# LEAN PRACTICES AND SUPPLY CHAIN PERFORMANCE AMONG AUTOMOTIVE ASSEMBLING FIRMS IN KENYA

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**A MANAGEMENT RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION, SCHOOL OF BUSINESS, UNIVERSITY OF NAIROBI**

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## DECLARATION

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

…….. ……..

This project has been submitted for Examination with my approval as the University Supervisor.

…….. ……..

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**God bless you all**

## DEDICATION

This research project is dedicated to my wife Elizabeth Smith-Sumo for her love and care together with our son and daughter Divine and Savior for their encouragement and invaluable support towards my study.

## ABSTRACT

Many organizations in the automotive industry have been found to struggle in the new customer driven and globally competitive markets. This has been attributed to the increasing competition in the automotive industry and recent global economic slowdown. One of the ways in which firms have employed to reverse the trend is to employ the lean manufacturing. The study was to establish the relationship between lean assembling practices and supply chain performance amongst automotive firms in Kenya. This study sought to achieve two objectives; firstly to document the extent to which Lean Assembling practices have been adopted by motor vehicle assemblers listed at the Kenya Motor Industry Association (KMIA) and secondly to determine the effects of Lean Assembling practices on the Supply Chain performance of motor vehicle assembling firms in Kenya. The study adopted a cross sectional study exploring the lean assembling practices amongst automotive firms in Kenya. The target population was all the motor vehicle assembling firms in Kenya registered with the Kenya Motor Industry Association (KMIA, 2015) whereby there are ten in total. The research use both primary and secondary sources of data. The research findings were that reduced inventory, reduced manufacturing costs, waste reduction and short set up time were found to be the aspects of just-in-time that were considered significant to supply chain performance. Further, the study found out that reduced cost of information processing and transmission were found to be moderately significant to influencing the performance of the automobile firms. These findings should help in encouraging the widespread adoption of lean assembling practices in Kenya considering that Supply Chain is an ever-growing field. Further study should be carried out to establish the impact of information sharing on the Supply Chain Performance of lean assembling firms.

## ACRONYMS AND ABBREVIATIONS

| | | |
|---|---|---|
| AVA | - | Associated Vehicle Assemblers |
| C&G | - | Car and General (C&G) Ltd |
| CMC | - | Cooper Motor Corporation |
| DT Dobie | - | DT Dobie Kenya |
| GM | - | General Motors East Africa |
| JIT | - | Just-In-Time |
| KPI | - | Key Performance Indicators |
| KVM | - | Kenya Vehicle Manufacturers |
| LM | - | Lean Manufacturing |
| MIT | - | Massachusetts Institute of Technology |
| MVA | - | Market Value Added |
| SCM | - | Supply Chain Management |
| SMED | - | Single Minute Exchange of Dies (SMED) |
| SPSS | - | Statistical Package For Social Sciences |
| TKL | - | Toyota Kenya Limited |
| TMC | - | Toyota Motor Corporation |
| TPM | - | Total Productive Maintenance |
| TPS | - | Toyota Production System |
| TQM | - | Total Quality Management |
| TTC | - | Toyota Tsusho Corporation |

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# CHAPTER ONE: INTRODUCTION

## 1.1 Background of the Study

Many organizations, particularly automotive organizations, struggled in the new customer driven and globally competitive markets. For instance, due to the increasing competition in the automobile industry and recent global economic slowdown companies such as Fiat lost its sales and as a result had to sell its stake in Ferrari and General Motors. In a similar way, Daewoo Motors, which had gone bankrupt and collapsed after the South Asian Crisis, was acquired by General Motors (www.reportsure.com, 2010).While some organizations continue to grow on the basis of economic constancy, others struggle because of their lack of understanding of the changes in customer mind-sets and cost practices. To overcome this situation and to become more profitable, many manufacturers turn to "lean manufacturing" (LM). The goal of LM is to be highly responsive to customer demand by reducing waste. LM aims at producing products and services at the lowest cost and as fast as required by the customer (Sangwan, 2014).

Today, all major car manufacturers have developed their own productions systems that share similarities with the TPS and the Lean approach. For example, Volkswagen, Europe's largest car manufacturer, writes in its 2008 annual report that a group-wide production system is supposed to be developed to increase the company's efficiency by focusing on processes, standardization, and workflow to ultimately become a *"*Self-learning organization" (Volkswagen AG, 2009) through the implementation of a continuous improvement process and the elimination of waste. Another example is the global corporation of Nissan and Renault. Renault developed the Renault Production System (RPS), which borrows elements *"*Extensively from the Nissan Production Way"(Renault, 2009). Its fundamental goal is to eliminate waste throughout their operations and to use best practices from within the

organization to improve their operations and to increase their competitiveness in the global market (Hidetoshi, 2008).

### 1.1.1 Lean Practices

Lean principles are implemented through some practices which are activities undertaken to bring about improvements in organisation, the lean practices are supported by set of tools and techniques (Dean and Bowen, 1998; Karlsson and Ahlström, 1997). The authors emphasise the difference between principles, practice, and techniques and try to separate them from one another. However, owing to the connectivity between the three terms, it is difficult to separate them, especially practices and techniques. Most of the time, some authors use the terms, practices, tools and techniques interchangeably. From the articles on lean in supply chain, some activities are identified in the process of transforming a supply chain to lean supply chain, and such activities can be referred to as lean practices. The identified lean practices are: sourcing of customer need information, value stream analysis (VSA), end customers focus, waste elimination, workplace organisation, strong and effective relationship, production of exact customer needs only when needed, problem search and problem solving (Levy, 1997; New and Ramsay, 1997; Taylor, 2006; Wee and Wu, 2009; Zarei et al, 2011).

Lean supply chain management involves implementation of lean concepts, principles, practices and techniques across the whole supply chain. Lean principles and techniques can be applied to achieve the supply chain management tasks. As a result of the lean management approach, traditional practice of push within a supply chain has been replaced with lean technique called; pull (Sezen and Erdogan, 2009). In contrast to the push system where the manufacturers determine production quantity and design, actual demand determines production quantity and design in pull system. Pull system helps to increase customer satisfaction and avoid waste due to overproduction. To achieve the desired quality and

delivery in a supply chain, lean advocates for close partnerships between suppliers and focal organisations (Levy, 1997). The success of lean management depends on success of supplier integration which involves careful selection of competent suppliers, effective information sharing, and long- term relationship (So and Sun, 2010).

### 1.1.2 Supply Chain Performance

Srinivasan *et al*. (2011) defined supply chain performance for a firm as the performance of the various processes included within the firm's supply chain function. Examples of measures specifically used to assess supply chain performance of a firm include supplier performance (Davis, 1993), customer satisfaction (Christopher, 1994), inventory costs, number of on-time deliveries, product availability performance and customer response time (Beamon, 1999). There exist several entities in a supply chain starting from manufacturers, transportation, distribution, wholesale, retail, and end customers. At each and every junction the supply chain partners expect timely, reliable and quality delivery of the right amount of products at low cost. A supply chain is all of the linked individual organizations that, by direct or indirect means, lead to the delivery of a service or a good to a customer (Chopra and Meindl, 2004).The outcome is a network of organizations that are linked through upstream and downstream relationships in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer (Christopher, 1998).

In the supply chain context, continuous performance improvement has become a topic of serious concern for each and every supply chain partner. Supply chain based companies such as Dell, Wal-Mart, Samsung, Toyota, Lenovo, and Gome, are amongst firms that have used different performance management tools to support their supply chain strategies. The organizations are finding the activities of monitoring and improvement of supply chain performance as an increasingly complex task (Morgan, 2007). The metrics of supply chain

performance enable firms to have a benchmark to assess their supply chain performance including internal and external firm. The application of internal linkage performance metrics results in elimination of non-value added activities, reduction in order variation, faster product flows, more efficient use of time, material and human resources, and reduction of the bullwhip effect (Frohlich & Westbrook, 2001). Benefits of usage of external linkage performance metrics include the creation of end-customer value through closer integration activities and communication with other member firms along the supply chain (Bowersox *et al.,* 2000).

### 1.1.3 Lean Practices and Supply Chain Performance

Lean practices have an optimizing effect on the supply chain performance to produce desired business result by reducing cost, total lead time, improved quality which as a result improves the supply chain performance. Every lean tool contributes in a unique way to solve its purpose. In a supply chain, various factors and process takes place and each of these events/ process is strongly associated with some other factors. Hence to have an optimized chain of supplies, the processes and factors should be balanced with one another. Lean practices aims at reducing waste through lean tools which has an impact on the supply chain factors in context to optimization. Lean paradigm connected to SCM is a strategy based on cost and time reduction to improve the effectiveness which involves optimizing the supply chain processes, searching for simplification, reducing waste and reducing activities that do not add value (Susana, 2011).

Lean operations add to competitive advantage through implementing complementary elements of environmental performance (Hart, 1997). Lean emphasis on rework elimination requires efficient systems to reduce generation of undesired by-products, thus creating an environmental benefit (James P.Womack, 1990)(Friedman, 2008). Lean practices can lead to

environmental benefits, inversely environmental practices often lead to improved lean practices (Kleindorfer, et al., 2005)(Hansen, et al., 2004). In practice, the implementation of both lean and green supply chain strategies involves organizations that pursue quality standards are likely to adopt ISO-14000 environmental standards (King & Lenox, 2001).

Wal-Mart has recognized that aligning green and lean practices across the supply chain drives the financial performance of the firm and earns respect from customers (Friedman, 2008). Firms that are benchmarked by Environmental Protection Agency (EPA) have increased savings by balancing strict lean principles and environmental efficiency. Organizations such as General Motors, Andersen corporation, Intel, 3M and Com Ed have saved significantly by integrating green and lean initiatives. Green and lean supply chain strategies examples can be seen in the furniture industry. Organizations have identified ways to reuse sawdust and wood scraps, employ alternative technologies to reduce VOC emissions, eliminate rework through increased efficiency and utilize recyclable pallets for deliveries (Handfield, et al., 1997).

Lean supply arrangements demand high levels of information sharing, rapid performance improvements with suppliers and minimal transaction costs (Dyer, 1997) (Lamming & Hampson, 1996). This type of relationship may provide the incentive firms need to bridge the lean and environmental supply chain practices of their suppliers. Improvements in manufacturing systems can lead to direct and indirect benefits for environmental management, usually in the form of waste reduction (Simpson & Power, 2005).

### 1.1.4 Automobile Assembling Firms in Kenya

Half of the Kenyan motor vehicle market is commercial, mainly made up of pick-ups, trucks and buses. However, the buses and trucks business is dominated by established players such as CMC, General Motors, Simba Colt and DT Dobie. Kenyan car industry has been in

existence since 1976 when the first car was assembled by Kenya Vehicle Manufacturers. Associated Vehicle Assemblers (AVA) was later incorporated and assembled its first car the following year. In 1986, the Kenyan government started the Nyayo project to manufacture Kenyan Cars. The project was being headed by The University of Nairobi where prototypes were made, named Pioneer Nyayo Cars. The Nyayo Motor Corporation was established to mass-produce these cars but due to lack of funds, the car never entered into production. Hornsby(2013). The Kenya Motor Industry Association (KMI) established in 1989, is the body that represents the corporate motor dealers in the country. The body coordinates commercial realities and national policies. Some of the measures that KMI has been advocating include: Implementation of strict criteria on importation of second hand vehicles, Incentives to promote local assembling of commercial vehicles and export incentives aimed at encouraging car manufacturers to expand operations in the region. (PWC 2013).

In Kenya, the automotive industry is mainly in the distribution and retail of motor vehicles. Some of the automotive dealers in the country including Toyota (East Africa), Cooper Motor Corporation (CMC), General Motors (GM), Simba Colt Motors Limited, Car and General (C&G) Ltd, Marshalls (E.A.) Ltd, Associated Vehicle Assemblers (AVA) and DT Dobie. There are Kenya has three major vehicle assembly plants which include Associated Vehicle Assemblers (AVA), General Motors East Africa (GM) and Kenya Vehicle Manufacturers (KVM). The Coast-based AVA is Kenya's largest vehicle assembler, and accounts for more than 40 per cent of total national output. It is owned by auto dealers Marshalls East Africa and Simba Colt on a 50-50 percent shareholding.

### 1.2 Statement of the Problem

Stiff competition arising from the global marketplace have compelled many organizations to find ways of reducing costs, improving quality to meet the ever-changing needs of a more

informed class of customers in order to suit their taste and preferences. In recent years, many manufacturing and service companies have been challenged to increase their focus on quality of products and customer satisfaction while minimizing the cost in order to survive the tough business environment.

Wheatley (2005) discussed the reasons why organizations are trying to copy TPS and applying Lean thinking in their own environments. The top five business factors according to Wheatley are continued pressure to improve operational performance, maintain competitive advantage in price and service, pressure to improve profit, customers demanding shorter order-cycle times and customers demanding reduced prices. Womack and Jones (2003) underlined the need for strong will at the top management during the transformation process. They added that leaders should create a crisis in order to force the organization to adopt Lean thinking and that should be the company strategy. Their findings were that Lean thinking should first be applied in a troubled business unit. This should be supported by senior management demonstrating impatience during Lean performance reports.

Wanjiku (2013) in related studies carried out in Kenya focused on "Lean Supply Chain Management In Manufacturing Firms in Kenya" which was very broad as she didn't narrow it down to any specific manufacturing firm in Kenya.

Achanga (2006) studied on "Four Critical Success Factors In The Implementation Of Lean Production" found that strong leadership and management, facilitates the integration of all infrastructure in the organization and good leadership fosters effective skills and knowledge among workers.

Achanga,however,did not address the challenges faced in the implementation of lean manufacturing practices.Another study also carried out by Mathenge (1995) on "The driving

force behind lean production" noted that lean production is the essence of creating substantial performance. Mathenge, only looks at the driving force behind lean production but did not look at its impact on supply chain performance.

From the reviewed literature, none of the studies has narrowed down to address lean practices amongst automotive firms in Kenya and how it affects supply chain performance. It is therefore the purpose of this study to fill the existing research gap by looking at lean practices and how they impact supply chain performance of automotive firms in Kenya. Given the benefits of Lean practices in both the manufacturing and service sectors it becomes of importance to document how the use of Lean practices affect the Supply Chain Performance of automotive firms in Kenya. Therefore this study intends to answer the following Research Questions; what is the extent to which lean practices are implemented by Automotive Assembling Firms in Kenya? and What is the effect of Lean practices on Supply Chain performance of Automotive Assembling Firms in Kenya?

## 1.3 Research Objectives

### 1.3.1 General Objective

To establish the relationship between lean assembling practices and supply chain performance amongst automotive firms in Kenya.

### 1.3.2 Specific Objectives

i. To establish the extent to which lean assembling practices are implemented by automotive firms in Kenya
ii. To establish the effect of lean assembling practices on Supply Chain performance of automotive firms in Kenya

## 1.4 Value of the Study

This study is expected to help managers as decision makers to improve on other management practices in the automotive sector by identifying major reasons why firms in this sector should now move to embrace lean philosophy as a strategy to enhance firm productivity now more than ever before.

Automotive firms in Kenya would particularly find this research useful as it will help them identify the relationship between lean practices and their supply chain performance. The automotive firms will appreciate the benefits that results from adopting lean practices and those that have not embraced it would realize the value of embracing it so as to become more competitive.

Automotive firms in Liberia will find this research very useful considering that the country is heavily reliant on importation of assembled vehicles since lean practices are non-existent in the automotive sector as well as the benefit of cost savings that the application of lean practices will have on their Supply Chain performance

The study will form a basis for interested researchers and scholars to research on and add to the body of knowledge on Lean Management as a subset of Supply Chain Management. Currently, there is no published research on lean practices by automotive firms in Kenya and the findings of this research project will contribute to new knowledge as far as adoption of lean practices in the sector is concerned. The study will also make suggestions for future researchers to work on.

# CHAPTER TWO: LITERATURE REVIEW

## 2.1 Introduction

This chapter focuses on the literature review conducted by the researcher. It includes a review of the various studies that have been conducted by other researchers on lean practices and supply chain performance. Among the areas highlighted include the lean concept, lean principles and tools that are being adopted; the benefits derived from the adoption of these practices and the challenges encountered in the implementation of these practices. The chapter also provides research gaps identified and the conceptual framework to show the relationship between the dependent and the independent variables.

## 2.2 Lean Concept

According to Manrodt and Vitasek (2008), lean is defined as a systematic approach to enhancing value to the customer by identifying and eliminating waste (of time, effort and materials) through continuous improvement in pursuit of perfection. They also defined lean supply chain as a set of organizations directly linked by upstream and downstream flows of products, services, finances and information that collaboratively work to reduce cost and waste by efficiently and effectively pulling what is required to meet the needs of the individual customer. Lean Manufacturing is a multi-dimensional approach that consists of production with minimum amount of waste ( JIT), continuous and uninterrupted production flow (Cellular Layout), well-maintained equipment (TPM), well-established quality system (TQM), and well-trained and empowered work force (HRM) that has positive impact on operations/competitive performance (quality, cost, fast response, and flexibility) (Manrodt and Vitasek, 2008).

The core idea of lean management is to maximize customer value while minimizing waste. A lean organization understands customer value and focuses its key processes to continuously

increase value. The ultimate goal is to provide perfect value to the customer through a value creation process that ultimately has zero waste. Lean thinking changes the focus of management from optimizing separate technologies, assets and vertical departments to optimizing the flow of products and services through the entire value stream. The flow is horizontal across technologies, assets and business units and departments to its customers (Brintrup *et al*., 2010).

### 2.3 Lean Principles and Tools

Lean principles include a set of strategies and tools with the aim of reducing costs, both internally and externally to increase customer satisfaction through value creation in its products and services. The objective of this multi-dimensional approach is the reduction of costs by eliminating the non-value activities, using tools such as just-in-time, cellular manufacturing, Value Stream Mapping, 5S, Kanban (pull) systems, Kaizen (Bicheno, J., 2000; Rother M. & Shook, J. 1988; Kocakulah, M.C., Austill, D.A &Shenk D.E 2011), total productive maintenance, Production smoothing or production leveling, setup reduction for waste elimination ( Abdulmalek, F.A &Rajgopal, J. 2007: Scherrer-Rathje, M., Boyle, T.A., & Deflrin, P. 2009). The implementation of the efficient production practices based on the flow of optimization is expected to lead to better operating results using for example, an inventory leanness ( Hofer, C. Eroglu, C. & Hofer, A.R, 2012), which in turn should enhance the enterprise's performances (Cuatrecasas-Arbos, L. Fortuny-Santos, J. & Vintro-Sanchez, C. 2011).

Shah and Ward (2003) noted that LM represents a multifaceted concept that maybe grouped together as distinct bundles of organizational practices. A list of bundles of lean practices includes Just-In-Time (JIT), Total Quality Management (TQM), Jidoka (Automation), Six Sigma, Muda (waste), Total Productive Maintenance (TPM), Poka-Yoke (Error proofing) and

PDCA (Plan, Do, Check, Act) among others. LMP enhance manufacturing productivity by reducing setup times and work in process inventory improving throughput times, and thus improve environmental performance (Al Asyraf *et al*., 2012).Appendix I indicates the key lean manufacturing tools and practices**.**

### 2.3.1. Value Stream Mapping

According to Rowther (1999) Value stream mapping is a pencil and paper tool which helps to visualize and understand the flow of material and information as a product makes its way through the value stream. The goal of value stream maps is to document all the processes used to produce and ship a product, both value-adding and non-value adding (waste) processes. Value stream mapping is a method of creating a "one page picture" of all processes that occur in a company, from the time a customer places an order for a product, until the customer received the product in their place.

### 2.3.2 Five (5) Ss

5S is a process of work place organization and housekeeping which is carried out gradually and systematically. The 5S method is a structured program to implement workplace organization and standardization. A well-organized workplace motivates people, both on the shop floor as well as others. 5S improves safety, work efficiency, improves productivity and establishes a sense of ownership.

SEIRI - Remove everything from the workplace that is not needed for production. This is the first stage of 5S is to organize the work area, leaving only the tools and materials necessary to perform day to day activities. When Sorting is done perfectly, communication between workers is improved and product quality and productivity are increased.

SEITON - Arrange and label items so they are easily located. This is the second stage of 5S involves the orderly arrangement of needed items so they are easy to use and accessible for anyone to find. Orderliness eliminates waste in production and clerical activities.

SEISO - Making sure that everything and all areas are clean and clear. The third stage of 5S is keeping everything clean and swept. This maintains a safer work area and problem area are quickly identified.

SEIKETSU - How you make Sort, Set, Shine common practice. The fourth stage of 5S involves creating a consistent approach for carrying out tasks and procedures. Orderliness is the core of standardization and is maintained by visual controls.

Impact of 5S implementation reduce inventory, efficient on workplace usage, reduce time for searching spare parts, reduce oil / water / air spilled, cleaning & checking machine condition, improve working condition, reduce work accident, increase discipline, follow procedure and better relationship among employees. (Lean manufacturing solutions Inc., 2008)

SHITSUKE - Making it all regular a common practice by building foundations and keeping it all together through checking or auditing practices.

The last stage of the 5S is the discipline and commitment of all other stages. Without sustaining, the work place can easily revert back to being dirty and chaotic. When employees take pride in their work and workplace it can lead to greater job satisfaction and higher productivity.

### 2.3.3 JIT (Just In Time)

Just in time is a term used to indicate that a process is capable of instant response to demand without the need for any over stocking, either in expectation of the demand being forth

coming or as a result of inefficiencies in the process (Hutchins, 1999). Waste, any activity which add cost without increasing the product value, such as unnecessary movement of materials, accumulation of excess inventory, or the use of faulty production methods that create products requiring subsequent rework (J.Schonberger, 1984).

### 2.3.4 Jidoka (Automation)

Principle is a process of quality control and refers to the automation of the functions of the production supervision, which means that the personnel is warned in case of an abnormal situation in order to stop the production line, thus preventing wastage, refuse and additional output, focusing on the attention on understanding why the problems occurred and how they can be avoided in future. Design equipment to partially automate the manufacturing process (partial automation is typically much less expensive than full automation) and to automatically stop when defects are detected.

### 2.3.5 Poka Yoke

Poka-Yoke (also referred to as “mistake proofing”) designs defect detection and prevention into equipment with the goal of achieving zero defects and enable operators to spend more time on autonomous maintenance. It aims at eliminating product defects by preventing, correcting or drawing attention to human errors. The Lean concept focuses primarily on techniques for improving the performance of the system implying that employees cannot be trusted in order to have good quality products, creating a need to eliminate the possibility of human error in the system. Vorne Industries Inc., (1999)

### 2.3.6 Kanban

The pull system and kanban are different lean tools and techniques, but the two usually go together. Pull system which is opposite of push is a technique which does not allow production or delivery from the upstream until a signal of need is received from downstream (Womack and Jones, 1996). The pull system is applied both within shop floor and beyond the focal organisation. Within the shop floor or assembly, a later process signals the need for parts from the earlier process only when it is ready to use the parts. The pull system is based on the idea of production or delivery based on the actual consumption, small lot delivery and low inventories (Agus and Hajinoor, 2012). Only actual consumption triggers production or delivery which is done in small lots, hence resulting in low inventories. The basis of pull system is kanban. Kanban is a means of communication in a pull system; kanban which is a small card usually attached to boxes of parts controls pull by signaling production and delivery (Womack and Jones, 1996).

### 2.3.7 One-Piece Flow

One-piece flow or continuous flow processing is a concept that involves the movements of processed items directly from one processing step to the next, one piece at a time. In contrast, "batch and queue" involves mass production of large lots of products or works large number of transactions at one time – sending them together as a group through each operational step. (LSS Academy, 2008)

Hopp and Spearman (2004) defined the pull system as one that explicitly limits the quantity of product entering the production process. The traditional production methods tend to push products in the manufacturing process, without limiting their quantity in the hope that it will

be a customer to buy the already made products. In a pull system not even a single production stage will be finalized until there is a demand for moving to a later stage.

### 2.4 The Benefits of Lean Practices

Lean manufacturing has been shown to greatly improve quality, customer service, and profitability (Standard and Davies, 1999). Lean manufacturing leads to reduction in demand-side lead time, eliminate defects in the final products, Reduces inventory and assembling cost, leads to improved customer satisfaction, Leads to improved product quality, Improved competitive advantage and improved company profitability (Jordan *et al.*, 2001).

The benefits of Lean manufacturing come from the elimination of waste at all stages. According to Mondem (1993) waste arrives in many ways in the production system: Stock/ Inventory- JIT replace the idea of 'Just In Case'. This meant that inventory was held only because there were problems in the production system. This made it impossible to supply within a period when customers wanted orders. The process itself/ over processing-Some processes add no value. Fitting and other adjustments are only required because of defects in upstream processes. If a machine cannot produce to define tolerances, it should be replaced or the tolerances themselves reviewed and the design changed. Material Movement/ Transport-The effect of excessive distances between processes is often disguised in a production system. Such movements and the associated stock that has to be in transit add no value. People Movement/Motion- Excessive movement of people may arise from poor job layouts, their having to go and look for material for the next task. Shops crowded with inventory lengthen the search too. Running process too early/ too fast/ Overproduction-Overproduction leads to the buildup of inventory which not only wastes investment but also space and transport resources as the stock often has to be moved several times to keep out of the way (Mondem, 1993).

## 2.5 The Challenges Facing Lean Practices

The most common challenge in lean implementation is maintaining it. Lean is a continuous process. Even though Toyota implemented lean more than fifty years ago, they are still utilizing it and continuously striving for improvement. Many companies implement lean concepts thinking it is to be done only once. Maintaining lean is challenging and requires a lot of work that companies are not prepared to commit to. "The journey to lean is not for the timid, and there are no stopping places along the way. Making the transition is highly challenging and many falls by the wayside" (Drew *et al.,* 2004).

Another common challenge in implementing lean is assuming that it can only be used in manufacturing. Womack and Jones introduced the concept of Lean Enterprise which entails the use of lean management throughout all departments in a company. Also the challenge that companies may have in implementing lean is the fact that "lean systems are inherently knowledge-intensive" (Drew *et al.,* 2004,). Toyota has had the advantage of having many years of learning and developing knowledge in lean principles and concepts. The knowledge of lean is not only captured in systems and processes but is also captured in the workers; they think 'lean'. Years of lean thinking enabled Toyota works to know how to respond (and when) to changes in production. Some companies may not be willing to invest so much time in developing a lean mind set in the workers (Drew *et al.,* 2004).

Lean implementation is a radical process as it changes the way of operating (such as eliminating the customary way of accumulating inventory) and senior management may be opposed to such drastic change (Drew *et al.,* 2004). This presents a challenge in fully implementing lean. Similar to the reduction of inventory is the reduction of the workforce. The workforce has a direct impact on productivity and reducing any labor that may have been saved by the lean system would lead to the work-force viewing lean as negative. A company

could in the meantime use the ‘spare’ work force as a kaizen team (Womack and Jones, 2009).

### 2.6 Summary and Knowledge Gap

Gupta *et al.* (2013) in a related research “A strategic and operational approach to assess the lean performance in radial Tyre manufacturing in India” established that financial capability of an organization drives the top management commitment for incorporating lean manufacturing practices in a tyre manufacturing organization. Since their study was carried out in a single (case) organization, a relatively small sample size restricts the outcome from being considered for generic industrial application.

Lucato *et al.* (2013) in their research “Performance evaluation of lean manufacturing implementation in Brazil” found out that the performance of lean initiative implementation is not uniform among companies. However, the study did not establish a relationship between the degree of leanness and the size of the firms.

Shahram and Morosan (2011) studied on “The impact of lean operations on the Chinese manufacturing performance” found out that lean performance factors are strongly related to operations practice and production system design. Their findings, however, was based on the experience of selected manufacturing plants in China, which should not be interpreted as indicative of the characteristics of the Chinese manufacturing plants in general.

Wanjiku (2013) studied on “Lean Supply Chain Management in Manufacturing Firms in Kenya” concluded that Lean Supply Chain Practices were evident among the manufacturing firms in Kenya and that the main reasons for the Lean Management practices was to reduce cost, increase profitability and long term survival of the firm. The study only concentrated on

Manufacturing Firms in Kenya but she didn't narrow it down to any specific Manufacturing Firm in Kenya.

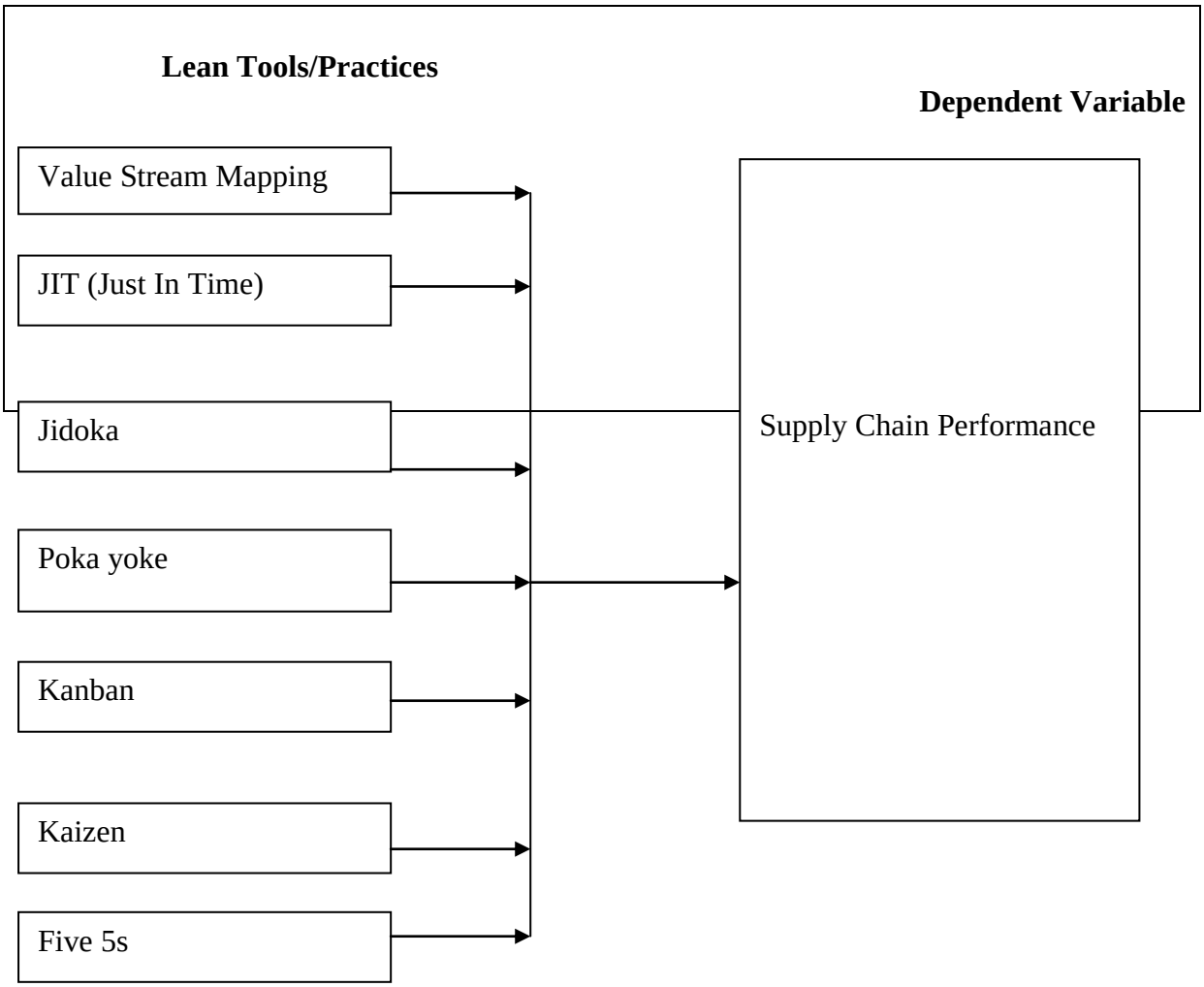
Mathenge (1995) studied on "The driving force behind lean production" noted that lean production is the essence of creating substantial performance. Mathenge, only looks at the driving force behind lean production but did not look at its impact on supply chain performance.

As evidenced by the above empirical review, none of the local studies have focused on the impact of lean practices on supply chain performance of the automotive industry in Kenya. It is therefore the purpose of this study to fill in the existing research gap. This study will seek to establish the link between lean practices and supply chain performance by automotive assembling firms in Kenya. The study will also seek to identify the benefits of using lean practices as well as the challenges faced while adopting the practices.

## 2.7 Conceptual Framework

**Figure 3.1: Conceptual Framework**

**Independent Variables**




**Source: Author (2015)**

# CHAPTER THREE: RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter describes the methods and procedures that the researcher used to collect the data required and analyze it. It discusses research design, study population, sample design, data collection, data analysis and presentation as well as data validity and reliability.

## 3.2 Research Design

This study adopted a cross sectional study exploring the Lean assembling practices amongst automotive firms in Kenya. The data was cross sectional in nature since it covered a cross section of all automobile assemblers in Kenya. A cross sectional design was appropriate in this case since the study was conducted at the same time across all the firms and also since a causal study was undertaken in a non-contrived setting with no researcher interference. This design has been applied successfully before in similar studies by Kald (2003) and Kosmidou et al (2005).

## 3.3 Population

The target population was all the motor vehicle assembling firms in Kenya. According to the Kenya Motor Industry Association (KMIA, 2015), there are ten firms in Kenya (Appendix, II). The reason of choosing these firms is because they are large enough and consequently are likely to engage in lean assembling practices. Given the relative small size of the population census is proposed.

## 3.4 Data Collection

The research use both primary and secondary sources of data. Primary data was obtained through self-administered questionnaires and was collected through a “drop and pick later” method to the firms. The questionnaire consisted of both open and closed ended questions

designed to elicit specific responses for qualitative analysis. The open ended questions were meant to avoid limiting the respondents in answering the questions. A questionnaire was chosen since it acts as a useful tool for collecting data from respondents because of the need to provide a means of expressing their views more openly and clearly. The questionnaire comprised of three Sections; Section "A" consisted of the demographic information of the respondent, Section "B" dealt with the extent to which lean assembling practices are implemented by automotive firms in Kenya, while Section "C" dealt with the effect of lean practices on Supply Chain performance of automotive firms in Kenya. The questionnaires were administered to the Supply Chain Managers, Operations Managers and Operations Officers in the production departments or its equivalent and procurement department in the respective firms targeting 20 respondents; 2 questionnaires per firm. Secondary data on the subject area was collected through annual reports and organizational publications both within and without the organization.

### 3.5 Data Analysis

The data collected were analyzed using descriptive statistics in Section "B" while Section "C" was analyzed using correlation and regression analysis. The dependent variable in the study was Supply Chain performance. The data was classified, tabulated and summarized using descriptive measures, percentages and frequency distribution tables while tables and graphs will be used for presentation of findings. However, before final analysis is performed, data was cleaned to eliminate discrepancies and thereafter, classified on the basis of similarity and then tabulated. A multiple regression model was developed to describe the relationship between the automobile assembler's performance and the adoption of the lean assembling practices. The regression equation assume the following form

$$Y = \beta o + \beta_1 X_1 + \beta X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \alpha$$

Where Y = Supply Chain Performance

$\beta_i$ = ( i = 0 – 6 ) = Regression coefficient

$X_1$ = Value Stream Mapping

$X_2$ = JIT

$X_3$ = Jidoka

$X_4$ = Pokayoke

$X_5$ = Kanban

$X_6$ = Kaizen

$X_7$ = Five Ss.

$\alpha$ = error term which captures variables not in the model the and pure chance factors

**Table 3.1: Summary of Research Methodology**

| **OBJECTIVE** | **DATA COLLECTION** | **DATA ANALYSIS TECHNIQUE** |
|---|---|---|
| To establish the extent to which lean assembling practices are implemented by automotive firms in Kenya | Section B of questionnaire | Descriptive Statistics |
| To establish the effect of lean practices on Supply Chain performance of automotive firms in Kenya | Derived from Sections C of questionnaire | Regression and Correlation Analysis |

# CHAPTER FOUR: DATA ANALYSIS, FINDINGS AND DISCUSSIONS

## 4.1 Introduction

The research objective was to establish the effect of lean practices on supply chain performance among automotive assembling firms in Kenya. This chapter presents the analysis, findings and the discussion with regard to the objectives.

## 4.2 General Information of the Company

The demographic information considered in this study included the position of the respondents, educational level, and the ownership structure of the firm. A total of 20 questionnaires were issued out. The completed questionnaires were edited for completeness and consistency. Of the 20 questionnaires distributed, 14 were returned. The returned questionnaires' represented a response rate of 70% and this response rate was deemed to be adequate in the realization of the research objectives.

### 4.2.1 Position of the Respondents

The respondents were asked to indicate their current working Position in the company. Table 4.1 shows the results of the research question

**Table 4.1: Position of the Respondents**

| | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| Supply Chain Manager | 2 | 14.3 | 14.3 |
| Operation Manager | 4 | 28.6 | 42.9 |
| Supply Chain Officer | 8 | 57.1 | 100.0 |
| Total | 14 | 100.0 | |

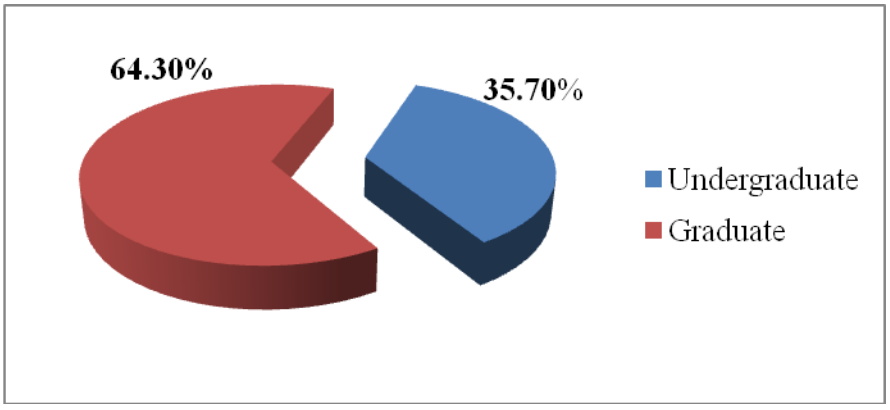
**Source: Research Data (2015)**

The above results show that majority of the respondents were holding the supply chain operations office position (57.1%), while 14.3% of the respondents were supply chain managers and 28.6% were operations managers. This results show that the senior management respondents were equal in proportion to those holding the middle and junior management position in the organizations. This implies that the views of all employees' cadres were represented in the sample.

### 4.2.2 Educational Level of the Respondents

The respondents were asked to indicate their highest level of education. The competence of a respondent is assumed to have a direct relationship with one's educational level. The results are provided in figure 4.1.

**Figure 4. 1: Education level of respondent**




**Source: Research Data (2015)**

Figure 4.1 shows majority of the respondents (64.3%) indicated they are graduate degree holders. This was followed by (35.7%) undergraduate degree holders. From the results, the respondents were deemed to be competent enough to answer according to the researchers questions. This indicates that there is high literacy level in the automotive industry.

### 4.2.3 Ownership structure

This section found out the ownership status of the automotive firms in Kenya. This is because a firm that has international operations and partnership would be expected to adopt more advanced and modern operations practices. The results are presented in table 4.2

**Table 4.2: Ownership Structure**

| | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| Local | 12 | 85.7 | 85.7 |
| Foreign | 1 | 7.1 | 92.9 |
| Both | 1 | 7.1 | 100.0 |
| Total | 14 | 100.0 | |

**Source: Research Data (2015)**

The findings on the ownership of the automotive companies indicate that majority of the automotive firms (85.7%) are locally owned while 14.2% of the firms are either foreign or both local foreign owned. The foreign owned firms have acquired a stake in the local firms and therefore introducing new management styles and practices in the locally owned firms.

## 4.3 The Extent of Adoption of Lean Assembling Practices

This section addresses objective one of the research. From the findings in Table 4.3 the respondents indicated that to a large extent Kaizen - Continuous Improvement has been adopted by the automotive firms as shown by a mean of 3.8571. The respondents to a moderate extent indicated that Kanban (Information Transparency) has been adopted in Lean Assembling practices as shown by a mean of m= 3.4286. The respondents to a moderate extent indicated that Value Stream Mapping has been adopted in Lean Assembling practices as shown by a mean of m= 3.1429. The respondents to a moderate extent indicated that Jidioka(Automation) has been adopted in Lean Assembling practices as shown by a mean of

m= 3.1429. The respondents to a moderate extent indicated that JIT (Just In Time) has been adopted in Lean Assembling practices as shown by a mean of m= 3.0714. The respondents to a moderate extent indicated that Pokayoke - Error proofing has been adopted in Lean Assembling practices as shown by a mean of m= 3.0714. The respondents to a moderate extent indicated that Five (5) Ss has been adopted in Lean Assembling practices as shown by a mean of m= 2.9286

From the literature review Lean implementation is a radical process as it changes the way of operating (such as eliminating the customary way of accumulating inventory) and senior management may be opposed to such drastic change (Drew *et al.*, 2004). This presents a challenge in fully implementing lean. Similar to the reduction of inventory is the reduction of the workforce. The workforce has a direct impact on productivity and reducing any labor that may have been saved by the lean system would lead to the work-force viewing lean as negative. A company could in the meantime use the 'spare' work force as a kaizen team (Womack and Jones, 2009).

These practices are widespread and mostly adopted than others since they have proven to be the key lean tools and principles that are simple to implement as a result of the value they bring to a firm through waste elimination, reduced cost, enhanced quality, and improved profitability which derives from customer satisfaction. Lean practices are seen everywhere across the globe as a key business strategy to stay competitive in a world of ever-changing needs from existing and potential customers.

The study findings are presented in table 4.3.

**Table 4.3: The Extent of Adoption of Lean Assembling Practices**

| Principle/Tool | Mean | Standard deviation |
|---|---|---|
| Kaizen - Continuous Improvement | 3.8571 | 0.94926 |
| Kanban – Information Transparency | 3.4286 | 0.93761 |
| Value Stream Mapping | 3.1429 | 0.86444 |
| Jidoka-Automation | 3.1429 | 1.29241 |
| JIT (Just In Time) | 3.0714 | 0.82874 |
| Pokayoke - Error proofing | 3.0714 | 1.14114 |
| Five (5) Ss | 2.9286 | 0.91687 |

**Source: Research Data (2015)**

### 4.4 Effects of Lean Implementation practices on Supply chain Performance

This section addresses objective two of the research. The respondents were asked to rate the effect of Value Stream Mapping, Just In Time, Flow and pull production, Pokayoke/Jidoka-Error Proofing/Automation, Kanban - Information Transparency, Kaizen/Continuous Improvements and Five (5) Ss as Lean Assembling practices on the performance of their firms supply Chain.

The descriptive analysis below shows the mean, and standard deviation of the different variables of interest in the study. The effect of each independent variable on some measures of performance by the firms on a five point Likert scale, ranging from 1(very small extent) to 5 (very large extent) are presented in their respective tables below.

### 4.4.1 Value Stream Mapping

The findings on the application of value steam mapping are presented in table 4.4.

**Table 4. 4: Value Stream Mapping**

| | Mean | Std. Deviation |
|---|---|---|
| Enhanced quality of output | 3.9286 | 0.73005 |
| Waste reduction | 3.7857 | 0.80178 |
| Production smoothing | 3.7857 | 0.57893 |
| Reduced production time | 3.5000 | 0.75955 |
| Reduced lead time | 3.4286 | 0.75593 |
| **Overall Mean** | **3.6857** | |

**Source: Research Data (2015)**

The results in table 4.4 show that majority of the respondents to a large extent indicated that Enhanced quality of output is significant in Value Stream Mapping in Lean assembling practices m=3.9286. The respondents also to a large extent indicated that waste reduction is significant in Value Stream Mapping in Lean assembling practices m=3.7857. The respondents to a large extent indicated that Production smoothing is significant in Value Stream Mapping in Lean assembling practices m=3.7857. The respondents to a Moderate extent indicated that Reduced production time is significant in Value Stream Mapping in Lean assembling practices m=3.5000. The respondents to Moderate extent indicated that Reduced lead time is significant in Value Stream Mapping in Lean assembling practices m=3.4286.

From the above finding, enhanced quality of the output came out as a major feature of the Value streaming mapping because the output of a motor vehicle assembler will be manifested

by the body works of the vehicle and therefore, a good quality and finishing on the motor vehicle body will determine the level of competitiveness of the assembler. Thus, the extent to which the value streaming mapping going to have on the quality of the production output and the wastage of material saving has a positive effect on the performance of the assembling firms and this came out as a major reason in the study. On the other hand the effect that the value streaming mapping on the production lead time was found to have a minimum effect on the performance of the firm due to the position that most of assembling firms import their raw materials and the management of the lead times will in most of the case be due to factors outside the control of the management such as state of the roads, clearance rate and supplier factors.

### 4.4.2 Just In Time

The findings on the application of JIT by motor vehicle assemblers are presented in table 4.5.

**Table 4.5: Just In Time**

| | Mean | Std. Deviation |
|---|---|---|
| Reduced inventory | 4.000 | 0.87706 |
| Reduced manufacturing costs | 3.8571 | 0.53452 |
| Waste reduction | 3.7857 | 0.80178 |
| Short setup time | 3.5714 | 0.64621 |
| Reduced changeover time | 3.2143 | 0.80178 |

**Source: Research Data (2015)**

From the findings, respondents considered reduced inventory, reduced manufacturing costs, waste reduction, and short set up time significant to supply chain performance to a large

extent as shown by a mean of 4.0000, 3.8571, 3.7857 and 3.5714 respectively. Respondents considered reduced changeover time moderately significant as shown by a mean of 3.2143.

### 4.4.3 Flow and pull production

From the findings, respondents considered, Enhanced quality of output, Demand driven production, Decreased lead time, Production smoothing significant to supply chain performance to a large extent as shown by a mean of 4.2857, 3.9286, 3.8571 and 3.7143 respectively. The study findings are presented in Table 4.6

**Table 4.6: Flow and Pull production**

| | Mean | Std. Deviation |
|---|---|---|
| Enhanced quality of output | 4.2857 | 0.46881 |
| Demand driven production | 3.9286 | 0.73005 |
| Decreased lead time | 3.8571 | 0.36314 |
| Production smoothing | 3.7143 | 0.72627 |

**Source: Research Data (2015)**

### 4.4.4 Pokayoke/ Jidoka-Error Proofing/Automation

The findings on the application of Pokayoke/Jidioka-Error Proofing/Automation by motor vehicle assemblers are presented in table 4.7

**Table 4.7: Jidoka-Error Proofing**

| | Mean | Std. Deviation |
|---|---|---|
| Enhanced quality of output | 3.7857 | 0.57893 |
| Waste elimination | 3.6429 | 0.8419 |
| Reduced lead time | 3.6429 | 0.63332 |
| Reduced errors | 3.3571 | 0.74495 |

**Source: Research Data (2015)**

From the findings, respondents considered enhanced quality of output, waste elimination and Reduced lead time significant to supply chain performance to a large extent as shown by a mean of 3.7857 3.6429 and 3.6429 respectively. Respondents further considered reduced errors moderately significant to supply chain performance as shown by a mean of 3.3571.

### 4.4.5 Kanban - Information Transparency

The findings on the application of this practice by the motor vehicles assemblers are presented in table 4.8.

**Table 4.8: Kanban Lean Practice**

| | Mean | Std. Deviation |
|---|---|---|
| Reduced cost of information processing | 3.5000 | 1.09193 |
| Smooth information transmission | 3.4286 | 0.85163 |
| Increase production process transparency | 3.4286 | 0.85163 |

**Source: Research Data (2015)**

From the findings, respondents considered reduced cost of information processing, significant to supply chain performance to a large extent as shown by a mean of 3.5000. The respondents further rated Increase production process and Smooth information transmission significant to supply chain performance to a moderate extent as shown by a mean of 3.4286 and 3.4286 respectively.

### 4.4.6 Kaizen /Continuous Improvement

The researcher sought to establish how the firms practiced the Kaizen improvement plans in their production. The findings are presented in table 4.9 below.

**Table 4.9: Kaizen**

| | Mean | Std. Deviation |
|---|---|---|
| Production smoothing | 4.0714 | 0.82874 |
| Enhanced quality of output | 3.9286 | 0.61573 |
| Reduced errors | 3.9286 | 1.14114 |
| Waste elimination | 3.8571 | 0.94926 |

**Source: Research Data (2015)**

From the findings, respondents considered production smoothing, enhanced quality of output, reduced errors and waste elimination, significant to supply chain performance to a large extent as shown by a mean of 4.0714, 3.9286, 3.9286 and 3.8571 respectively. Hence Production smoothing was found to be a dominant attribute in the operation of the Kaizen operations.

### 4.4.7 Five (5) Ss

The adaption of the 5S by the automotive assemblers was sought and the results are presented in Table 4.10

**Table 4.10: Five (5) S**

| | Mean | Std. Deviation |
|---|---|---|
| Self discipline | 4.0714 | 0.82874 |
| Sweeping/seiso | 3.9286 | 0.47463 |
| Standardization/seiketsu | 3.7857 | 0.80178 |
| Sorting/seiton | 3.7143 | 0.91387 |
| Simplifying | 3.6429 | 0.92878 |

**Source: Research Data (2015)**

From the findings on the application of the 5s that is Self discipline, Standardization/seiketsu, Sweeping/seiso, Sorting/seiton, and Simplifying were considered significant to supply chain

performance to a large extent as shown by a means of 4.0714, 3.9286, 3.7857, 3.7143 and 3.6429 respectively.

Hence, Self discipline was found to be a dominant attribute in the operation of the Five(5)s as shown by a mean of 4.0714 amongst automotive firms given that it is the first phase of eliminating all that is not needed in the workshop to complete the tasks of straightening and configuration which had positive implication on a firm's Supply Chain Performance, while simplifying was the least in terms of ranking amongst automotive firms Supply Chain performance with a mean of 3.6492. Maintaining cleanliness and order in the workshop are every day custom and practices that are used by automotive firms which had a positive implication on the supply chain performance.

Sweeping/Seiso was found to have a mean of 3.9286 which indicates that sweeping and shining were important factors that were taken into consideration by automotive firms to ensure that everything must be kept clean in the workshop. The removal of production scraps and refuse were important and had positive implication on the Supply Chain Performance of automotive firms.

Standardizaion/Seiketsu was found to have a mean of 3.7857 which indicates that standardization of the processes through efficient organization of the working equipment while programming them in order to have maximum efficiency, consistency and conformity had positive implication on Supply Chain Performance.

Sorting/Seiton was found to have a mean of 3.7143 which indicates that identifying the stages of production and the elements necessary for the performance of the tasks required in those stages, which are organized in the optimal manner in order to avoid wasting time on handling of materials and parts had positive implication on Supply chain performance.

### 4.5 Correlation Analysis

Table 4.11 below shows the Pearson and Spearman's correlation coefficient generated from the data. Consistent with Shin and Soenen (1998), the Spearman's rank correlation coefficients are on the upper right triangle while the Pearson product moment correlation coefficients are on the lower left triangle. Pearson's Correlation analysis is used for data to see the relationship between variables such as those Lean practices and Supply Chain performance. A correlation value of 1, shows that, the variables are perfectly and positively correlated and vice versa. From the table 4.11, all the variables are positively correlated with a high value of Pearson correlation which is close to 1.This shows that the variables are dependent on each other.

The matrix indicated high correlation between the response and predictor variables, that is, Value Stream Mapping, JIT (Just In Time), Jidoka-Automation, Pokayoke - Error proofing, Kanban – Information Transparency, Kaizen - Continuous Improvement, Five (5) Ss,

**Table 4.11: Correlation Analysis**

| | | Supply Chain performance | Just in time | Jidoka | Pokayoke | Kanban | Kaizen | Fives | Value |
|---|---|---|---|---|---|---|---|---|---|
| Supply Chain performance | Pearson Correlation | 1 | .682** | .484 | .643* | .385 | .317 | .026 | .626* |
| Just in time | Pearson Correlation | .682** | 1 | .780** | .726** | .651* | .601* | .007 | .951** |
| Jidoka | Pearson Correlation | .484 | .780** | 1 | .827** | .834** | .896** | .464 | .807** |
| Pokayoke | Pearson Correlation | .643* | .726** | .827** | 1 | .472 | .649* | .152 | .769** |
| Kanban | Pearson Correlation | .385 | .651* | .834** | .472 | 1 | .765** | .486 | .678** |
| Kaizen | Pearson Correlation | .317 | .601* | .896** | .649* | .765** | 1 | .694** | .683** |
| Five's | Pearson Correlation | .026 | .007 | .464 | .152 | .486 | .694** | 1 | .014 |
| Value | Pearson Correlation | .626* | .951** | .807** | .769** | .678** | .683** | .014 | 1 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | | | | | | |
| *. Correlation is significant at the 0.05 level (2-tailed). | | | | | | | | | |

**Source: Research Data (2015)**

From the findings, it is evident that all the independent variables have a positive correlation with just in time having the strongest effect on the supply chain performance (r=0.682) and followed closely by Pakayoke (r=0.643) lean tools and practices. This means that in terms of their effect on supply chain practices, the just-in-time will affect more positively the performance of the Motor vehicle assemblers in Kenya. This is because automotive firms in Kenya are able to deliver services to their customers when and where they are needed without overstocking inventory since holding inventory poses a huge cost implication on management. On the other hand, the 5's features of lean supply chain have the least effects on the supply chain performance of the Motor vehicles assemblers. This is because most of the assembling firms have established the same tools of lean production, such as improvement of safety standards and efficiency of the production system as theses practices are no longer being considered as a major attribute to influencing the supply chain performance.

### 4.6 Regression Analysis

Coefficient of determination explains the extent to which changes in the dependent variable can be explained by the change in the independent variables or the percentage of variation in the dependent variable (Supply Chain Performance) that is explained by the independent variable (Value Stream Mapping, JIT, Jidoka, Pokayoke, Kanban, Kaizen, Five Ss.).

From table 4.12 below the studied variables explains 84.6% of the performance as represented by the $R^2$. This therefore means that other factors not studied in this research contributes to 15.4% of the firms' supply chain performance and also the high coefficient of determination shows that the model have a strong relationship between the dependent and the independent variable. This shows that the model is fit for the study**.** The supply chain performance was measured by such variables as improved number of repeat customers and the total number of customers which the assemblers do business with. The other measures of

supply chain in which the lean principles affected include the increased financial profits of the firms over past years, cost reduction over the same time period as well as maintaining the supplier partnership both downstream as well as upstream of the motor vehicle assembling plants.

**Table 4.2: Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .920[a] | .846 | .667 | 3.81504 |

a. Predictors: (Constant), Value Stream Mapping, JIT, Jidoka, Pokayoke, Kanban, Kaizen, Five Ss.

**Source: Research Data(2015)**

The F critical at 5% level of significance is 4.21presented in table 4.13. Since the F calculated is 4.712 is greater than the F critical (value =4.21), then this shows that the overall model is significant. Further the P-value is less than 0.05 ie 0.039, thus indicating that the overall model is statistically significant. This findings supports that made by Gupta et al (2013) that "A strategic and operational approach to Lean performance and operational performance leads to increased financial capability of an organization which will drive top management to incorporate lean manufacturing practices in their organization."

**Table 4.13: ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. p-value |
|---|---|---|---|---|---|---|
| 1 | Regression | 480.101 | 7 | 68.586 | 4.712 | .039[b] |
| | Residual | 87.327 | 6 | 14.555 | | |
| | Total | 567.429 | 13 | | | |

a. Dependent Variable: supply chain performance

b. Predictors: (Constant), Value Stream Mapping, JIT, Jidoka, Pokayoke, Kanban, Kaizen, Five Ss

**Source: Research Data (2015)**

From table 4.14 below, the independent variables as represented by the lean tools and principles of value stream mapping, JIT, Jidoka, Pakayoke and Kanban, were found to be significant individual predicators of Supply Chain performance. This is because the computed p-values are less than the significance level value of 0.05. The measures of significance indicate whether the predictor variable coefficient affects the supply chain performance. The predictor variable coefficient of Kaizen and the 5'S are not statistically significant at 5% significant level since their p-values are greater than 0.05 this is because their computed p-values are more than the critical value at 0.05 significant levels.

**Table 4.14: Significance of Individual Predictors**

| Model | | unstandardized Coefficients | | Standardized Coefficients | t-value | p-value |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 4.454 | 13.449 | | .331 | .752 |
| | x1 | 1.752 | 1.077 | .567 | 1.9626 | .0155 |
| | x2 | .985 | .865 | .400 | 1.7139 | .0298 |
| | x3 | 1.660 | .981 | .384 | 2.191 | .0142 |
| | x4 | 4.361 | 1.519 | 1.435 | 2.871 | .028 |
| | x5 | .555 | .895 | .205 | 1.620 | .0558 |
| | x6 | .753 | 1.136 | .350 | 1.663 | .0532 |
| | x7 | .652 | .875 | .276 | 2.945 | .0484 |

a. Dependent Variable: Supply Chain performance

The regression equation assumed the following form:

$Y = 4.454 + 1.752\ X_1 + .985\ X_2 + 1.660\ X_3 + 4.361\ X_4 + .555\ X_5 + .753\ X_6 + .652 X_7 + \alpha$

Where

$Y$ = Supply Chain Performance;

$\beta_i$ = ( i = 0 – 6 ) = Regression coefficient

$X_1$ = Value Stream Mapping; $X_2$ = JIT;

$X_3$ = Jidoka; $X_4$ = Pokayoke

$X_5$ = Kanban $X_6$ = Kaizen

$X_7$ = Five Ss.

$\alpha$ = error term which captures variables not in the model and pure chance factors

Further Behrouzi and Wong (2011) in their study while investigating and identifying lean supply chain performance measures in the automotive SMEs found that the lean practices are significant in the success of a business.

# CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATION

## 5.1 Introduction

This section covers the summary of findings, conclusion, and recommendations in line with the topic of study which is to establish the relationship between lean assembling practices and supply chain performance amongst automotive firms in Kenya.

## 5.2 Summary of Findings and Discussions

The study concludes that reduced inventory, reduced manufacturing costs, waste reduction, reduced changeover time and Short setup time as aspects of "JIT" are significant to supply chain performance. Of the lean tools and principles, the Kaizen-continuous plans, Kanban and value streaming mapping were found to be the most commonly used practices adopted by automotive assembling firms in Kenya. These practices are widely used since they are simple to implement and the benefits they bring to the firm through continuous improvement, reduced cost, information transparency, error detection in work processes, tracking material flows ,and improved profitability derived from customer satisfaction. The application of these practices have greatly influenced the supply chain operation of firms by making them stand out as top performing businesses through the delivery of quality products and services to their customers thereby capturing a huge segment of the market.

Further the study concludes that enhanced quality of output, demand driven production, decreased lead time and production smoothing as aspects of flow and pull production are significant to supply chain performance to a large extent.

The study also found out that enhanced quality of output, demand driven production, decreased lead time and production smoothing as aspects of flow and pull production were considered significant to supply chain performance to a large extent.

Ranking “Pokayoke/Jidoka - Error Proofing/ Automation ” as an attribute of the Lean assembling practices adopted by automotive and extent to which its considered significant to supply chain performance, enhanced quality of output, waste elimination and reduced lead time were considered significant to supply chain performance to a large extent. Reduced errors were considered moderately significant to supply chain performance.

The study further found out that reduced cost of information processing was considered significant to supply chain performance to a large extent followed by increased production process and Smooth information transmission which was considered significant to supply chain performance to a moderate extent. Ranking “Kaizen/Continuous Improvement” as an attribute of the Lean assembling practices adopted by automotive and extent to which it is considered significant to supply chain performance

The study found out that output, reduced errors and Waste elimination as aspects of Continuous improvement were considered significant to supply chain performance to a large extent. From the findings, the 5s that is Self-discipline, Standardization/seiketsu, Sweeping/seiso, Sorting/seiton and Simplifying were considered significant to supply chain performance to a large extent.

### 5.3 Conclusions

The study concludes that the Kaizen-continuous plans, Kanban and value streaming mapping,Jidioka,JIT,Pokayoke and Five(5)s are significant to the supply chain performance of firms.

Further the study concludes that enhanced quality of output, demand driven production, decreased lead time and production smoothing as aspects of flow and pull production are significant to supply chain performance to a large extent.

Enhanced quality of output, waste elimination and reduced lead time are also considered significant to supply chain performance to a large extent. The study further concludes that reduced cost of information processing was considered significant to supply chain performance to a large extent followed by increased production process and smooth information transmission which was considered significant to supply chain performance to a moderate.

Finally the study concludes that output, reduced errors and waste elimination as aspects of continuous improvement are significant to supply chain performance just like the 5s that is Self-discipline, Standardization/seiketsu, Sweeping/seiso, Sorting/seiton and Simplifying.

### 5.4 Recommendations

The study recommends implementation of the Five(5)S,Pokayoke, Just in Time(JIT) and Jidioka as the application of these practices will influence the supply chain operation of firms by making them stand out as top performing businesses through the delivery of quality products and services to their customers. The recommendations are based on ranking from the study findings since these were lean practices that came out least amongst the practices adopted by automotive firms.

Jidoka (Automation) which is a process of quality control and refers to the automation of the functions of the production supervision, which means that the personnel is warned in case of an abnormal situation in order to stop the production line, thus preventing wastage, refuse and additional output, focusing on the attention on understanding why the problems occurred and how they can be avoided in future. This position is made due to the lower ranking of the principle in the application of the lean practice by the assembling firms.

The study recommends reduced inventory, reduced manufacturing costs, Waste reduction, and reduced changeover time since they have a great effect on supply chain performance.

Further the study recommends Poka -Yoke(also referred to as “mistake proofing”) which is a design defect detection and prevention into equipment with the goal of achieving zero defects and enable operators to spend more time on autonomous maintenance. It aims at eliminating product defects by preventing, correcting or drawing attention to human errors. The Lean concept focuses primarily on techniques for improving the performance of the system implying that employees cannot be trusted in order to have good quality products, creating a need to eliminate the possibility of human error in the system.

Finally the study recommends the use of 5s which are Self-discipline, Standardization/seiketsu, Sweeping/seiso, Sorting/seiton and Simplifying. A well-organized workplace motivates people, both on the shop floor as well as others. 5S improves safety, work efficiency, improves productivity and establishes a sense of ownership.

### 5.5 Limitations of the study

The study encountered difficulties in gaining access to the respondents most of whom were senior managers and the researcher had to keep rescheduling their time to align with the availability of the respondents.

Confidentiality is a major obstruction in gathering information relating to Lean assembling practices owing to its sensitive nature. This caused difficulties in convincing the respondents of the importance of giving sincere answers to the asked questions evidenced through reluctance of accepting invitation to participate in the study to counter the challenge, the researcher had to inform the respondents in advance that the purpose for the research study being carried out was meant for academic purpose only and not for other investigations though it was stipulated on the questionnaire.

One limitation of the study is that the researcher measured only the production side of the lean manufacturing and that the “after production part” of the lean manufacturing was not considered and this might not give the correct picture of the production system.

### 5.6 Suggestions for further study

The study was done to establish the relationship between lean assembling practices and supply chain performance amongst automotive firms in Kenya. Further study should be carried out to establish the impact of information sharing on the Supply Chain Performance of lean assembling firms.

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## APPENDIX I: RESEARCH QUESTIONNAIRE

This research is aimed at getting an understanding of the impact, challenges and benefits of implementing Lean assembling practices amongst automotive firms in Kenya. The responses to this questionnaire will be purely used for academic purposes and will be treated with strict confidence.

Thank you for your assistance.

**Section A: General Information of the Company**

1. Position of Respondent

   ( ) Supply Chain Manager ( ) Operations Manager ( ) Supply Chain/Operations Officer

   Other (specify)……

2. Educational level of Respondent

   ( ) Under graduate ( ) Graduate ( ) Doctorate

   Other (specify)…….....

3. How can you describe ownership of your company: please tick appropriately inside the box

   Local ( ) Foreign ( ) Both ( )

**Section B: The Extent of Adoption of Lean Assembling Practices**

1) Indicate the extent of adoption by your organization for each of the following Lean Assembling Practices. On a scale of 1 to 5 where 5 = to a very large extent, 4 = large extent, 3 = moderate extent, 2 = small extent, 1 = very small extent),

| | **Principle/Tool** | **5** | **4** | **3** | **2** | **1** |
|---|---|---|---|---|---|---|
| 1 | Value Stream Mapping | | | | | |
| 2 | JIT (Just In Time) | | | | | |
| 3 | Jidoka-Automation | | | | | |
| 4 | Pokayoke - Error proofing | | | | | |
| 5 | Kanban – Information Transparency | | | | | |
| 6 | Kaizen - Continuous Improvement | | | | | |
| 7 | Five (5) Ss | | | | | |
| 8 | Any other (please indicate) | | | | | |
| | | | | | | |

**Section C: Effect of Lean Implementation Practices**

1) Listed below are some of the attributes of the Lean assembling practices adopted by automotive firms. Please rank by a tick in the appropriate box the effect of lean implementation practices on your firm Supply Chain Performance using the following rating; 5 = to a very large extent, 4 = Large extent, 3 = Moderate extent, 2 = Small extent, 1 = Very small extent

| **Value Stream Mapping** | **5** | **4** | **3** | **2** | **1** |
|---|---|---|---|---|---|
| Waste reduction | | | | | |
| Reduced production time | | | | | |
| Reduced lead time | | | | | |
| Enhanced quality of output | | | | | |
| Production smoothing | | | | | |
| Any other (please indicate) | | | | | |
| | | | | | |
| **Just In Time** | | | | | |
| Reduced inventory | | | | | |
| Short setup time | | | | | |
| Reduced changeover time | | | | | |
| Reduced manufacturing costs | | | | | |
| Waste reduction | | | | | |
| Any other (please indicate) | | | | | |
| | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Flow and pull production** | | | | | |
| Enhanced quality of output | | | | | |
| Decreased lead time | | | | | |
| Demand driven production | | | | | |
| Production smoothing | | | | | |
| Any other (please indicate) | | | | | |
| | | | | | |
| **Pokayoke/Jidoka-Error Proofing/Automation** | | | | | |
| Reduced errors | | | | | |
| Waste elimination | | | | | |
| Enhanced quality of output | | | | | |
| Reduced lead time | | | | | |
| Any other (please indicate) | | | | | |
| | | | | | |
| **Kanban - Information Transparency** | | | | | |
| Reduced cost of information processing | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Smooth information transmission | | | | | |
| Increase production process transparency | | | | | |
| Any other (please indicate) | | | | | |
| | | | | | |
| **Kaizen/Continuous Improvement** | | | | | |
| Production smoothing | | | | | |
| Waste elimination | | | | | |
| Enhanced quality of output | | | | | |
| Reduced errors | | | | | |
| Any other (please indicate) | | | | | |
| | | | | | |
| **Five (5) Ss** | | | | | |
| Standardization/seiketsu | | | | | |
| Simplifying | | | | | |
| Sorting/seiton | | | | | |
| Sweeping/seiso | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Self discipline | | | | | |
| Any other (please indicate) | | | | | |

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

## APPENDIX II: AUTOMOTIVE ASSEMBLING FIRMS IN KENYA AS AT 31ST OF MARCH 2015

| AUTOMOTIVE ASSEMBLING FIRMS | Location |
|---|---|
| Associated Vehicle Assemblers (AVA) | Gilgil Rd, industrial area |
| General Motors East Africa (GM) | Enterprise/Mombasa Rd |
| Kenya Vehicle Manufacturers (KVM) | Addis Ababa Rd industrial Area |
| Banbros | Mombasa Road |
| Foton EA | Mombasa Road |
| Labh Sing & Hanan Sing | Mtama Rd Industrial Area |
| Bachu | Enterprise/Mombasa Rd |
| Rondon | Enterprise/Mombasa Rd |
| Central Farmers Garage | Central Farmers Garage |
| Kenya Coach Industries | Addis Ababa Rd industrial Area |

**Source: Kenya Motor Industry Association (2015)**