

**LEAN MANUFACTURING PRACTICES IN A CONTINUOUS PROCESS
INDUSTRY: A CASE STUDY OF BAMBURI CEMENT LIMITED**

BY

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DECLARATION

This research project is my original work and has not been submitted to any University for examination.

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This research project has been submitted for examination with my approval as the University supervisor.

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May God bless you all.

DEDICATION

To my lovely husband Oliver Biyogo

ABSTRACT

The only way to stay competitive in the globalized market is to be efficient. Lean manufacturing is a strategic tool used to reduce waste and improve the efficiency and competitiveness of an organization. Lean manufacturing focuses on creating more value for customers by eliminating activities that are considered waste. Organizations that can meet or exceed customer's expectation have a higher chance of survival in the highly competitive market. This study sought to determine the extent to which lean manufacturing practices have been adopted at Bamburi Cement Limited, the drivers and barriers to effective implementation of lean manufacturing and finally to determine the benefits of implementing lean manufacturing practices at Bamburi Cement Limited. The research methodology adopted was a case study using Bamburi Cement Limited as the unit of study. The research findings revealed that Bamburi Cement Limited have systems and structures of lean manufacturing practices well in place. However they are not practically or well implemented thus hindering the organization from reaping full benefits of lean manufacturing. The lean manufacturing practices that have been adopted by Bamburi Cement Limited include: continuous improvement, standardization of work, poka yoke, production smoothing, 5S and total productive maintenance. Value stream mapping and JIT have not implemented. The drivers of lean manufacturing include: increased competition in the industry, to reduce costs, to conserve the natural resources, to attract and retain employees, to improve the company's performance and to produce high quality products and services at the right time and place thus satisfying the customer's needs. The benefits of lean manufacturing include: improved housekeeping, improved performance of the organization, multiskilling of workforce, cost control, reduction of waste, improved culture through teamwork activities and most importantly maintaining good relationship with the customers by producing high quality products and services at the required time and place. The challenges to effective implementation of lean manufacturing can be managed well and through training of the lean manufacturing concept, its implementation in the organization will be successful. It is also important that the management of Bamburi Cement Limited implement a system of tracking the effectiveness of each technique and ensure there is a consistent follow up of the systems and structures. In addition, the company can also explore the possibility of implementing value stream mapping and JIT.

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ABBREVIATIONS AND ACRONYMS

BCL	-	Bamburi Cement Limited
LM	-	Lean Manufacturing
POM	-	Plant Operating Model
RCA	-	Root Cause Analysis
SOP	-	Standard Operating Procedure
TPS	-	Toyota Production System
TOC	-	Theory of Constraints
TPM	-	Total Productive Maintenance
TQM	-	Total Quality Management
VSM	-	Value Stream Mapping
WIP	-	Work In Progress

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

According to Kumar and Kumar (2012), global competition in the manufacturing sector mirrors Darwin's theory of survival of the fittest. Organizations that can meet or exceed customer's expectation have a higher chance of survival. Aly and Mullen (2010) emphasized that businesses have to find a strategy that will help them survive, as the past strategies seem not to be working today. Tourki (2010) noted that many organizations have realized the essential need to adopt the lean philosophy instead of the traditional mass production concepts in order to stay competitive and survive in the global rivalry situation. Hence, adoption of production standards and strategies such as lean manufacturing has become a key survival technique for many companies across the world.

One way to stay competitive in the globalized market is to become more efficient. Lean manufacturing has been receiving a lot of attentions and the effects claimed after implementing it are enormous (Wong, Wong & Ali, 2009). Researchers have recognized lean manufacturing as the key to improving competitiveness for manufacturing companies. Muslimen, Yusaf and Abidin (2011) noted that lean manufacturing has become a widely acceptable and adoptable best manufacturing practice across countries and industries. Lean manufacturing not only reduces operational costs but also targets to boost, restore and significantly raise the competitiveness of a company (Mehta, Mehta & Mehta, 2012).

Lean manufacturing and Theory of Constraints are both systematic methods for improving operational performance of an organization. The theory of constraints effectively talks about a

value stream and the main cause for lack of flow due to constraints in the system (Melton, 2005). Dettmer (2001) explained how failure to act at the constraints in the system prevents it from realizing better performance in relation to goal of organization.

The cement manufacturing industry is one of the core industries playing a key role in the development of a country. It has strong linkage to other sectors like construction, transportation, coal, fuel and power. The industry is characterized by high levels of consumption of raw materials and energy with fuel accounting for 30-40% of the production costs (Khalil, Stockton & Tourki, 2012). It is therefore very important that cement companies embrace ideas that will guarantee their survival and profitability in the market since the cement industry plays a significant role in the economy.

1.1.1 Lean Manufacturing

What is Lean Manufacturing? In 1990, a book written by James .P. Womack, Daniel. T. Jones and Daniel Ross “*The machine that changed the world*” introduced a new concept called lean production or lean manufacturing (Kumar & Kumar, 2012). Lean manufacturing started as the Toyota Production System (TPS), developed by the Toyoda (now Toyota) Motor Car Company. Womack coined the phrase "lean manufacturing" (Mehta et al., 2012).

There are many definitions of lean manufacturing by different researchers. The term lean as Womack and his colleagues define it, denotes a system that utilizes less in terms of all inputs to create the same outputs as those created by traditional mass production system while contributing increased varieties for the end customer (Abdullah, 2003). Nordin, Deros and Wahab (2010) defined lean manufacturing as a manufacturing strategy that aims to achieve smooth production flow by eliminating waste and by increasing the activities value. Lean

manufacturing is about creating more value for customers by eliminating activities that are considered waste (Ondiek & Kisombe, 2012). El-Namrouty and AbuShaaban (2013) defines it as a philosophy, based on Toyota Production System, and other Japanese management practices that strive to shorten the time line between the customer order and the shipment of the final product, by consistent elimination of waste. Abdullah (2003) explained that, once companies pinpoint the major sources of waste, tools such as continuous improvement, just-in-time production, production smoothing, and others will guide companies through corrective actions so as to eliminate waste.

The ultimate goal of a lean organization is to create a smooth and high quality organization that is able to produce finished products concerning the customers demand in the quality looked for with no waste (Nordin et al., 2010). “Lean” focuses on abolishing or reducing wastes (or “muda”, the Japanese word for waste) and on maximizing or fully utilizing activities that add value from the customer’s perspective (Abdullah, 2003). It is thus clear that elimination of waste is the basic principle of Lean Manufacturing. Erfan (2010) defined waste as anything that does not add value to the process or service delivered to the customer.

1.1.2 Cement Industry in Kenya

Cement satisfies one of humanity’s most basic needs, shelter. Osano (2008) defined cement as a binder, a substance that sets and hardens independently, binding material together. The cement industry is one of the core industries playing a critical role in the development of country. It has strong linkage to other sectors like construction, transportation, coal, fuel and power. It also supports the community in terms of income, community programs and skills.

There are six cement manufacturing companies in Kenya; Bamburi Cement Limited, East African Portland Cement (EAPC), Athi River Mining (ARM), Mombasa Cement, National Cement and Savannah Cement. There are several factors affecting the cement industry in Kenya. Increased competition in the industry from new entrants has forced prices and margins to stay low as all cement producers compete on the basis of price (EAPCC Annual Report, 2012). Njeru (2007) highlighted the challenges affecting the strategic actions in the cement industry in Kenya as: political anxieties, threats posed by new entrants, technological advancement, legislative changes, government policy changes and economic changes.

Kenya's cement consumption rose to 3.4 million tonnes in 2012 compared to 3.1 million tonnes in 2011. Public sector infrastructure projects and the rapidly growing middle class in Kenya will be the main drivers of cement consumption going forward (EAPCC Annual Report, 2012). Tourki (2010) emphasized the need for improving the efficiency of the cement production line in order to reduce the downtime rates, and satisfy high levels of market demand where the demand for cement is mostly second substance behind water. It is therefore important for cement companies to adopt production standards and strategies such as lean manufacturing that will guarantee their survival in the vibrant and turbulent environment.

1.1.3 Bamburi Cement Limited

Bamburi Cement Limited is a subsidiary of Lafarge. It was started in 1951 with its first plant located in Mombasa beginning production in 1954. It is the largest cement manufacturer in Kenya, enjoying local dominance both in terms of production and market share (Kenya cement industry, 2012). It has three active subsidiaries: Hima Cement Limited, Bamburi Special Products Limited and Lafarge Eco Systems Limited. In addition it has the world famous quarry rehabilitation, Haller Park. Bamburi Cement Limited has a number of high quality products on

the market, including Power Plus, Bamburi Blox, Power Max and Nguvu brand cement. In addition, it gives utmost priority to safety in all its operations (Bamburi Cement Annual Report, 2012).

The entry of new players into the cement sector is eating into the profitability and market share of the established players like Bamburi Cement Limited. In the East African Cement Sector (2012), the domestic market share estimates clearly shows that Bamburi Cement Limited has been losing its market share to the new entrants. Its market share was 55% in 2005, 40.5% in 2011 and projected to be 38% in 2015. This trend is worrying, in order to survive and continue enjoying local dominance in production and market share, BCL has to develop and embrace new technologies and strategies.

High cost of production due to frequent fluctuations of fuel and oil prices, competition and stockholding costs are some of challenges highlighted by Mwanzia (2009) that are facing Bamburi Cement Limited. Old Mutual, an investment company, projects that the East African region will face a situation of excess supply by 2015, due to the entry of new players and further capacity enhancement by existing producers, leading to downward pricing pressures (Michira, 2012).

Tourki (2010) in his SWOT analysis for the cement industry highlighted the changing forces that drive the decision maker to think about applying and implementing lean philosophy as significant global increases of fuel and energy costs, the pressure to keep prices lower than the competitors and high market demand that put the cement industry under pressure to simultaneously reduce cycle time and downtimes, and increase utilization and throughput of the

equipments. Is lean manufacturing one of the possible solutions to some of the challenges facing Bamburi Cement Ltd?

1.2 Research Problem

Implementation of lean manufacturing helps many organizations to improve their productivity and efficiency (Tourki, 2010). Lean manufacturing practices such as cellular manufacturing, continuous improvement, JIT, production smoothing, standardization of work and poka yoke are used to reduce waste in the manufacturing process. Reduced cost, reduced lead time, waste reduction, improved productivity, reduced inventory, lower cycle times, improved flexibility, multiskilled worker, better utilization of equipment and space and reduced defects are some of the advantages of lean manufacturing highlighted by Kumar and Kumar (2012). Lean manufacturing is therefore an essential strategy for companies to continue being competitive in the globalized market. Nordin, Deros and Wahab (2010) warned that, an organization that ignores the lean manufacturing strategy would not be able to stand a chance against the current global competition for higher quality, faster delivery and lower costs.

Cement industry is one of the core industries playing a key role in the development of a country. Njeru (2007) argued that the cement industry plays a forward and backward linkage with other economic sectors hence playing a critical role as an indicator to the general economic conditions. It also supports the community in term of income, community programs and skills. However the industry faces a lot of challenges that threaten its survival in the globalized market. Tourki (2010) in his SWOT analysis for the cement industry highlighted the changing forces that drive the decision maker to think about applying and implementing lean philosophy as significant global increases of fuel and energy costs, pressure to keep prices lower than the competitors and

high market demand. Bamburi Cement Limited was selected since it is a continuous process and has implemented some of the lean manufacturing practices. It is also the largest cement producer in Sub-Saharan Africa and the largest industry on the Kenyan Coast. Mwanzia (2009) highlighted high cost of production due to frequent fluctuations of fuel and oil prices as one of the challenges facing Bamburi Cement Limited. The entry of new players into the cement sector is also eating into the profitability and market share of Bamburi Cement Limited. The increased competition leads to downward pricing pressures as all cement producers are competing on the basis of price.

The tools and techniques of lean manufacturing have been widely used in the discrete industry as compared to the continuous industry starting with the introduction of the Toyota Production System. The current challenge is to implement the lean philosophy within non-discrete production environments such as continuous manufacturing industries and service industries regardless to the type, size, or mission of the applicant organization (Khalil et al., 2012). According to Abdullah (2003), managers have been hesitant to adopt lean manufacturing tools and techniques to the continuous process industry because of high volume, low variety products, large inflexible machines and long set up times. This research was driven by the fact that while researchers have widely researched on lean manufacturing tools in the discrete industry, few scholars have investigated application of the lean manufacturing tools and techniques to a continuous process industry. Ondiek and Kisombe (2012) noted with concern that there is need for further research in the area of lean manufacturing not only in the sugar sector but also in other areas of the Kenyan economy. Gichere (2007) is among the few who examined the degree of adoption of lean principles in the Kenyan petroleum industry.

This study sought to research on the lean manufacturing practices in the cement industry in Kenya using Bamburi Cement Limited as the unit of study. Specifically, the study sought to answer the following questions; to what extent has lean manufacturing been applied and what are the factors that led Bamburi Cement Limited to adopt lean manufacturing? Is lean manufacturing beneficial to Bamburi Cement Limited? What are the hindrances to successful implementation of lean manufacturing in Bamburi Cement Limited?

1.3 Research Objectives

- i. To determine lean manufacturing practices adopted by Bamburi Cement Limited.
- ii. To determine the factors that led Bamburi Cement Limited to adopt lean manufacturing practices.
- iii. To determine the benefits of practicing lean manufacturing practices at Bamburi Cement Limited.
- iv. To investigate the challenges faced in implementing lean manufacturing practices at Bamburi Cement Limited.

1.4 Value of the Study

The findings of this research will contribute to the realization of Bamburi's Cement Vision; "To Be a World Class Plant". This will be through identification of lean manufacturing practices used in the company, determine to what extent they are utilized and what other lean manufacturing tools and techniques that can be employed to enable improvement in the company's operations performance. In addition, by highlighting the challenges faced in lean manufacturing, the study could help the management of Bamburi Cement Limited to brainstorm on how they could

overcome them. Other cement companies in Kenya will also find this study very useful in terms of understanding the benefits of adopting lean manufacturing practices and what challenges they are likely to face.

To the policy makers, the findings will provide insight into the practices of lean manufacturing in the cement industry in Kenya. This understanding will help during formulation of policies regarding regulation of importation of cement. This can be done by reviewing the taxation policy to protect the local manufacturing companies from cheap imports from countries like Egypt and India.

Scholars and academicians will also find this study an invaluable source of secondary data for future studies in the field of lean manufacturing. This research will build into the knowledge of lean manufacturing in a continuous process industry in Kenya. The research will also provide insights into the implementation of lean practices in the cement industry in Kenya. It will also help in identifying the challenges faced in implementation of lean manufacturing to a continuous process industry in Kenya.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter focuses on a review of literature on lean manufacturing. The chapter begins by a discussion of the concept of lean manufacturing and then highlights the lean manufacturing practices. The benefits and barriers to adoption of lean manufacturing by organizations are then discussed. A summary of the chapter discussing some issues raised by researchers in this field is given at the end.

2.2 Lean Manufacturing

The concept of lean manufacturing was pioneered by a Japanese automotive company, Toyota, during 1950's which was famously known as Toyota Production System (Tourki, 2010). Taiichi Ohno, who was given the task of developing a system that would enhance productivity at Toyota, is generally considered to be the primary force behind its system (El-Namrouy & AbuShabaan, 2013). The primary goal of TPS was to reduce the cost and to improve productivity by eliminating wastes or non-value added activities (Nordin et al., 2010). The term Lean as Womack and his colleagues define it, denotes a system that utilizes less in terms of all inputs to create the same outputs as those created by traditional mass production system while contributing increased varieties for the end customer (Abdullah, 2003). Elimination of waste is the basic principle of lean manufacturing. Rogstad (2010) defines value as what the customer is willing to pay for while non-value added activities as waste or incidental activities that are necessary but add no value to the product.

Erfan (2010) categorized waste into eight categories: over production, waiting, including time in queue, work in progress, transportation between workstations or between supplier and customers, inappropriate processing, excess motion or ergonomic problems, defected products, and underutilization of employees. Waste sources are all related to each other and getting rid of one source of waste can lead to either elimination of, or reduction in others. The most significant source of waste is inventory (Abdullah, 2003). Companies store inventories to enable continuous deliveries and overcome problems such as demand variabilities, unreliable deliveries from suppliers, and breakdowns in production processes (Wong et al., 2009). Work-in-process and finished parts inventory do not add value to a product and they should be eliminated or reduced. When inventory is reduced, hidden problems can appear and action can be taken immediately (Abdullah, 2003). Wong et al. (2009) added that there is a need to maintain inventories at the minimum level because excess inventories would require more valuable spaces and result in higher carrying costs. Moreover, they accumulate the risk of “products becoming obsolete” However, it is not advisable to eliminate inventory mindlessly. Instead, the reasons for the existence of inventory must first be removed. One important way of doing this is by minimizing downtime in machines. This is accomplished through preventive maintenance (Karlsson & Åhlström, 1996).

It is thus clear that the elimination of waste is an essential ingredient for survival in today’s manufacturing world. A lean organization can make twice as much product with twice the quality and half the time and space, at half the cost, with a fraction of the normal work-in-process inventory (El-Namrouty & AbuShabaan, 2013). One of the ways to decrease wastages can be elimination of non productive activities that can result in drop in time, cost, and lead time. Time is money, if additional time is incurred in a product or service extra money is involved. By

responding faster to make a product as per customer demand, the company can capitalize less money and more savings (Islam, Khan & Uddin, 2013).

2.3 Lean Manufacturing Practices

Elimination of waste is the basic principle of lean manufacturing. Erfan (2010) explained that the lean manufacturing practices are used to identify and remove wastes from the system continuously. These lean manufacturing practices include: Cellular manufacturing, continuous improvement, 5S, standardization of work, total productive maintenance, just in time, production smoothing, poka yoke and value stream mapping.

2.3.1 Cellular Manufacturing

In cellular production layouts, equipment and workstations are arranged into a large number of small tightly connected cells so that many stages or all stages of a production process can occur within a single cell or a series of cells (Kumar & Kumar, 2012). Bhasin and Burcher (2006) explained that it is important to group closely all the facilities required to make a product or related products in order to reduce transport, waiting and process time. Paneru (2011) explained that the advantage of a closed loop arrangement of machines is that the operators inside the cell are familiar with each other's operations and they understand each other better. This improves the relation between the operators and helps to improve productivity.

2.3.2 Continuous Improvement

Continuous improvement is defined as the planned, organized and systematic process of ongoing, incremental and company-wide change of existing practices aimed at improving company performance (Paneru, 2011). It focuses on elimination of non value added activities in

the process. Identification and elimination of non value added activities in the process results to increased production, reduction of cost, time and improving quality.

2.3.3 The Five S's

Moore and Scheinkopf (1998) explained 5S as follows; Seiri means to separate the necessary things from the unnecessary and discard the unnecessary. Seiton refers to arranging neatly and identifying things for ease of use. Seiso means to always clean up; to maintain tidiness and cleanliness, to clean your workplace thoroughly .While Seiketsu, is to constantly maintain the 3S mentioned above. It means keeping a clean workplace without rubbish. Finally, Shitsuke, to have workers make a habit of always conforming to rules. Taken together; 5S means good housekeeping and better workplace organization (Abdullah, 2003). Melton (2005) explained it as activities used to create a workplace suited for visual control and lean practices. In addition, a well maintained work place creates a healthy environment to work in.

2.3.4 Standardization of Work

It refers to organizing the job and performing it in the most effective way. In a standardized workplace every worker follows the same steps within the production process (Tinoco, 2004). When the work is standardized, the same quality of output is achieved. Toyota managers recognize that the lack of details and explicit description of work content, sequence, timing, and outcome allows operators or employees to perform tasks differently, which results in more variation in outcome (Mohanty, Yadav & Jain, 2007).

2.3.5 Total Productive Maintenance

Seiichi Nakajima a major contributor of TPM, defined it as an innovative approach to maintenance that optimizes equipment effectiveness, eliminates breakdowns, and promotes

autonomous maintenance by operators through day-to-day activities involving the total workforce (Ahuja & Khamba, 2007). Rajput and Jayaswal (2012) explained that TPM is an approach to keep the current plant and equipment at its higher productive level through cooperation of all areas of organization.

2.3.6 Just In Time

Just-in-time manufacturing is a Japanese management philosophy applied in manufacturing field. It involves having the right items with the right quality and quantity in the right place at the right time (Paneru, 2011). The primary goal for all the companies is customer's satisfaction and if a company cannot reach perfection in this area then all the processes are worthless. JIT is a tool if well implemented, improves business performance and efficiency through reduction of costs, better quality products and increased production.

2.3.7 Production Smoothing

It is a method for planning and leveling customer demand by volume and variety, while keeping the level of production as constant as possible over a specific time period (Tinoco, 2004). If the production level is not constant this leads to waste (such as work-in-process inventory) at the workplace (Abdullah, 2003). Work-in-process inventory do not add value to a product and they should be eliminated or reduced. This will expose hidden problems and action can be taken immediately. Ondiek and Kisombe (2012) explained that the main advantage the manufacturing unit gains by implementing production smoothing is that the output will be the exact amount as required at the required time and there will be reduced chance of accumulating inventory.

2.3.8 Poka Yoke

Poka-yoke is a quality assurance technique developed by Japanese manufacturing engineer Shigeo Shingo in 1961. It is translated as "resistance to errors" that is avoiding (yoker) errors resulting from inattention (poka). The aim of poka-yoke is to eliminate defects in a product by preventing or correcting mistakes as early as possible (Dudek-Burlikowska & Szewieczek, 2009). Dos Santos and Powell (1999) explained that one of the most common sources of errors in production systems is the human being itself. Human beings are always prone to making errors. When errors are made and are not caught then defective parts will appear at the end of the process. However, if the errors can be prevented before they happen then defective parts can be avoided and eventually leading to production of high quality products.

2.3.9 Value Stream Mapping

Rao, Subbaiah, Rao and Rao (2011) defined VSM as the process of visually mapping the flow of information and material as they are preparing a future state map with better methods and performance. This helps in the identification of value-added activities and non value-added activities. Value stream map serves as a critical tool that can reveal substantial opportunities to reduce costs improve production flow, save time and reduce inventory (Ondiek & Kisombe, 2012). It helps to visualize the station cycle times, inventory at each stage, manpower and information flow across the supply chain.

2.4 Theoretical Review

Lean Manufacturing and Theory of Constraints are both systematic methods for improving operational performance of an organization that have received a great deal of attention in recent years. Theory of Constraints is a popular business philosophy that first emerged with Dr. Eliyahu

Goldratt's landmark book, *The Goal*. It guides its practitioners to improve their organizations by focusing on very few issues, the constraints to ongoing profitability (Moore & Scheinkopf, 1998). This theory aligns with lean thinking in the way it considers an organization as a system consisting of resources which are connected by processes which ultimately make product which can be sold. It effectively talks about a value stream and the main causes for the lack of flow; constraints in the system (Melton, 2005). Goldratt believed that each system contained leverage points, critical places where force could be applied and do the most good. He referred to these leverage points as constraints, because inaction at these locations prevented the system from realizing better performance in relation to its goal (Dettmer, 2001).

Drum-Buffer Rope (DBR) is the application of TOC in production systems. The main theme of DBR is that within any production line there is one or more limited resources, which control the overall throughput and the whole system should be scheduled regarding to the constraint (Tourki, 2010). Rahman (1998) defined DBR as follows: The drum is the system schedule or the pace at which the constraint works. Rope provides communications between critical control points to ensure their synchronization. Buffer is strategically placed inventory to protect the system's output from the variations that occur in the system.

2.5 Benefits of Adopting Lean Manufacturing

Lean manufacturing not only reduces operational costs but also targets to boost, restore and significantly raise the competitiveness of a company (Gupta & Mehta, 2013). El-Namrouty and AbuShabaan (2013) argued that a lean organization can make twice as much product with twice the quality and half the time and space, at half the cost, with a fraction of the normal work-in-process inventory. Lean production is an intellectual approach consisting of a system of

strategies which, when taken together, produce high quality products at the pace of customer demand with little or no waste (Ondiek & Kisombe, 2012). Mehta et al. (2012) pointed out that, when customer satisfaction is achieved, sales will surely rise. The best way to establish a good relationship with customers is to improve the products and services offered to them.

Implementation of lean helps many organizations to improve their productivity and efficiency; (Tourki, 2010). Khalil et al. (2012) pointed out that; implementation of lean manufacturing can generate superior operational and financial improvements within all systems. The following are benefits of lean manufacturing implementation as highlighted by Kumar and Kumar (2012): Reduced cost reduced lead time, waste reduction, improved productivity, reduced work in progress (WIP) inventory, lower cycle times, improved flexibility, multiskilled workers, better utilization of equipment and space and reduced defects. Lean manufacturing leads to increased process understanding. Melton (2005) explained that it increases the understanding of the whole supply chain including the manufacturing processes and all other processes within the value stream. Through 5S, lean manufacturing aids in maintaining high standard of housekeeping in the organization. Its successful implementation requires active involvement by everyone, flow of information along value chain and support by the management. Thus lean manufacturing promotes teamwork and effective communication in the organization. With all these benefits of lean manufacturing, what might stop companies from adopting it?

2.6 Challenges faced when adopting Lean Manufacturing

The case of not achieving the expected results of implementing lean is not because of limitation of lean to specific organizations type; however the misconception of the lean philosophy is amongst the main failure's factors (Tourki, 2010). The main barriers to implement lean

manufacturing system are the lack of understanding of lean concepts and shop floor employees' attitude (Nordin et al., 2010). One of the major barriers to lean implementation is providing evidence of its potential benefit to end users (Khalil et al., 2012). Wong et al. (2009) identified people factor as one of the major challenge when adopting lean manufacturing. This is by employees reverting to the old ways of working probably because lean manufacturing initiatives might have burdened them with additional work. In addition, resistance from employees due to the "fear factor" that they would lose their jobs if they find out that their jobs do not add values, since lean manufacturing is about eliminating non value added activities. Levy (1997) added that, lean production requires rapid flows of information along the value chain which is costly and difficult when value chain activities are geographically dispersed.

Obstacles of lean manufacturing implementation highlighted by Kumar and Kumar (2012) include lack of management support, lack of training, lack of communication, resistance to change and no direct financial advantage. Lean does not produces any direct financial benefits but it helps in identification and elimination of waste hence reduction of cost. Therefore it is very important that lean manufacturing potential benefits are made known to all employees to ensure that they are supportive and have a common goal to achieve it. Bhasin and Burcher (2006) in their analysis noted that the major difficulties companies encounter in attempting to apply lean are a lack of direction, a lack of planning and a lack of adequate project sequencing. The challenge to organizations utilizing lean manufacturing is to create a culture that will create and sustain long-term commitment from top management through the entire workforce (Prakash & Kumar, 2011). Nordin et al. (2010) pointed out that to implement lean manufacturing system is not an easy task for any change in organization to take hold and success, the resistance forces or barriers need to be identified and understood.

2.7 Empirical Literature Review

Wong et al. (2009) did a study on lean manufacturing implementation in the Malaysian electrical and electronics industry and Nordin et al. (2010) on lean manufacturing implementation in Malaysian automotive industry. Muslimen et al. (2011) investigated on how to implement and what suitable approach to be used in order to successfully implement LM in Malaysian manufacturing industries. The researchers have investigated the implementation of lean manufacturing within a discrete industry while cement industry is a continuous process industry.

Ondiek and Kisombe (2012) did a survey of lean manufacturing tools and techniques in the industrial operations in the sugar sector in Kenya. They examined the extent to which lean manufacturing tools and techniques are adopted by sugar processing companies in Kenya and their impact on factory time efficiency. Factory time efficiency is the index that measures the ability of a factory to sustain operations throughout the year without interruptions and is an important pointer to operational performance of a manufacturing industry. Abdullah (2003) investigated the lean manufacturing tools and techniques in the process industry with a focus on steel. He investigated how lean manufacturing tools can be adapted from the discrete to the continuous manufacturing environment, and evaluated their benefits on steel industry. Gichere (2007) examined the degree of adoption of lean principles in the Kenyan Petroleum Industry. She conducted survey of major petroleum companies in Kenya.

This research is driven by the fact that few studies have been done on a continuous process industry and especially in the Kenyan context. Ondiek and Kisombe (2012) noted with concern that there is need for further research in the area of lean manufacturing not only in the sugar

sector but also in other areas of the Kenyan economy. In addition, no research has been done on lean manufacturing practices at Bamburi Cement Limited.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter details the research methodology that was adopted so as to meet the objectives set out in chapter one which was to establish the lean manufacturing practices at Bamburi Cement Limited and determine the benefits and challenges to effective implementation of lean manufacturing. The research design and justification, data collection method and data analysis technique are discussed.

3.2 Research Design

The design adopted for this research was a case study method of Bamburi Cement Limited being the unit of study. A case study is a holistic inquiry whose goal is to gain insight, explore the depth and complexity inherent in a contemporary phenomenon. It is used to have a hand on all details and gain in-depth understanding of the chosen sample case instead of the whole population (Tourki, 2010).

The main reason for choosing a case study method for this research is that the reality is captured in great detail. Zainal (2007) argued that case studies not only help to explore or describe the data in real-life environment, but also help to explain the complexities of real life situations which may not be captured through experimental or survey research. The study intended to provide an in-depth description of lean manufacturing at the target unit and document the benefits and challenges of its implementation.

3.3 Data Collection

The study used primary data relating to lean manufacturing at Bamburi Cement Limited. The primary data was obtained through in-depth personal interviews with the Plant Manager, Production Manager, Process Manager, Maintenance Manager, some of the shop floor employees and suppliers. The variables covered in the literature review together with the research objectives formed the basis of the interview schedule design. Mcgrath (2007) argued that use of in-depth interviews is effective in case studies as superior depth of information and detail can be obtained as compared to other techniques.

3.4 Data Analysis

The feedback from the in-depth personal interviews formed the basis for content analysis. Content analysis is a technique for making inferences by objectively and systematically identifying specified characteristics of message (Kohlbacher, 2006). Bodolay (2010) justified the use of content analysis in a case study that the qualitative data found through a case study is put into numerical form for analysis and comparison. This allows for developing results and drawing conclusions on the topic. Collected data was organized and reduced by coding into manageable content categories. By breaking down the contents of materials into meaningful information, certain characteristics of the message relating to lean manufacturing were analyzed and interpreted.

CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Introduction

The main objective of this research was to establish lean manufacturing practices adopted at Bamburi Cement Limited and determine the benefits and challenges to effective implementation of lean manufacturing. This chapter presents the analysis and interpretations of the data from the field. The instrument used to collect the primary data was an interview guide which was designed in line with the objectives of the study as well as the lean manufacturing constructs discussed in literature review.

4.2 Lean Manufacturing Practices Adopted By Bamburi Cement Limited

One of the objectives of this research was to determine the lean manufacturing practices adopted at Bamburi Cement Limited. All the informants interviewed acknowledged the fact that lean manufacturing has not been fully implemented. They explained that the systems and structures are in place but not religiously implemented or adopted as required.

Standardization of work has been applied to ensure that every worker follows the same steps in the production process aiming at achieving the same quality of output. There are standard operating procedures in every department explaining how to manage different situations or incidents. All jobs have a standard operating procedure. There is a risk assessment done before executing any task to ensure that one is safe when performing any duty. This is done by filling a job safety analysis form. However with this procedures well documented, they are sometimes not given the necessary attention when needed.

Total productive maintenance has also been adopted at Bamburi Cement Limited. The main objective being to increase the reliability of the equipments and plant. First level inspection of the equipment is done by both the production and mechanical departments. This is the inspection done using the five common senses of hearing, touching, smelling, seeing and feeling any abnormal condition of the equipment. This helps in arresting the problems before the equipment fails. Planned maintenance is done as per the schedule so as to maintain the equipment at its optimum productive level.

Continuous improvement has been adopted in many ways. There are daily meetings done to discuss the performance of the plant. These meetings are attended by all departments and actions are generated and followed up, tracked to completion in the online actions tracking tool. Plant operating model (POM) is a set of coherent principles, practices, processes, procedures and tools that enable the organization to function effectively and efficiently. It is based on four key principles namely: anticipation, prevention, continuous improvement and certification. Plant ownership teams consists of a cross functional team. The teams meet monthly to discuss the performance of the respective sections and come up with ideas of improvement. Root cause analysis (RCA) meetings are held to discuss incidents and come up with actions to prevent reoccurrence of the same. The actions generated from all these meetings are mainly to improve the performance of the plant and they are tracked to completion in the actions tracking tool.

Production smoothing is done through the sales and operation meetings conducted daily to discuss the production and sales and try to match them up and meet the customers demand without overproducing or under producing. This meeting constitutes the logistics department, production department, dispatch department, sales department and maintenance department all with the aim of achieving one goal which is to satisfy the customer's demand.

Poka yoke has been applied to eliminate the defects and correct mistakes as early as possible. This is through automation of the process. As soon as an error occurs an alarm is triggered prompting someone to attend to the problem otherwise there is a time bomb that will stop the process. The weigh feeders have been automated such that if one of them stops, the rest stop to avoid milling an off spec product thus affecting the quality of the end product. If one of the feeders is out of calibration an alarm will be triggered stopping the system for a corrective action to be taken to ensure it is operating within the required range.

5S has been applied to maintain good housekeeping in the plant. Cement manufacturing process generates a lot of dust and if it is not well managed it can be detrimental to employees' health. All the departments have been tasked to maintain good housekeeping in their respective sections. The foremen are fully responsible for the housekeeping in their shops. An audit is done and every section in the plant and offices is given a score. This keeps everyone in the plant on toes to maintain the required standard of housekeeping.

4.3 Drivers of Lean Manufacturing Adoption by Bamburi Cement Limited

The informants mentioned competition as one of the key drivers to adoption of lean manufacturing. Increased competition in the industry from new entrants has forced prices and margins to stay low as all cement producers compete on the basis of price. In addition the emergence of new entrants in the industry has resulted to reduction of BCL's market share. Reduction of waste is a key driver of lean manufacturing at BCL as it results to reduction of costs.

Other drivers of lean manufacturing cited by the informants include: to get bonuses, improve company's performance, attract and retain employees, avoid worst case scenario of retrenchment

due to rising costs, depletion of natural resources such as the quarries. One of the informants mentioned that by respecting the planned maintenance of the equipment and executing it well with quality it minimizes the breakdowns and thus he can be free to do other things instead of spending most of the time in the plant doing corrective maintenance or attending meetings to discuss the root cause of the failures (RCA meetings). This reduces fatigue and allows time to refresh and do other activities.

4.4 Benefits of Lean Manufacturing Practices at Bamburi Cement Limited

The third objective of this study was to determine the benefits of practicing lean manufacturing practices at Bamburi Cement Limited. The following are the benefits of lean manufacturing practices at Bamburi Cement Limited as explained by the informants. Lean manufacturing helps in improving the reliability of the equipment. It also results to improved housekeeping in the plant. It has improved the culture through teamwork activities such as plant ownership teams which constitutes a cross functional team.

Other benefits of lean manufacturing cited by the informants are: improved performance of the organization, multiskilling of workforce, cost control and reduction of waste. Lean manufacturing has also helped in maintaining good relationship with the customers by producing high quality product without delays. Hence Bamburi Cement Limited is still at the top, enjoying the local dominance in terms of market share.

4.5 Challenges Faced in Implementation of Lean Manufacturing Practices at Bamburi Cement Limited

The fourth objective of this study was to determine the challenges faced in implementing lean manufacturing practices at Bamburi Cement Limited. Lack of understanding of lean

manufacturing was explained by one of the informants as the main challenge affecting the effective implementation of lean manufacturing at Bamburi Cement Limited. This could explain the resistance of employees to successful implementation of lean manufacturing. Lean manufacturing is also not linked to the reward system thus employees are not motivated to participate in its implementation. It is also hard to quantify the benefits achieved from lean manufacturing. Structures and systems exist but are not adhered to. Almost all the informants explained the fact that some meetings are held as a routine but missing out on the objective. For instance the RCAs are done as a routine but the actions generated are not closed out resulting to repetitive RCAs when the same incidents occur. This is a waste of time and money. Planned maintenance schedules are not strictly followed resulting to equipment breakdowns.

One of the informants cited poor planning as a major challenge leading to reaction to problems. He referred to it as fighting problems as they happen. In addition, lack of empowerment, lack of motivation and unclear objectives were mentioned as the barriers to effective implementation of lean manufacturing. One of the informants cited lack of an enabling environment for contribution of new innovative ideas.

Other challenges mentioned by the informants include; lack of consistency in the follow up of objectives, an organizational culture of 'know it all' also limits learning. In other words, can't learn won't learn. Lack of skills and competencies, internal inefficiencies, lack of a common shared objective which was explained as silo mentality (not my problem) are other challenges cited by the informants. The objective of speed of delivery of results rather than value/effectiveness of job done during equipment maintenance compromises on quality of work done. Poor inspection of equipment, the decision making process taking too long and lack of

alignment of departments to support one another were also mentioned as great challenges to implementation of lean manufacturing.

One of the informants explained taking shortcuts to accommodate problems as killing the effective implementation of lean. Over dependency on one supplier due to high costs of importation and government licenses on environmental policies were explained as limiting the bargaining power of the organization and a risk to consistency of supply. One of the informants explained that JIT is not applied especially in the supply of cement bags. This is to avoid bag breakages as they are supposed to cure before usage.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary discussion on lean manufacturing practice and the drivers, benefits and challenges faced in the effective implementation of lean manufacturing at Bamburi Cement Limited. A conclusion discussing the general findings of the research is highlighted followed by recommendation based on the findings of the study. The limitations of the study and suggestions on areas of further research are discussed at the end of the chapter.

5.2 Summary of Findings

The research findings revealed that Bamburi Cement Limited has the systems and structures of lean manufacturing practices well in place. However they are not practically or well implemented thus hindering the organization from reaping full benefits of lean manufacturing. The lean manufacturing practices adopted are continuous improvement, 5S, standardization of work, Total Productive Maintenance and poka yoke. Value stream mapping and JIT are the lean manufacturing practices not implemented in the organization.

The drivers of lean manufacturing at Bamburi Cement Limited include: increased competition in the industry, to reduce costs, to conserve the natural resources, to attract and retain employees, to improve the company's performance and to produce high quality products and services at the right time and place thus satisfying the customer's needs. The benefits of lean manufacturing cited by the informants include: improved housekeeping, improved performance of the organization, multiskilling of workforce, cost control, reduction of waste, improved culture

through teamwork activities and most importantly maintaining good relationship with the customers by producing high quality products and services at the required time and place.

The challenges cited by the informants are within the control of the management of Bamburi Cement Limited. These challenges include: lack of understanding of lean manufacturing concept, lack of empowerment, lack of motivation, unclear objectives, poor planning, lack of an enabling environment for contribution of new innovative ideas, inconsistency in the follow up of objectives and poor inspection of the equipment. The top management is supportive of the concept and the informants are positive about lean manufacturing concept and are willing to participate in implementing it.

5.3 Conclusion

The findings of this research are consistent with the research done by other scholars. The key driver of adopting lean manufacturing at Bamburi Cement Limited is competition. Tourki (2010) explained that many organizations have realized the essential need to adopt lean manufacturing in order to survive in the global rivalry situation. Bamburi Cement Limited also strives to maintain a good relationship with the customers by producing high quality products at the right time and place. Kumar and Kumar (2012) explained that organizations that can meet or exceed customers' expectations have a higher chance of survival. Reduction of costs was cited by the informants as among the key drivers of adoption of lean manufacturing. Mehta, Mehta and Mehta (2012) explained how lean manufacturing not only reduces operational costs but also targets to boost, restore and significantly raise the competitiveness of a company.

The benefits of lean manufacturing cited by the informants are consistent with the research done by other scholars. Ondiek and Kisombe (2012) explained that lean manufacturing consists of a

system of strategies which produce high quality products at the pace of customer with little or no waste. Khalil et al. (2012) highlighted that lean manufacturing implementation generates superior operational and financial improvements within all systems. Abdullah (2003) explained how 5S results to good housekeeping and a better workplace organization. Kumar and Kumar (2012) summarized the benefits of lean manufacturing as follows: reduced cost, waste reduction, improved productivity, multiskilled workers and better utilization of the equipment.

Bhasin and Burcher (2006) highlighted lack of planning as a barrier to effective implementation of lean manufacturing. Nordin et al. (2010) noted that the main barrier to the implementation of lean manufacturing is the lack of understanding of lean concepts. Tourki (2010) explained that the misconception of lean manufacturing is a major hindrance to its effective implementation. Khalil et al. (2012) explained that the major barrier to lean manufacturing implementation is providing evidence of its potential benefit to end users. All these are consistent with the findings of this research.

5.4 Recommendations

There is a general lack of understanding of lean manufacturing hence training on lean manufacturing is recommended. This will result to a better understanding of the concept among the employees. It is important that the potential benefits of lean manufacturing are made known to all employees to ensure they are supportive in its implementation.

Overall, very good systems and structures exists that support lean manufacturing which if religiously implemented will greatly improve the performance of the organization. It is important that the management implements a system of tracking the effectiveness of each technique and

ensure that there is a consistent follow up of the systems and structures in place to ensure they are implemented as required.

Value stream mapping has not been implemented. It is a very good tool that can help in mapping out the entire process of cement manufacturing at BCL and visually separate the non added value activities from the value added activities. In addition the company can also explore the possibility of implementing JIT.

The challenges cited by the informants as hindering effective implementation should be addressed by the management of BCL in order to reap the full benefits of lean manufacturing and significantly improve the operational performance of the company. It is important to note that the top management is supportive and the employees are also positive about lean manufacturing concept and are willing to participate in implementing it.

5.5 Limitations of the study

The study was largely constrained by the short time available. The informants also had tight schedules and could only manage limited time to provide the required data. In addition there were a lot of interferences during the interview due to the nature of their work. The concept of lean manufacturing was also not well understood and this posed challenges in getting feedback and gathering information on its implementation.

The Kenyan manufacturing environment and sector is highly competitive and players have a tendency not to disclose information touching on their manufacturing practices or challenges as they suspiciously consider this as a platform for industrial espionage or it may expose their weakness or strengths to their business rivals. This phenomenon has resulted to limited scholarly

articles on the Kenyan case touching on lean manufacturing thus hampering benchmarking or cross referencing.

5.6 Suggestions for further studies

One of the main challenges is to quantify the benefits reaped from lean manufacturing. How does its implementation translate to monetary value or operational excellence? The researcher thus recommends further studies on how the lean manufacturing improves the operational performance of the organization.

Cement industry plays a significant role in the economy of Kenya. However, the industry faces a lot of challenges that threaten its survival in the globalized market. Adoption of lean manufacturing is a key survival technique for the cement companies in Kenya. Hence it is important that more research is done on lean manufacturing implementation in the cement industry in Kenya.

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the Malaysian electrical and electronics industry. *European Journal of Scientific Research*, 38(4), 521-535.

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APPENDICES

Appendix One: University's Letter of Introduction



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MOMBASA CAMPUS

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8th August, 2013

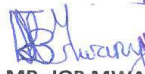

TO WHOM IT MAY CONCERN

The bearer of this letter, **Faith Chebet Rono** of Registration number **D61/62810/2010** is a Master of Business Administration (MBA) student of the University of Nairobi, Mombasa Campus.

She is required to submit as part of her coursework assessment a research project report. We would like the student to do his project on "**Lean Manufacturing Practices in a Continuous Process Industry: A Case Study of Bamburi Cement Limited**". We would therefore, appreciate if you assist her by allowing her to collect data within your organization for the research.

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

Thank you.



MR. JOB MWANYOTA
ASSISTANT CO-ORDINATOR, MOMBASA CAMPUS

JM/maa

Appendix Two: Interview Guide

Demographic

Interview date: _____

Interviewee: _____

Title: _____

Department: _____

Interview Questions

1. Has your company begun to implement lean manufacturing?
2. What lean manufacturing techniques has your company used?
3. How effective was the implementation of each technique?
4. What are the driving forces behind implementing lean manufacturing?
5. What did you expect to gain from implementing lean manufacturing?
6. To date, what benefits have you gained by implementing lean manufacturing?
7. While implementing lean manufacturing, have there been any other unexpected changes within your company?
8. What phrase best reflects your top management support of lean manufacturing?
9. What challenges have you faced when implementing lean manufacturing?
10. What are the employees' opinions to lean manufacturing?