then randomly selected to participate in the study. This brought the total number of respondents in the study to 80.

3.5 Data collection

As mentioned in section 3.4 above, the respondents involved 2 respondents from the supply chain department of the selected companies. The researcher used structured and semi structured questionnaires which were administered personally. The questionnaires were of two types: One questionnaire collected data from the Kenya roads board and the other from the road construction companies. The questionnaire to the road construction companies carried four sets of questions: The first set of questions included questions on the relevant personal information of the respondents; the second set included questions on lean supply chain practices; the third set included questions on the challenges in lean practices implementation in large road construction projects in Nairobi whereas the last set of questions sought data on the motivators of lean supply chain implementation. The other questionnaire contained general questions to establish how the Kenya roads board views the implementation of lean supply chain practices among road construction companies.

3.6 Data analysis

Once the data had been successfully collected, the researcher sorted the same and coded it appropriately for analysis purposes. Since there were two varieties of data available for analysis, the researcher subjected any data that was quantitative in nature to SPSS for analysis. The first objective was to determine the lean supply chain practices adopted in urban road construction projects in Nairobi County, Kenya. The supply chain practices that received the highest frequencies from the responses were considered the most commonly adopted lean supply chain practices. The second objective was to establish the challenges in implementing these lean supply chain practices. The researcher conducted factor analysis in order to identify the challenges faced. Tables and graphs were used to present the quantitative findings. The data from

the semi-structured questions was reviewed and the opinions of the respondents were reported by paraphrasing the original views of the respondents without interfering with the meaning.

CHAPTER FOUR: DATA ANALYSIS, RESULTS AND INTERPRETATIONS

4.1 Introduction

This chapter presents the data analysis, findings and study interpretations. Data was collected from class 'A' road construction companies in Nairobi County, Kenya, analyzed and the findings presented in tables and graphs. Out of the eighty (80) questionnaires that were distributed to respondents, fifty seven (57) were successfully filled and collected giving a response rate of 71.25%.

4.2 Personal Information

The study sought to establish the general profile of the respondents such as gender, age category, educational level, and duration in employment. Also the study sought to determine whether the respondents had professional qualifications in the supply chain, they were working in the supply chain department, they understood the concept of lean supply chain, and whether they had been involved in lean supply chain implementation. The findings concerning personal information are presented and explained below.

4.2.1 Gender Distribution of Respondents

The researcher sought to determine the gender distribution of the respondents and the study results are as shown in the table 4.1.

Table 4.1: Gender of Respondents

Gender	Frequency	Percent
Male	48	84.2
Female	9	15.8
Total	57	100.0

As shown in the table above, it is clear that the majority of the respondents were male with 84.2% while the rest 15.8% were females. This is an indication that most supply chain managers in class "A" road construction companies in Nairobi are male.

4.2.2 Age Category

The respondents were required to indicate their age category and the study results are presented in table 4.2 below.

Table 4.2: Age category

Years	Frequency	Percent
21-30 years	16	28.1
31 -40 years	33	57.9
41 -50 years	8	14.0
Total	57	100.0

From table 4.2 above, 28.1% of the total study participants were between 21-30 years, 57.9% were between 31-40 years while 14.0% were 41-50 years. This therefore means that majority of the study participants were in the age category of 31 -40 years.

4.2.3 Educational Level

The respondents were also required to indicate their level of education and the study results are presented in the figure below.

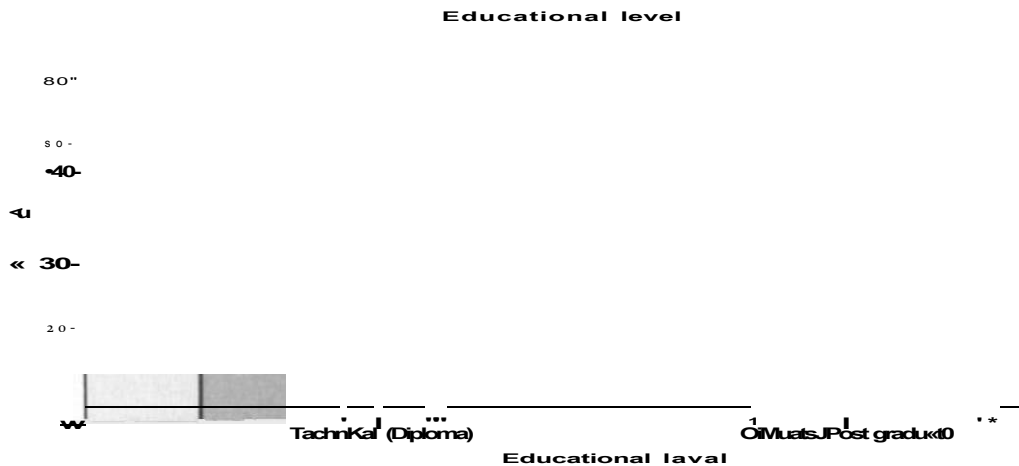


Figure 4.1: Educational level

Figure 4.1 indicates that the educational level of the respondents was technical/diploma (majority) and/or graduate/postgraduate. This implies that the study participants were knowledgeable about lean supply chain practices in urban road construction projects.

4.2.4 Duration in Employment

The study sought to determine the duration in years the respondents have been in employment and the findings are presented in figure 4.2.

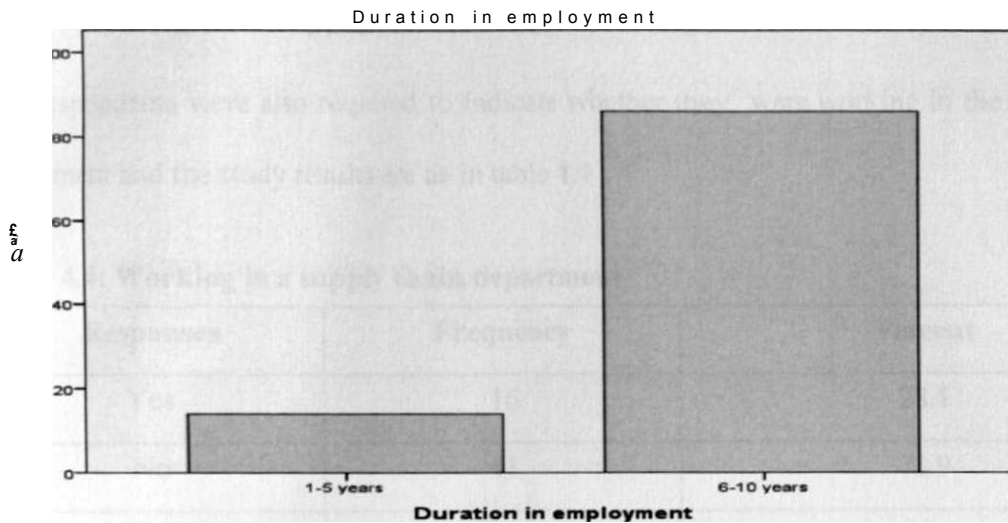


Figure 4.2: Duration in employment

The study findings in figure 4.2 indicate that majority of the respondents have been in employment for duration of 6-10 years. This means that the respondents are aware and have experience in lean supply chain practices employed in urban road construction projects.

4.2.5 Professional qualification in supply chain

The study sought to determine whether the respondents held professional qualifications in supply chain and the study results are as shown in table 4.3.

Table 4.3: Professional qualification in supply chain

Responses	Frequency	Percent
Yes	8	14.0
No	49	86.0
Total	57	100.0

As shown in table 4.3, only 14.0% of the study participants hold professional qualification in supply chain while majority (86.0%) do not.

4.2.5 Working in a Supply Chain Department

The respondents were also required to indicate whether they were working in the supply chain department and the study results are as in table 4.4

Table 4.4: Working in a supply chain department

Responses	Frequency	Percent
Yes	16	28.1
No	41	71.9
Total	57	100.0

As shown in table 4.4 above, only 28.1% of the study participants were working in supply chain departments while 71.9% were not.

4.2.6 Understand the Concept of Lean Supply Chain

The study wanted to determine whether the respondents understood the concept of lean supply chain. The findings of the study are as shown in figure 4.3 below.

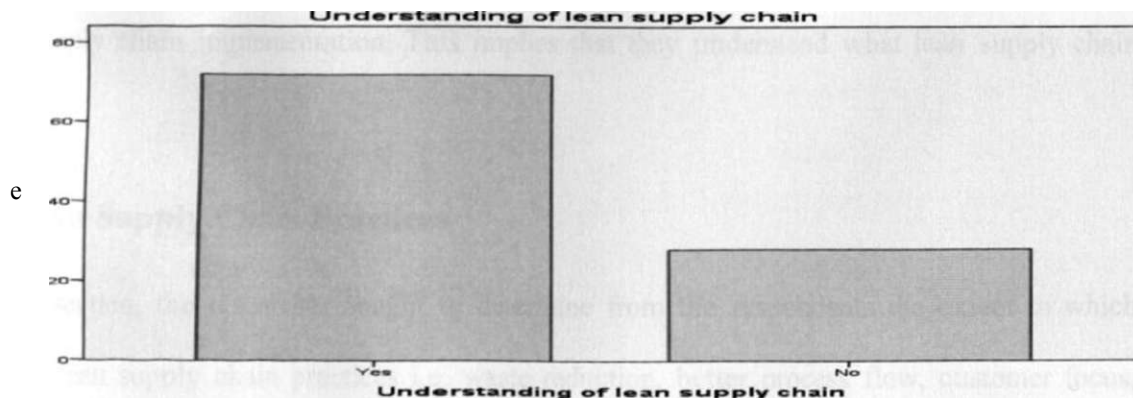


Figure 4.3: Understand the concept of lean supply chain

From figure 4.3, it is clear that majority of the study participants understand the lean supply chain concept.

4.2.7 Involvement in Supply Chain Implementation

The study sought to determine whether the respondents had been involved in lean supply chain implementation and the study results are as in figure 4.4.

Figure 4.4: Involvement in lean supply chain implementation

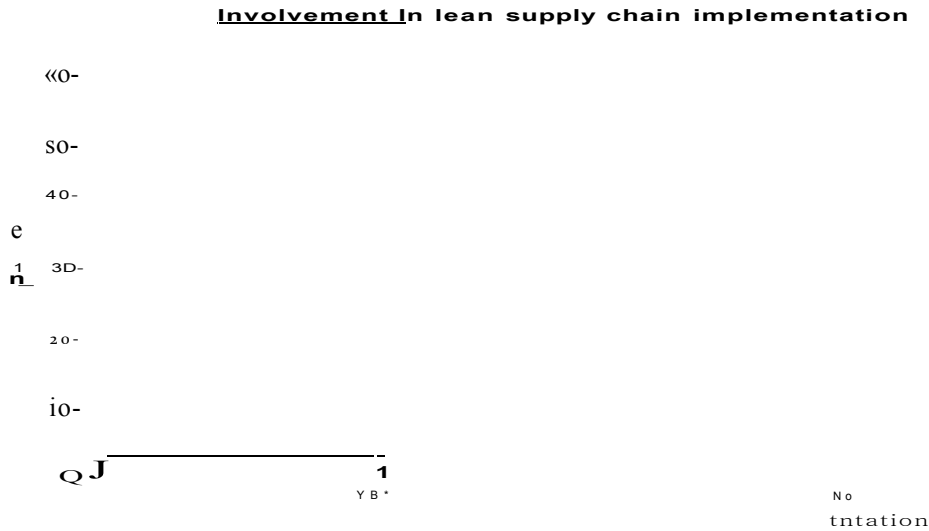


Figure 4.4: Involvement in lean supply chain implementation

As shown in figure 4.4. majority of the study participants agreed that they had been involved in lean supply chain implementation. This implies that they understand what lean supply chain entails.

4.3 Lean Supply Chain Practices

In this section, the researcher sought to determine from the respondents the extent to which various lean supply chain practices i.e. waste reduction, better process flow, customer focus, continuous improvement and partnering as well as reliable workflows were adopted among the companies. The study findings are presented and explained below. On a five likert scale of 1-5 where 1= Very great extent; 2= Great extent; 3= Medium extent; 4= Small extent and 5= Very

small extent, the study sought to get the rating of the respondents on lean supply chain practices prevalent among their respective companies and the results are as follows:

4.3.1 Waste Reduction

The respondents were required to indicate whether their respective companies identify and eliminate waste through continuous improvement in construction projects and the results are as in table 4.5.

Table 4.5: Eliminating wastes through continuous improvement

Responses	Frequency	Percent
Yes	57	100.0

As shown in table 4.5. all the companies that participated in the study identify and eliminate waste through continuous improvement in construction projects.

The study sought to get the rating of the respondents on waste reduction practices prevalent among their respective companies and the study results are as in table 4.6.

Table 4.6: Waste reduction practices

Waste reduction practices	Mean	Std Dev
Construction site is usually well organized	2.16	.649
Construction site cleared at regular intervals regularly	2.28	.701
Effective material management on construction sites	2.28	.701
Materials purchased and delivered only when required	1.44	.732
Stakeholders involved in waste reduction	2.02	.935

From the table it can be seen that almost all the aspects were achieved to a great extent; organization of the construction site (M=2.16. SD=.65), clearing of the construction site at

regular intervals and effective material management on the construction sites (M=2.28, SD=.70), and the involvement of stakeholders in waste reduction (M=2.02, SD=.94). It is also clear that purchasing and delivering of materials only when required (M=2.16, SD=.65) stands out as the waste reduction practice that has been achieved to a very great extent in urban road construction projects.

These findings are in line with the observations made by Salem et al. (2006) that the central waste reduction aspect of lean construction is keeping the construction site well organized, clean and tidy. Equally the findings on purchasing and delivering of materials only when required are in agreement with the assertion made by Mao and Zhang (2008) that the crucial aspect of waste reduction in lean construction is efficient transportation and stockholding of material often termed as Just-in-Time (JIT) delivery.

4.3.2 Better Process Flow

The respondents were required to indicate the extent they agreed on the achievement of various process flow aspects among the construction companies. The study results are presented and explained in table 4.7.

Table 4.7: Better process flows

Process flows	Mean	Std Dev
Efficient production, planning and control	2.44	.501
Preparation of plans to control workflow	2.86	.639
Determining the root cause and developing an action plan if assignments are not completed on time	1.88	.847
Self control to prevent defects at the source	1.72	.453
Well defined multi-step approach	2.42	1.051

From the table it is clear that to a great extent: efficient production, planning and control (M= 2.44, SD= .50). determining the root cause and developing an action plan when assignments are not completed on time (M= 1.88. SD= .85), self control in preventing defects at the source (M= 1.72, SD= .45) and well defined multi-step approach (M= 2.42, SD= 1.05) had been achieved to a great extent. On the hand the findings indicate that preparation of plans to control workflow had been achieved to a medium extent (M= 2.86, SD= .64). Generally, the study findings imply that to a great extent, there is a better process flow in the construction projects.

The study finding agrees with the observations made by Ballard et al. (2003) and Salem et al. (2006) that in constructing projects, each planner should prepare weekly work plans to control the workflow, and if assignments are not completed on time, the root cause must be determined and action plan developed to prevent future failures. The findings on well defined multi-step agree with the arguments put forward by Kent and Attri (nd) that lean deployment methodology has evolved over the last few decades into a highly capable, well-defined multi-step approach that can be applied to administrative processes as effectively as production processes.

4.3.3 Customer Focus

The researcher sought to establish from the study participants the extent to which they agreed with various statements concerning customer focus in road construction projects. The study results are presented and explained in Table 4.8.

Table 4.8: Customer Focus

Customer focus aspects	Mean	Std Dev
Understanding customer needs	2.04	1.336
Suppliers understand the needs of customers	1.74	.897
Suppliers are involved earlier in the project	1.44	.501
Customers' needs are established	1.74	.897
Delivering only what satisfies the customer	1.74	.897

Table 4.8 indicates that understanding customer needs (M= 2.04. SD= 1.34), suppliers understanding the needs of customers (M= 1.74. SD= .90), establishing customers needs and delivering only what satisfies the customer (M= 1.74, SD= .90) had been achieved to a great extent in constructing projects among the companies. It is also clear from the table that involvement of suppliers earlier in the project (M= 1.44. SD= .50) had been achieved to a very great extent. The study findings concur with those by Styhre et al. (2004) that contractors and suppliers must understand the needs of the customers so that they can supply the customers with what they need.

4.3.4 Continuous Improvement

The study also sought to establish from the respondents the extent they agreed that the companies practiced various aspects of continuous improvement in road construction projects. The study findings are presented in table 4.9.

Table 4.9: Continuous improvement

Continuous improvement aspects	Mean	Std Dev
Use of 6 sigma to drive continuous improvement	2.84	1.461
Less defects, reduced setup times and order quantities	2.86	.990
Adoption of continuous improvement through lean constructions	2.28	.701
Sales and operations done to enhance continuous improvement	2.58	.731
Lean processes frequently reviewed to improve on them	2.86	.990

From the table it is clear that adoption of continuous improvement through lean constructions (M= 2.86. SD= .99) had been achieved to a great extent. The Findings also indicate that to a medium extent; use of 6 sigma (M= 2.84, SD= 1.46), less defects, reduced setup times and order quantities (M= 2.86, SD= .99), sales and operations done to enhance continuous improvement (M= 2.58. SD= .73) and lean processes frequently reviewed for improvement (M= 2.86. SD= .99) had been achieved to a medium extent among companies. As pointed out by Salem et al. (2006), the lean manufacturing tools such as 6 Sigma to drive continuous improvement - reduce defects, cut set up times and order quantities, slash lead times, increase productivity, reduce obsolescence, and cut costs can be extend to construction projects.

4.3.5 Partnering and Reliable Workflow

The researcher also sought to establish from the respondents the extent to which various aspects of partnering and reliable workflow were employed among the companies and he study findings areas in table4.10.

Table 4.10: Partnering and reliable workflow

Partnering and reliable workflow aspects	Mean	Std Dev
Subcontracting to increase project value	2.16	.841
Integration of different stakeholders' competences and efforts in joint problem-solving	2.16	.841
Cooperative relationships among supply chain actors	1.86	.350
Making coherent procurement decisions that support one another	1.88	.847
Reliable workflow in the supply chain	2.30	1.034

From the table, it is clear that all aspects; subcontracting to increase project value and integration of different stakeholders' competences and efforts in joint problem-solving (M=2.16, SD=.84), cooperative relationships among supply chain actors (M=1.86, SD=.35), making coherent procurement decisions that support one another (M=1.88, SD=.85) and reliable workflow in the supply chain (M=2.30, SD=1.03) had been achieved to a great extent among the companies.

The findings agree with the assertion by Green and May (2005) and Jorgensen and Emmitt (2008) that cooperative relationships among the supply chain actors are an important element of lean supply chain in facilitating the integration of different actors' competences and efforts in joint problem-solving. The findings on subcontracting to increase project value are in agreement with the observation made by Miller et al. (2002) that subcontracting can account for most of the project value therefore, harmonization between main contractors and subcontractors is important for partnering and for lean construction. The findings on making coherent procurement decisions that support one another are supported by Eriksson and Pesamaa (2007) who argues that making

coherent procurement decisions that support or complement one another is an important aspect in partnering and reliable workflow.

4.4: Challenges in Implementing Lean Supply Chain Practices

In this section, the researcher was interested in finding out the main challenges that affect the implementation of lean supply chain management practices among the companies. Factor analysis was conducted in order to identify the challenges with more weight. The results are as presented in table 4.11.

Table4.11: Correlation Matrix

	a	b	c	d	e	f	g	g	i	J
Difficulties in changing organizational culture	1.000	.749	.793	-.345	-.405	-.512	-.512	-.261	.069	.405
Challenge in training employees on lean supply chain tools	.749	1.000	.306	.160	.141	-.292	-.292	.024	.413	.146
Resistance from suppliers	.793	.306	1.000	-.485	-.525	-.209	-.209	-.057	.136	.801
Lack of top management support and commitment	-.345	.160	-.485	1.000	.972	.722	.722	.717	.661	-.160
Failure of supply chain activities	-.405	.141	-.525	.972	1.000	.686	.686	.694	.656	-.141
Effective communication of the vision and plan for lean implementation	-.512	-.292	-.209	.722	.686	1.000	1.000	.899	.712	.292
Challenging costs associated in the implementation process	-.512	-.292	-.209	.722	.686	1.000	1.000	.899	.712	.292
Failure of lean information technology	-.261	.024	-.057	.717	.694	.899	.899	1.000	.867	.423
Challenge in retaining of skilled employees	.069	.413	.136	.661	.656	.712	.712	.867	1.000	.558
Resistance from employees	.405	.146	.801	-.160	-.141	.292	.292	.423	.558	1.000

The challenges listed in the first column of the correlation matrix are the same challenges represented by the alphabetical letters from (a) to (j) in the first row and in the same order.

It can be observed that there are a number of strong positive and negative correlations between challenges. For instance there is a strong direct relationship between difficulties in changing organizational culture and challenge in training employees on lean supply chain tools ($r = .75$). These two challenges are directly correlated an indication that both of them move the same direction almost at similar magnitudes. It was also established that there is a strong positive correlation between difficulties in changing organizational culture and resistance from suppliers($r = .79$). This is an indication that if there are difficulties in changing organizational culture, then it is likely that there will be supplier resistance towards implementation of lean supply chain management practices. The negative correlations observed in the correlation matrix are of medium strength. One such correlation is between failure of supply chain activities and resistance from suppliers ($r = -.53$). This indicates that resistance from suppliers does not necessarily lead to failure in supply chain activities and the reverse is also true.

There is a very strong direct relation between lack of top management support and failure of supply chain activities ($r = .97$). This therefore means that if there is no top management commitment towards lean supply chain implementation, then there is failure of supply chain activities. Another strong positive correlation was also evident between failure of lean information technology and effective communication of the vision and plan for lean implementation ($r = .69$). This is an indication that when there is no effective communication then any lean information technology being adopted will definitely flop.

There were also strong positive correlations between challenging costs associated in the implementation process and failure of lean information technology ($r = .69$). This means that when the costs of implementing lean supply chain tools are high then failure of lean information technology is ostensible. It was also established that when a company had challenges in

retaining skilled employees, failure of lean information technology had to take place. This can be best explained using the correlation between the two challenges ($r = .87$). Finally, there was found to be a medium positive correlation between challenge in retaining of skilled employees and resistance from employees ($r = .56$). This is an indication that if there was resistance from employees on the implementation of lean supply chain management initiatives, then retaining of skilled employees may be equally difficult.

Table 4.13: Total Variance Explained

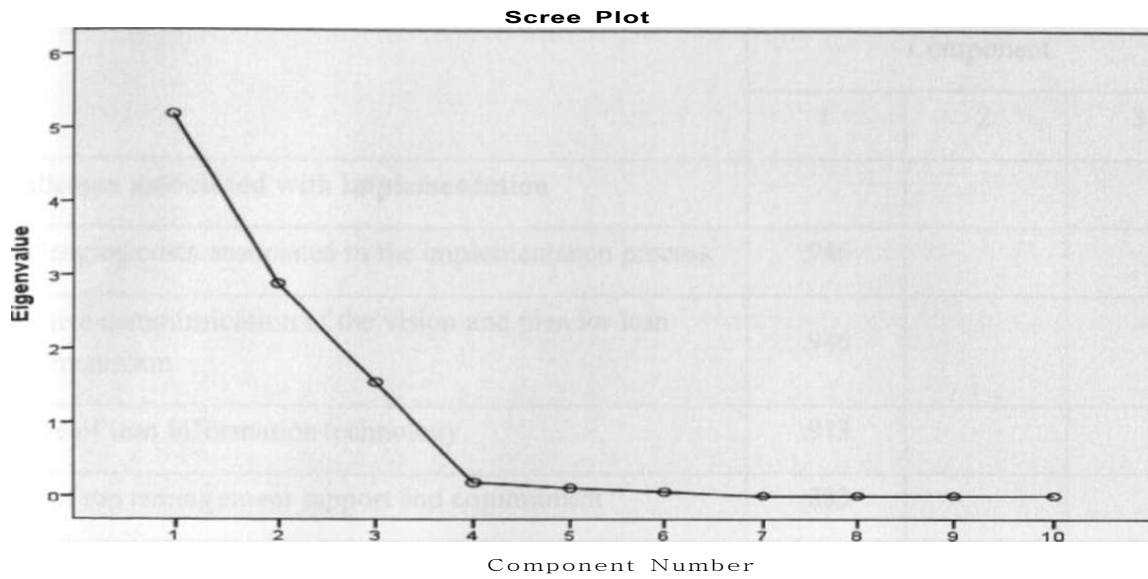
There were a total of 10 challenges subjected to factor analysis. This table shows the challenges that scored the highest loadings.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.19	51.897	51.897	5.19	51.9	51.9
2	2.891	28.912	80.809	2.891	28.9	80.8
3	1.555	15.545	96.354	1.555	15.5	96.3
4	0.191	1.91	98.265			
5	0.114	1.136	99.401			
6	0.06	0.599	100			
7	3.24E-16	3.24E-15	100			
8	-1.76E-16	-1.76E-15	100			
9	-2.92E-16	-2.92E-15	100			
10	-6.98E-16	-6.98E-15	100			

Extraction Method: Principal Component Analysis.

The total variance explained indicates the weight that each challenges has. It also shows the allocation of eigenvalues after the challenges were subjected to factor analysis. Challenge number one explains a variance of 51.9% and it has the highest weight. Challenge number two accounts for 28.9% of the total variance whereas the third challenge accounts for 15.5% of the variance. Only challenges that had eigenvalues above one were extracted.

Figure 4.5: Scree plot



From the scree plot above, it can be observed that the factors within the steep gradient are four. After factor number four, the gradient assumes a plateau shape hence they are not very important in this study and will not therefore be considered. This means that the study will extract four challenges that affect the implementation of lean supply management initiatives among the companies.

Table 4.14: Component Matrix"

	Component		
	1	2	3
Challenges associated with implementation			
Challenging costs associated in the implementation process	.946		
Effective communication of the vision and plan for lean implementation	.946		
Failure of lean information technology	.913		
Lack of top management support and commitment	.883		
Failure of supply chain activities	.874		
Challenge in retaining of skilled employees	.775		
Challenges associated with change management			
Resistance from suppliers		.859	
Resistance from employees		.848	
Difficulties in changing organizational culture		.776	
Training challenges			
Challenge in training employees on lean supply chain tools			.772

Extraction Method: Principal Component Analysis.³

a. 3 components extracted.

The items that cluster on the same components suggest that component 1 represents challenges associated with implementation, component 2 challenges associated with change of management and component 3 training challenges. In each component, factors differ in their loading. In column one there are two challenges with the same loading and are the highest: The first is challenging costs associated in the implementation process. Admides et al., (2008) also agree

that costs incurred when involving many suppliers during lean implementation. The second is effective communication of the vision and plan for lean implementation. Effective communication is achieved when there is commitment from top management as confirmed by Czapke et al. (2008) who asserts that communicating the lean implementation practices to the employees is very important. In the second column resistance from suppliers is the challenge with the highest loading. Successful companies have developed long term relationships with the key suppliers, to the extent of helping some of them even get the Deming Award for quality improvement. This position is held by Kate et al who indicate that a long term strategic relationship is important in making lean implementation successful. In the last column challenge in training employees on lean supply chain tools had the highest loading. This therefore means that there are four main challenges when it comes to implementation of lean supply chain initiatives among the companies.

4.5: Benefits of Implementing Lean Supply Chain Practices

In this section, the study sought to establish from the study participants the extent to which the respondents agreed with various statements concerning benefits of implementing lean supply chain practices in their respective companies. The study findings are presented in table 4.15.

Table 4.15: Benefits of implementing lean supply chain practices

Benefits of implementing lean supply chain practices	Mean	Std Dev
The need to reduce costs	1.89	1.385
The need to reduce wastes	1.60	.923
The need to meet customer requirements	2.46	1.691
Competitive pressures	2.18	1.269
Profit maximization	1.89	1.385

As shown in the table, all the practices: cost reduction (M= 1.89. SD= 1.39). waste reduction (M= 1.60, SD= .92). meeting customer requirements (M= 2.46. SD= 1.69), competitive pressures (M= 2.18. SD= 1.27) and profit maximization (M= 1.89. SD= 1.39) are considered to a great extent as benefits of implementing lean supply chain practices among the companies. The findings are in agreement with the observations made by Atkinson (2004) who points out that a strong psychological commitment to lean supply chain implementation is key and must be tied in with deliverables (Atkinson, 2004).

4.6 Kenya Urban Roads Board views

In this section, the study sought to establish the views of the three roads board authorities on the lean supply chain practices adopted by the companies. The respondents were required to indicate on a scale of 1-5 where 1= very great extent; 2= great extent; 3= medium extent; 4= small extent and 5= very small extent. The findings are presented in the table below.

Table 4.16: Lean supply chain Management practices

Lean Supply Chain Management practices	N	Mean	Std Dev
Contractors provide high quality services	6	2.13	.732
Road construction projects are completed in time	6	3.21	.652
There are wastes that need to be eliminated by contractors	6	1.45	.321
Integration of stakeholders by contractors is usually carried out	6	3.54	.556
Most contractors practice JIT	6	2.51	.841
Contractors always take into consideration the needs of road users	6	2.84	.745
Contractors ensure less defects, reduced setup times and order quantities	6	2.23	.932

It can be observed from the table above that the Kenya urban roads board authority considers the following as some of the lean supply chain management practices among the companies: The board agrees that the companies provide high quality services to the board as the customer (M= 2.13, SD= .73). The board also agreed that most contractors practice Just In Time (JIT) in most of their activities (M= 2.51, SD= .84). This means that they do not hold any inventory but instead purchase and deliver as and when materials are required for use. The board also agreed that contractors always take into consideration the needs of road users when working on their projects (M= 2.84, SD= .75). It was also established that contractors ensure less defects, reduced setup times and order quantities (M= 2.23, SD= .93).

However, the findings from the study indicate that road contractors are not scoring well in terms of project completion timelines (M= 3.21. SD= .65). The respondents indicated that in most cases, the projects are delayed for longer times than expected. The reasons for these include natural phenomenon like unfavorable weather patterns, delays in remission of funds from treasury, disagreements with donors, lack of accountability from the contractors and failure to stick to set timelines. It was also established that integration of stakeholders by contractors is not usually carried out (M= 3.54. SD= .56). The study also found out that the contractors need to eliminate certain wastes in order to attain lean construction. These wastes include importation of labour, wastage of materials and performing quality work to avoid repeat.

CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the findings on lean supply chain management practices among Class "A" road construction companies in Nairobi. The chapter also highlights the conclusions, recommendations made by the researcher based on the findings as well as suggestions for further academic research.

5.2 Summary of Findings

The study established that all the companies eliminate wastes through continuous improvement. It was also confirmed that there are a number of waste reduction practices that are common among the companies. These waste reduction practices include: Ensuring that the construction sites are well arranged so that work can be able to move smoothly; clearing of the construction sites on a regular basis to ensure that only the required items are left at the site; effective management of materials at the construction sites to ensure no wastage of materials; practicing JIT in the purchasing and delivery of materials to the construction site to avoid incurring unnecessary inventory holding costs and involving all the stakeholders such as the suppliers, customers, employees and others in lean supply chain implementation.

The findings from the study showed evidence that better process flow was also given a lot of attention by the companies. The study revealed that the companies insist on efficient production, planning and control in order to avoid overproduction or underproduction; preparation of work plans on a weekly basis to assist the companies in controlling the flow of work at their

construction sites: determining the root cause and developing an action plan if assignments are not completed on time; effective and efficient quality control to ensure that defects are minimized at the source of materials and having in place a well-defined multi-step approach towards handling their activities. On customer focus as a lean supply chain initiative, the findings indicate that the companies strive to understand the needs of their customers so that they provide exactly what the customer wants with limited wastage of resources. They also ensure that their suppliers understand the needs of their customers so that they can be able to supply the right materials. This is achieved by involving suppliers earlier in the project.

The study revealed that the companies embrace various continuous improvement practices as on way of implementing lean supply chain management. It was established that they use 6 sigma to drive continuous improvement. The companies also ensure that they minimize the number of defects in their work, reduced set up times and the quantity of materials they order. The companies also conduct frequent reviews of their lean processes with an aim of improving them. The findings also indicate that some partnering practices were evident among the companies. They include: The companies engage in subcontracting part of their projects to increase project value; Integration of different stakeholders' competences and efforts in joint problem-solving; building Cooperative relationships among supply chain actors as well as making coherent decisions that support one another.

This study, through a factor analysis identified four main challenges that affect the implementation of lean supply chain initiatives among the companies. These factors have different weights in terms of the threat they pose towards the implementation of lean supply chain management. The first challenge that was identified was the enormous costs associated with the implementation process and the second is effective communication of the vision and

plan for lean implementation. These two challenges had the highest variance. This was a clear indication that they are the main challenges that the companies encounter when implementing lean supply chain management practices. The study found out that there is resistance from suppliers and this adversely affects the implementation of lean practices in supply chain. It was also evident from the findings that challenges in training employees on lean supply chain tools is a challenge that the companies have to reckon with as they implement lean supply chain management practices.

Finally the study established that there are a number of benefits that can be associated with implementation of lean supply chain practices by the companies. The study established that lean supply chain practices lead to reduction in costs, it also leads to elimination of wastes among the road construction companies and enables the companies to maximize their profits.

5.3 Conclusions

The companies have adopted various lean supply chain management practices. These practices include: emphasizing on proper customer focus; developing avenues for waste reduction in their activities; practicing continuous improvement in their processes and adopting Just in Time technique of inventory management.

There are four main challenges that the companies encounter when implementing lean supply chain management practices. These challenges include: Enormous costs associated with the implementation process; effective communication of the vision and plan for lean implementation; resistance from suppliers and challenges in training employees on lean supply chain tools. The study revealed that the benefits accrued from implementation of lean supply chain practices include cost reduction, waste elimination and profit maximization.

5.4 Recommendations

There is evidence from the study that implementation of lean supply chain management practices enables companies to reduce costs and maximize profits. All road construction companies should be encouraged to adopt these practices so that they can enjoy the consequent benefits.

The study identified four main challenges that the companies encounter when implementing lean supply chain practices. It will be prudent if they concentrate on getting workable and lasting solutions to these challenges so that they can be assured of success.

The Kenya Urban roads board is the customer of the companies. The board has indicated that projects delay due to reasons partly emanating from the contractors themselves. It is important for the companies to find ways of ensuring that the projects they are responsible for are completed in time.

5.5 Limitations of the Study

The researcher encountered challenges in tracing some of the companies. They could not be traced using either the physical location or the telephone contacts. This explains the reason why the study could not achieve 100% response rate.

Most respondents from the roads board were very adamant to give the information requested for. Bureaucracy in government institutions is a major limitation when it comes to data collection from the government of Kenya.

Time and resources were also scarce. This is the reason why the researcher chose to do a case study of Nairobi County. The researcher also focused on class "A" road construction companies in Nairobi thus leaving the others due to time and financial limitations.

5.6 Suggestions for Further research

A study should be carried out to establish whether the other road construction companies have implemented lean supply chain management practices.

This study can also be replicated after five or more years to ascertain whether the situation would have changed.

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APPENDICES

Appendix I: Questionnaire

Section A: Personal Information

1. Gender (please choose from the following)

- Male
- Female

2. Age category (please choose from the following)

- 21-30 years
- 31 -40 years
- 41-50 years
- 51 years and above

Others (please specify)

3. Educational level (please choose from the following)

- Secondary School
- Under Graduate
- Technical (Diploma)
- Graduate/Post Graduate

Others (please specify)

4. Duration in employment (please choose from the following)

- 1 - 5 years
- 6 - 10 years
- 11 - 15 years
- 16 years and above

Others (please specify)

Kindly tick the most appropriate response to the following set of questions

No.	Question	Yes	No
1	Do you hold professional qualifications in supply chain?		
2	Do you work in a supply chain department?		

5	Stakeholders are involved in waste reduction					
BETTER PROCESS FLOW						
I	There are efficient production planning and control					
2	Each of our planners prepares weekly work plans to control workflow					
f	If assignments are not completed on time, we must determine the root cause and develop an action plan					
4	There is self-control to prevent defects at the source					
5	well-defined multi-step approach that can be applied to administrative processes as effectively as production processes					
CUSTOMER FOCUS						
1	We understand the needs of our customer					
7	Our suppliers understand the needs of our customers					
3	Suppliers are involved earlier in the project					
4	Customer needs are established					
5	Only what will satisfy the customer is delivered					
CONTINUOUS IMPROVEMENT						
1	There is the use of 6 Sigma to drive continuous improvement					
2	There are less defects, reduced setup times and order quantities					

1	The company adopts continuous improvement through lean construction						
4	Sales and operations planning is done to enhance continuous improvement						
5	Lean processes are frequently reviewed in order to improve on them						
PARTNERING AND RELIABLE WORKFLOW							
1	subcontracting is done to increase project value						
2	Integration of different stakeholders' competences and efforts in joint problem-solving						
j	There are cooperative relationships among the supply chain actors						
4	The company makes coherent procurement decisions that support or complement one another						
5	There is a reliable workflow in our supply chain						

Section C: Challenges in implementing lean supply chain practices

To what extent does your firm experience the following challenges in lean supply chain implementation?

Use the scale of:

1. Very great extent (VGE)
2. Great extent (GE)
3. Medium extent (ME)
4. Small extent (SE)
5. Very small extent (VSE)

	CHALLENGES OF LEAN SUPPLY CHAIN	1	2	3	4	5
11	Changing organization culture while implementing lean supply chain is difficult					
: 2	Training the employees on lean supply chain tools is a challenge					
3	Resistance from suppliers hinders implementation of lean practices					
4	Lack of top management support and commitment is also a challenge in lean supply chain implementation					
5	Failure to tie the supply chain activities with specific deliverables					
6	Effective communication of the vision and plan for lean implementation in the workforce is a challenge					
7	Costs associated in the implementation process is also a challenge					
8	Failure of lean information technology applications outnumbering the number of success					
	Lack/retention of skilled employees is a challenge					
10	Resistance from employees hinders successful implementation of lean supply chain					

Section D: Benefits of implementing lean supply chain practices

To what extent do consider the following as factors motivating your firm to implement lean supply chain practices?

Use the scale of:

- 1. Very great extent (VGE)
- 2. Great extent (GE)
- 3. Medium extent (ME)
- 4. Small extent (SE)
- 5. Very small extent (VSE)

	MOTIVATORS	1	2	3	4	5
1	The need to reduce costs					
2	The need to reduce waste					
3	The need to meet customer requirements					
4	Competitive pressures					
5	Profit maximization					

Appendix II: Questionnaire 2

Kenya Roads Board questionnaire

Please state the extent to which you agree with the following statements concerning implementation of lean supply chain practices by urban road constructors in Nairobi County.

Use the scale of:

1. Very great extent (VGE)
2. Great extent (GE)
3. Medium extent (ME)
4. Small extent (SE)
5. Very small extent (VSE)

	LEAN SUPPLY CHAIN PRACTICES	1	2	3	4	5
I	Contractors provide high quality services					
2	Road construction projects are completed in time					
3	There are wastes that need to be eliminated by contractors					
4	Integration of stakeholders by contractors is usually carried out					
5	Most contractors practice JIT					
6	Contractors always take into consideration the needs of road users					
7	Contractors ensure less defects, reduced setup times and order quantities					

8. Kindly list any wastes that still need to be eliminated by the contractors if any.

9. Please list the likely causes of road construction project delays by contractors

10. How can lean supply chain practices assist in solving this problem?

II. Please mention of any measures that you have put in place to ensure the contractors adopt lean supply chain management strategies.

Appendix III: Registered class "A" contractors in Kenya

NO	NAME OF CONTRACTOR	ADDRESS	TELEPHONE
1	A. A BAYUSUF & SONS LTD	94024 MOMBASA	041-222088
2	AEGIS CONSTRUCTION LTD	10188 NAIROBI	2726916/723872
3	ARAB CONTRACTORS LIMITED	967-00606 NAIROBI	020-4452138
4	ARSHAD SAZEH TOOLS KENYA LIMITED	9473-00100 NAIROBI	020-4453019
5	ASSOCIATED CONSTRUCTION COMPANY LIMITED	31114 NAIROBI	2715526/716512
6	ASSOCIATED ELECTRICALS & HARDWARE SUPPLIERS LIMITED	89157 MOMBASA	041-2493523
7	BRIDGESTONE CONSTRUCTION COMPANY LIMITED	2634 KISUMU	057-42319/21360
8	CHINA DALIAN INTERNATIONAL ECONOMIC & TECHNICAL COOPERATIVE GROUP LIMITED	10340-00100 NAIROBI	0737-294895
9	CHINA NATIONAL OVERSEAS ENGINEERING		
10	CORPORATION (COVEC) LTD	28 KAREN-NAIROBI	020-891699
11	CHINA SICHUAN INTERNATIONAL COOPERATION COMPANY LIMITED	19666 NAIROBI	020-810686
13	CHINA ROAD AND BRIDGE	39037 NAIROBI	020-570331

13	CHINA WU YI CO. LIMITED	49282- OOIOONAIROBI	020-2735091
14	CHINA JIANGXI INTERNATIONAL KENYA LIMITED	47662 NAIROBI	0791-6372788 CHINA
15	CHINA RAILWAY NUMBER FIVE ENGINEERING GROUP CO (K) LIMITED	3843-00200 NAIROBI	0717-019700
16	CHINA RAILWAYS SEVENTH GORUP 1COMPANY LTD	34024- OOIOONAIROBI	0736-749514
17	C & M CONSTRUCTION (K) LIMITED	UNIT 8/9 DULEEK BUSINESS PARK DULEEK. CO.MEATH (IRELAND).	0722-514018
18	CRESCENT CONSTRUCTION COMPANY LIMITED	49094 NAIROBI	533819/20
19	DHANJAL BROS LIMITED	82909 MOMBASA	020-491651/52
20	EVEN AMI LIMITED	49925- OOIOONAIROBI	020-4184035
21	ETERNAL FOUNDATION CONSTRUCTION COMPANY LTD	4225-00506 NAIROBI	CHINA
22	GLENCARRICK CONSTRUCTION (KENYA) LIMITED	856-00600 NAIROBI	0714-801096
23	G.ISSAIAS & CO. (K) LIMITED	43500 NAIROBI	020-2716717
24	GOGNI RAJOPE CONSTRUCTION CO. LTD	353 K1SUMU	057-21692

25	H.YOUNG CO LIMITED	30118 NAIROBI	020-530145/530151
26	GOWHARRUD CONSTRUCTION AFRICA LIMITED	4000-00506 NAIROBI	020-820583/6/7
27	HAYER BISHAN SINGH & SONS LTD	253 KISUMU	020-221471
28	INTERNATIONAL CORPORATION OF CONSULTANTS & CONTRACTORS (ICON) KENYA LIMITED	12253 NAIROBI	0733-940522
29	INTEX CONSTRUCTION LIMITED	60293-00200NAIROBI	0722-206161
30	KABUITO CONTRACTORS LIMITED	140554-0080NAIROBI	020-241830
31	KAY CONSTRUCTION COMPANY LIMITED	43114 NAIROBI	020-824903/5/6
32	KIMILILI HAULIERS LIMITED	11ELDORET	053-63622
33	KIRINYAGA CONSTRUCTION (K) LIMITED	48632-00100NAIROBI	020-2713222
34	KUNDAN SINGH CONSTRUCTION LTD	15018 NAIROBI	020-802594
35	LANDMARK HOLDINGS LIMITED	66537-00800NAIROBI	020-559844
36	MATTAN CONTRACTORS LIMITED	71143-00610NAIROBI	0722-515100
1"	MRZ CONSTRUCTION CO LIMITED	4000 NAIROBI	0721-814292

38	rtULJI DEVRAJ & BROTHERS LIMITED	82261 MOMBASA	0722-713009
39	POWER CONSTRUCTION EAST AFRICA LIMITED	67136- 00200NAIROBI	020-2714775
40	PROGRESSIVE CONSTRUCTIONS PRIVATE LIMITED	24883-00502 NAIROBI	0722-518383
J41	PUT SARAJEVO ENG. CO.	48331- 00100NAIROBI	020-2718571
42	SHENGLI ENGINEERING CONSTRUCTION (GROUP) COMPANY LIMITED OF SHENGLI OILFIELD	48297-00100 NAIROBI	008618653698201 CHINA
43 1	SPENCON KENYA LIMITED	14294- 00800NAIROBI	860264. 0722- 810608
44	S.S. MEHTA & SONS LIMITED	41853- 00100NAIROBI	020-553498, 555306
45 1	SBI INTERNATIONAL HOLDINGS AG	25027- 00603NAIROBI	0723-933682
46	SINOHYDRO CORPORATION LTD	24446- 00100NAIROBI	020-3870589
1 47 	TM-AM CONSTRUCTION GROUP (AFRICA)	18424- 00500NAIROBI	020-559088
48	TRANSTECH CONSTRUCTION COMPANY LIMITED	14580-00100 NAIROBI	0713-188853

Source: <http://www.roads.go.ke/files/categoryAcontractors.pdf>