

**EFFECT OF LEAN MANUFACTURING PRACTICES ON SUPPLY CHAIN
PERFORMANCE OF MANUFACTURING FIRMS IN KENYA: A CASE OF FOOD
MANUFACTURING FIRMS IN NAIROBI COUNTY**

By

FREDRICK JUMA ONGARO

**MASTER OF BUSINESS ADMINISTRATION (PROCUREMENT AND SUPPLY
CHAIN MANAGEMENT OPTION)**

KCA UNIVERSITY

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE AWARD OF DEGREE OF MASTER OF BUSINESS
ADMINISTRATION (PROCUREMENT AND SUPPLY CHAIN MANAGEMENT
OPTION) AT KCA UNIVERSITY**

NOVEMBER, 2019

DECLARATION

I declare that this dissertation is my original work and has not been previously published or submitted elsewhere for award of a degree. I also declare that this contains no material written or published by other people except where due reference is made and author duly acknowledged.

FREDRICK JUMA ONGARO

17/01369

Sign..... Date.....

I do hereby confirm that I have examined the master’s dissertation of

FREDRICK JUMA ONGARO

And have certified that all revisions that the dissertation panel and examiners recommended have been adequately addressed.

Sign..... Date.....

Dr. Edward Owino

Dissertation Supervisor

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ABSTRACT

Poor performance of food and beverage companies arising as a result of an increase in costs can be indicated by the closure of a fast consumer goods manufacturer such as Cadbury Kenya which closed down its Nairobi plant due to poor performance. On the other hand, other manufacturing firms in Kenya such as the tea manufacturing firms have implemented energy efficiency practices so as to manage energy wastage and reduce production costs. Scholars argue that lean practices have a direct correlation to the overall performance of the supply chain process with over a half of the performance of the supply chain process being directly determined by wastage and costs. The importance of lean manufacturing therefore motivated this study to focus on establishing the effect of lean manufacturing practices on supply chain performance of manufacturing firms in Kenya: A case of food manufacturing firms in Nairobi County. The study specifically focused on time production, cellular manufacturing, pre-production planning and total quality control. The study target population were 29 Food and Beverage Firms in Nairobi County. The study employed a descriptive research design to collect quantitative data. A census was conducted on all the 29 Food and Beverage Firms in Nairobi County. The units of analysis were the procurement managers, production managers and operations managers. Quantitative primary data was collected through questionnaires and analyzed using statistical package for social sciences. Descriptive statistics of the form of mean and frequency analysis was used to describe the population. On the other hand, correlations and regressions was used to test the study hypotheses. The findings were presented in form of tables and figures. The findings of the study indicated that the four lean production practices of just in time production, cellular manufacturing, pre-production planning and total quality control are positively and significantly associated with supply chain performance. The study concluded that just in time production, cellular manufacturing, pre-production planning and total quality control are positively and significantly influenced supply chain performance of food manufacturing firms. The study recommended adoption of just in time production practices such as availing labor on demand in order to manage labor costs, availing resources on demand in order to manage wastage, production on demand in order to manage inventory costs, ordering raw materials from the suppliers only when there is demand for production from customers, having a simplified production design to ensure timely production and having multiple skill workers to ensure faster production. The study also recommended food manufacturing firms to consider increasing their use of cellular manufacturing by having a scheduled cell based layouts for production, using group technology to produce similar products and prioritizing sequential production for similar products.

Key Words: Just in Time Production, Cellular Manufacturing, Pre-production Planning, Total Quality Control, Supply Chain Performance, Food Manufacturing Firms

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DEDICATION

This project is dedicated to all my family members for their support.

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ACRONYMS AND ABBREVIATIONS

ANOVA	Analysis of Variance
GDP	Gross Domestic Product
GSCM	Green Supply Chain Management
GST	General Systems Theory
JIT	Just in Time
KAM	Kenya Association of Manufacturers
KS	Kolmogorov Smirnov
MMR	Moderated Multiple Regression
NEMA	National Environmental Management Authority
QMT	Quality Management Theory
RoK	Republic of Kenya
SC	Supply Chain
SC	Supply Chain
SCM	Supply chain management
SCM	Supply chain management
SPSS	Statistical Package for Social Sciences

TOC

Theory of Constraints

USA

United States of America

TERMS AND DEFINITION

Cellular Production refers to a type of process whereby 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).

Food Processing refers to production of foods ranging from drinking bottle alcohol, non-alcoholic drinks, bottled water, fruit or vegetable juices and soft drinks (carbonated drinks) (Olhager, 2010).

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).

Lean Manufacturing refers to strategies that aim to achieve smooth production flow by eliminating waste and by increasing the activities value (Vore, 2002)

Production Planning 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 (Tsuchiya, 2010).

Supply Chain Management includes a set of approaches and practices to effectively integrate suppliers, manufacturers, distributors and customers for improving the long-term performance of the individual firms and the supply chain as a whole in a cohesive and high-performing business model (Chopra & Meindl, 2011).

Supply Chain

is a homogeneous and interconnected network of firms which manages supplies, storages and handles material, information, personnel, equipment and final products throughout its length (Zuckerman, 2014).

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The chapter presents a review of the study theme where the relationship between lean practices and supply chain performance has been reviewed. The chapter has also presented a review of food and beverages manufacturing firms in Nairobi, statement of the problem, research objectives, research questions and significance of the study. The scope of the study has also been presented.

Lean supply chain management practices is one of the ways of reducing waste in organizations due to benefits that accrue in adoption of these practices (Margaret, 2013). Adoption of lean supply chain management enables the firms to tailor their supply chain processes and organizational roles to support lean supply chain principles. Organizations within a lean supply chain are able to leverage their own lean journey more easily, delivering better customer value by responding more efficiently, quickly, and predictably to customer needs (Demirbag, Koh, Tatoglu & Zaim, 2006). That, in turn, facilitates the operation of the lean supply chain by creating a virtuous cycle that ultimately translates to superior financial performance for these organizations.

Lean has become a strategic method for gaining competitive advantage and even for survival, for manufacturers, retailers and wholesalers. According to Lassalle (2005), the best practices in lean supply chain management include: demand management that involves providing products and services when requested by the customer, cost and waste reduction, process standardization which enables continuous flow, industry standardization, and cultural change and cross enterprise collaboration.

The organizations striving to become lean would benefit from a systematic approach towards building and managing their supply chain (York & Miree, 2004). Lean supply chain requires organizations to examine their business processes in order to identify areas whereby resources are wasted which can be measured in monetary value. This creates a window to minimize wastage and improve on the way of doing things. According to Hines, Holweg and Rich (2004) argue that manufacturing firms in Belgian service have adopted lean management practices to create value to the customer perspective other than the producer perspective by redesigning the organization into value streams and adopting practices that add value. Lean supply chain management led to improved organizational performance.

Manufacturing involves transformation of raw materials into either intermediate goods or final products through mechanized process. The manufacturing firms consist of setups that engage in the mechanical, physical or chemical transformation of materials, substances or component into new products (Kushwaha, 2012). According to KAM (2011) there are 752 manufacturing firms in Kenya operating in twelve subsectors ranging from construction, food processing, chemicals, energy, plastic, textiles, wood, pharmaceuticals, metal, leather, automobiles and paper processing firms According to the ministry of industrialization of Kenya, in the past decade, the assembling base has stayed static at 11% of the nation's GDP, and its industrial exports have diminished in supreme terms (Magutu, 2013). Expanding this base is basic to creating jobs and fiscal growth and development, in addition improvement in both local and foreign investment.

Historically, the growth in manufacturing has been a key element in the successful transformation of most economies that have seen sustained rises in their per capita incomes (WB, 2014).The United States of America's 12% GDP is accounted for by its manufacturing sector, while it employs about 9% of the countries workforce, every dollar spent in

manufacturing adds \$1.37 to the U.S. economy, and every 100 jobs in a manufacturing facility creates an additional 250 jobs in other sectors, (NAM, 2015).

However, as posited by Levinson (2015), it is important to note that even though the USA's manufacturing output growth has over the last decade outperformed that of most European countries and Japan, it has continued to lag behind that of China, Korea and other Asian countries. Also, the USA's share of global manufacturing activity declined from 30% in 2002 to 17.4% in 2012, while it was displaced by China as the largest manufacturing economy in the year 2010. According to Klynveld Peat Marwick Goerdeler (KPMG) International (2015), China's growth in its GDP slowed down as from the year 2013 to 2014 to stand at 74% partly due to challenging environment within the manufacturing sector. The contribution to GDP is 13.9% lower than that of the service sector which stands at 73% (Taborda, 2015).

In most of Africa, performance in manufacturing has been particularly poor over the last decades compared to the development countries (WB, 2014). Manufacturing is extremely important for the modernization of any country. It is the main activity that split the developed world from the developing one. Although there is no universal definition, nevertheless, developing countries are in general countries which have not achieved a significant degree of industrialization relative to their populations. In most cases, a developing country will have a medium to low standard of living (Mamaghani, 2010).

Manufacturing establishes for a better welfare for the citizens. Tybout (2000) suggests that the manufacturing sector is well taken care of by policy makers because it is the tool for modernization, employs skilled workforce, and results. The business environment has changed dramatically in the last few years, especially in developing countries. Regionally the

manufacturing sector in Kenya is growing far slower at rate of 7% than those in Ethiopia at 24%, Rwanda 35%, Tanzania 25% and Uganda 22%. If this trend continues, other East African countries will begin to dominate manufacturing in the region. Further, governments in East Africa seem to be putting more pronounced effort into building manufacturing through the creation of industrial parks (Ethiopia) and making land available for manufacturing, particularly labor-intensive manufacturing. Uganda and Tanzania are also determinedly positioning themselves as investment destinations for manufacturing in the region. Kenya does not seem to be echoing this impetus, ODI (2016).

In terms of growth of the value of manufacturing exports, Nigeria is a leader in Africa a study by ODI published earlier this year looked at data from Ethiopia, Kenya, Nigeria and Rwanda and the distribution of gross value addition by manufacturing subsector Food and beverages (usually a domestically-oriented industry) is the dominant manufacturing sector (40–70%), followed by textiles and clothing, which is more likely to be export-oriented. (ODI, 2016).

The ‘other’ category is a mixed bag; for example, 6% for cement in Nigeria, 12% for machinery and transport equipment in Kenya and 5% for non-metallic mineral products in Rwanda (ODI, 2016). Food and beverages (usually a domestically-oriented industry) is the dominant manufacturing sector (40–70%), followed by textiles and clothing, which is more likely to be export-oriented. The ‘other’ category is a mixed bag; for example, 6% for cement in Nigeria, 12% for machinery and transport equipment in Kenya and 5% for non-metallic mineral products in Rwanda (ODI, 2016).

The good news from a regional perspective is related to the fact that the East African Community (EAC) is aligning itself as the next global manufacturing destination. Such regional initiatives can be leveraged by the manufacturing sector in Kenya and catalyze its growth. There is clearly room for growth, evidenced in the fact that the combined manufacturing sector in the seven countries in Eastern Africa as a whole is only about one-third the size of the manufacturing sector in Vietnam, which has a population one-third the size of the seven countries (AFDB, 2014).

Locally manufacturing is very important sector in Kenya as it makes a substantial contribution to the country's economic development. The manufacturing sector in Kenya grew at 3.5% in 2015 and 3.2% in 2014, contributing 10.3% to gross domestic product (GDP) (KNBS, 2016). On average, however, manufacturing has been growing at a slower rate than the economy, which expanded by 5.6% in 2015. This implies that the share of manufacturing in GDP has been reducing over time. As a result, it can be argued that Kenya is going through premature deindustrialization in a context where manufacturing and industry are still relatively under-developed. Kenya seems to have 'peaked' at a point much lower than in much of Asia.

The sector is one of the key economic pillar in the vision 2030 geared to make the nation a middle level income country by the year 2030. The manufacturing sector is the third biggest industrial sector after agriculture and transport and communication (KPMG, 2014). Although Kenya is the most industrially developed country in East Africa, the manufacturing sector constitutes merely 10 per cent of the industrial sector contribution to GDP (RoK, 2014).

The manufacturing sector in Kenya constitutes 70 per cent of the industrial sector contribution to Gross Domestic Product (GDP), with building, construction, mining and quarrying cumulatively contributing the remaining 30 per cent (KAM, 2016). Kenya Vision 2030 identifies the manufacturing sector as one of the key drivers for realizing a sustained annual GDP growth of 10 per cent (KER, 2013). The manufacturing sector has high, yet untapped potential to contribute to employment and GDP growth. For example, compared to the agriculture sector, which is greatly limited by land size, the manufacturing sector has high potential in employment creation and poverty alleviation since it is less affected by land size (ROK, 2013).

1.1.1 Lean Manufacturing Practices of Manufacturing Firms

According to Vore (2002), lean manufacturing practices are strategies that aim to achieve smooth production flow by eliminating waste and by increasing the activities value. According to Reichhart and Holweg (2007) lean manufacturing practices include: environment lean practices, lean procurement practices, lean transformation practices and lean transportation practices. According to Tsuchiya (2010), lean manufacturing practice is a thought process and philosophy, used to look at firm whether it is manufacturing, service or any other activity with a supplier and a customer relation with a goal of eliminating non-value added tasks. Most companies in Kenya have a major opportunity to reduce their cost, customer lead-time and cycle time through the application of lean manufacturing practices (Flynn, 2011).

Lean thinking focuses on value-added lean and consists of best practices, tools and techniques from throughout industry with the aims of reducing waste and maximizing the flow and efficiency of the overall system to achieve the ultimate customer satisfaction. Lean

manufacturing is a manufacturing philosophy that shortens the time between the customer order and the product build/shipment by eliminating sources of waste. Lean is most widely used in industries that are assembly oriented or have a high amount of repetitive human processes. These are typically industries for which productivity is highly influenced by the efficiency and attention to detail of the people who are working manually with tools or operating equipment. For these kinds of companies, improved systems can eliminate significant levels of waste or inefficiency (Rosenzweig & Easton, 2012). Examples of these include wood processing, garment manufacturing, automobile assembly, electronics assembly and equipment 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.

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 firm performance and efficiency through reduction of costs, better quality products and increased production.

According to Vore (2002), total quality control 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. Bhasin and Burcher, (2006) explained that total quality control is an approach to keep the current plant and equipment at its higher productive level through cooperation of all areas of organization. Continuous improvement and quality management programs go hand in hand as they seek to achieve excellence through improvement.

Production planning 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 (Tsuchiya, 2010). If the production level is not constant this leads to waste (such as work-in-process inventory) at the workplace (Billesbach, 2006). 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.

1.1.2 Supply Chain Performance of Manufacturing Firms in Kenya

Supply Chain (SC) is a homogeneous and interconnected network of firms which manages supplies, storages and handles material, information, personnel, equipment and final products throughout its length (Zuckerman, 2014). The SC can be the means by which businesses add value to customers and therefore competitive advantage in the international market. Supply chain management (SCM) includes a set of approaches and practices to effectively integrate suppliers, manufacturers, distributors and customers for improving the

long-term performance of the individual firms and the supply chain as a whole in a cohesive and high-performing business model (Chopra & Meindl, 2011).

As global competition increases, manufacturing companies should be more involved in how their suppliers and customers conduct their businesses. To compete successfully in today's challenging business environment manufacturing companies should be able to effectively integrate the internal functions within a company and effectively link them with the external operations of suppliers and supply chain members (Zuckerman, 2014). They need to focus on supply chain management practices that have an impact on enhancing SCM activities and ultimately performances (Arawati, 2011).

According to Thatte, (2016), effective and efficient supply chain management has become a very valuable and important way to remain competitive in the market and to improve the organizational performance. It plays a very important role in staying competitive because the competition among the organizations is effected by the SCM. However, several external factors continue to thrust the organization to adopt the new way of conducting businesses; that is, increasing globalization, decreased barriers to international trade, improvement of information availability through information technology and increasing customer demand (Power, 2005).

In order to survive companies must be able to reduce cost, improve quality and provide fast response to the customer needs. One of the ways of achieving that competitive edge is through the implementation of SCM practices (Muhammad, 2014). Thus this study will seek to establish the effect of lean manufacturing practices on supply chain performance of manufacturing firms in Kenya, a case of food manufacturing firms in Nairobi County.

1.1.3 Food and Beverages Manufacturing Firms in Nairobi County

Food processing consists of multiple value chains beginning with agricultural production and reaching into domestic, regional, and global markets. Beverage or drink processing firms are concerned with products ranging from drinking bottle alcohol, non-alcoholic drinks, bottled water, fruit or vegetable juices and soft drinks (carbonated drinks). Apart from forming part of the culture of the society, drinks also fulfill a basic need. In published statistics food processing is grouped with beverages and tobacco, and the combined total in 2008 was KShs 58.6 billion, or about 2.8% of GDP (Olhager, 2010).

Due to the large dependence of the Kenyan economy on agriculture for its manufacturing sector, the food and beverage industry is a very vital industry in Kenya. Agricultural products that have value being added and foods that are processed whose preparation is quick and simple have demand created by the above together with the influx of people in urban areas (Lee, Hau, & Billington, 2010). The firms have been driven by this demand into vigorous struggle for sustainable competitive advantage. Food and beverage industry in Kenya is a basic productive sectors singled out for development and expansion of the economy thus it has enormous possibilities for creation of employment, reducing or eradicating poverty and creation of wealth (Nyaga, Whipple& Lynch, 2010).

The sector continues to positively contribute towards accomplishment of vision 2030. The largest component of the Kenyan manufacturing sector remains to be sector that processes food which is food, beverages and tobacco. So as to supply the domestic and neighboring markets, operations in Nairobi have been established by major multinationals either as companies that are foreign owned or Kenyan shareholding that are joint ventures (Okello, & Were, 2014).

1.2 Statement of the Problem

The Kenyan manufacturing sector contributes to 10% of the Gross Domestic Product (GDP), 13% of formal employment and 12.5% of exports. However this contribution is being threatened since statistics from World Bank show that Kenyan manufacturers have registered stagnation and declining profits for the last five years due to a turbulent operating environment. It is estimated that manufacturing companies in Kenya have lost 70 per cent of their market share in East Africa largely attributed to contingencies arising from among other factors, improper management of supply chain (KAM, 2014).

The intermediate and capital goods industries are also relatively underdeveloped, implying that Kenya's food manufacturing sector is highly import dependent. Locally-manufactured food comprises 10% of Kenya's exports. Poor performance of food and beverage companies arising as a result of an increase in costs can be indicated by the closure of a fast consumer goods manufacturer such as Cadbury Kenya which closed down its Nairobi plant due to poor performance (RoK, 2014). On the other hand, other manufacturing firms in Kenya such as the Tea manufacturing firms have implemented energy efficiency practices so as to manage energy wastage and reduce production costs. Since scholars such as Murigi (2014) argues that lean practices have a direct correlation to the overall performance of the SCM process with 57.1% of the performance of the SCM process being directly determined by wastage and costs, this therefore calls for an investigation into the lean manufacturing practices being used by the manufacturing firms.

In the food manufacturing process, there is much waste that can affect the profits of the business. In recent years, there has been substantial interest in lean thinking by researchers especially in the manufacturing sector. According to Anand and Kodali (2008),

reduction of waste is one of the ways that organizations perceive to be appropriate in enhancing organizational performance. Lean supply chain management practices are popular ways of reducing waste in organizations due to benefits that accrue in adoption of these practices for example reduced waste, value creation, and efficiency and reduced costs among others. Aberdeen group (2006) indicates that more than 50 % of organizations that adopt lean supply chain management practices minimize waste and operational costs. Therefore there was need to establish the lean manufacturing practices adopted by food and beverages companies and establish their effect on supply chain performance. This study was also motivated by the outcry from the manufacturing firms about the high costs of electricity which could otherwise be managed by adoption of lean manufacturing practices.

1.3 Research Objectives

The main objective was to establish the effect of lean manufacturing practices on supply chain performance of manufacturing firms in Nairobi County, Kenya. The following were the study's specific objectives:

- i. To establish the effect of just in time production on supply chain performance of food manufacturing firms in Nairobi County, Kenya
- ii. To determine effect of cellular manufacturing on supply chain performance of food manufacturing firms in Nairobi County, Kenya
- iii. To determine the effects of pre-production planning on supply chain performance of food manufacturing firms in Nairobi County, Kenya
- iv. To establish the effect of total quality control on supply chain performance of food manufacturing firms in Nairobi County, Kenya

- v. To establish the moderating effect of government regulations on the relationship between lean manufacturing practices and supply chain performance of food manufacturing firms in Nairobi County, Kenya

1.4 Research Questions

- i. Does just in time production affect supply chain performance of food manufacturing firms in Nairobi County, Kenya?
- ii. What is the effect of cellular manufacturing on supply chain performance of food manufacturing firms in Nairobi County, Kenya?
- iii. What is the effect of pre-production planning on supply chain performance of food manufacturing firms in Nairobi County, Kenya?
- iv. How does total quality control affect supply chain performance of food manufacturing firms in Nairobi County, Kenya?
- v. What is the moderating effect of government regulations on the relationship between lean manufacturing practices and supply chain performance of food manufacturing firms in Nairobi County, Kenya?

1.5 Significance of the Study

The findings of the study are expected to be beneficial to various stakeholders and firms in procurement and supply chain management policy makers and food and beverages firms. The scholars and academicians can also benefit from the findings.

1.5.1 Policy Makers

The findings of the study provide insights for supply chain managers on the importance of adopting lean manufacturing practices as a critical success factor in enhancing

supply chain and organizational performance. The results of the study also provide vital information to the supply chain managers in formulating lean manufacturing policies.

1.5.2 Food and Beverage Firms

The study findings are beneficial to the Management of Food and Beverage Firms in understanding of how supply chain management practices affect organizational performance. The results aid in developing the right policies and practices that would positively improve their market share, growth and raise their sales. The findings of the study can benefit in decision-makers on prioritizing certain supply chain decisions regarding their desired performance.

1.5.3 Academicians and Scholars

Finally, the findings of this study may be used by future researchers and scholars in the field of procurement. The scholars may use the findings of this study in justification of the study and source of references. The study expounds the utility adopted theories in the field of lean manufacturing practices.

1.6 Scope of the Study

The study focused on establishing the effect of lean manufacturing practices on supply chain performance of manufacturing firms in Nairobi County, Kenya. The study specifically focused on time production, cellular manufacturing, pre-production planning and total quality control. The study also established the moderating effect of government regulations on the relationship between lean manufacturing practices and supply chain performance of food manufacturing firms in Nairobi County.

The target population was 29 Food and Beverage Firms in Nairobi County. The study employed a descriptive research design to collect quantitative data. A census was conducted on all the 29 Food and Beverage Firms in Nairobi County. The unit of observation was the procurement officers, production managers and operations managers. The study was carried out in 2019.

1.7 Limitations of the Study

One of the challenges faced by the study was that some managers failed to provide information sought for fear of intimidations should the information be traced back to them particularly if the information is too sensitive and potentially likely to reveal their lean strategies to competitors. This limitation was however managed by making clarifications and giving assurance that the purpose of the study was purely for academic purposes with confidentiality.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The chapter gives insights on information contained in other publications on topics associated with the research problem. It reveals what different scholars and authors have thought on the concept of lean manufacturing practices on supply chain performance of manufacturing firms. The chapter covers the concept of lean manufacturing functions such as just in time production, cellular manufacturing, pre-production planning and total quality control. The chapter also covers theoretical review of the functions, empirical review, conceptual framework, operationalization of variables and ends with research gaps.

2.2 Theoretical Review

In explaining the concepts of lean manufacturing on supply chain performance, the literature hinged on Lean Theory, System Theory, Theory of Constraints and Quality Management Theory.

2.2.1 *Lean Theory*

Lean theory forms the basis of this research as it evaluates and brings out lean practices that aim at removing production overburden, inconsistency and minimizing waste. According to Ciarniene and Vienazindiene(2012),lean is a functional model comprising of comprehensive techniques which aim at reducing and eliminating wastage when combined together in a production process hence making a firm more responsive and flexible to changes in demand. Nash, Poling and Ward (2006) advanced the theory by seeing it as a systematic approach that aims at enhancing a continuous flow of quality product or service to

customers just at the time they need it. According to the theory, processes that aim at fully satisfying customers' needs should follow prescribed principles while minimizing all forms of loss.

Similarly, the operating system should contain stream values that must be individually optimized from the start to the end (Ciarniene& Vienazindiene, 2012). Organizations aiming at applying lean theory in their production lines should have a strong focus on customers, should be willing to remove production wastes form all production processes on daily routine and must be willing to grow and survive prevailing stiff competition. According to Moroz (2018), a well-designed production process should aim at delivering a predictable and consistent product while minimizing wastage. Lean theory capitalizes on a continuous quality delivery to customers basing on customers' needs at specific time. By doing so, the production process eliminates waste characterized by unnecessary planning meetings, unnecessary inventories, overproduction, unnecessary transport and over processing (Rand, 2011).

The theory informed the objective of the effect of just-in-time production on supply chain performance of manufacturing firms. Just-in-time is a strategy applied by firms and aligns ordering supplies from suppliers with production schedules (Ciarniene& Vienazindiene, 2012). Firms applying this strategy aim at increasing efficiency while at the same time decreasing waste since they receive goods just when they are needed in production process. The strategy enables producers to accurately forecast demand. Bautista and Fortuny-Santos (2016) asserts that organizations are able to reduce the amount of working capital due to the reduction in inventory levels. Consequently, the strategy ensures step by step inspection of the production process hence minimizing wastage.

2.2.2 System Theory

The theory was proposed by Bertalanffy's in his work the general systems theory (GST). The theory posits that a firm is a system which can be sub divided into groups where each group performs set activities. Each group is assigned tasks to accomplish within a stipulated period of time. By dividing a firm into functional groups, a firm aims at assigning each group specific tasks and related tasks whose end results translates into large production. This is contrary to when a firm executes the entire production as a whole system.

According to system theory interrelates to all functions of a process with the aim of achieving a common goal. Any activity being executed by one group affects the end results of the entire system. The theory argues that all parts in a system should work together to create an enabling process that culminates into achievement of set production goals by a firm. Hamed, Esmaeilian and Ismail, (2011) contends that every participant in a system has a specified task to accomplish in a certain duration of time and the success of the goal depends on feedback contribution from the surrounding subsystems. Additionally, every group in the system depends with each other and works together towards achieving the set goals. In the course of execution of the set activity, a system is bound to adapt to changes in environment in order to stay in course with accomplishment of the set activity ((Tupa, 2014 ;Ralescu, 2009). According to Canel (2008), failure to adhere to changes in the environment leads to disruptions of the entire system leading to failure in accomplishing set goals and objectives.

Hamed *et al* (2011) agrees that operations within a process are proximately executed and this allows immediate feedback in case of a problem or any issue that may interfere with the process. Participants within a cell a highly trained and possess multitasking skills that contributes significantly to smooth flow of processes. Canel (2008) asserts that cellular

manufacturing applies group technology which separates groups with similar characteristics to perform a specified task. The design assumes a U-shape or a straight line where a product passes through all participants in the cell from the start until the end.

The theory is of significance to the study as it explains the need for cellular manufacturing in a company. According to the theory, the entire process can be divided into smaller functional groups such as cells representing a workstation to facilitate a continuous production flow. These functional groups can be monitored to work together with an aim of making the entire process a success.

2.2.3 Theory of Constraints

The theory of constraints developed by Goldratt (1954) forms a basis for identifying limiting factors (constraints) in a production process that acts as a hindrance to achieving set goals and objectives. Once the limiting factor is identified, a systematic way of improving it is developed so that it is no longer a constraint. The theory asserts that every complex system such as a production process is characterized by interrelated activities some of which act as constraints to the entire system. In their study, Ceniga and Sukalova (2014) asserts that optimizing a non-limiting factor brings insignificant benefits to a process, therefore only improving the constraints leads to achievement of the set goal.

In order to achieve maximum benefit of every process, it is important to identify possible limiting factors to enable setting corrective measures. According to the theory, managers are tasked with the responsibility of pre-evaluating a process before its commencement to reduce possibilities of breakdown brought by the limiting factors. When dealing with production constraints, managers need to handle a constraint one at a time before moving to the other (Dettmer, 1996). This gives a room for further re-evaluation and

identifying the next constant. According to Goldratt (1954), the theory of constraints rests its power on its ability to direct strong focus on achieving a goal while removing impediments that hinders achievement of the goal. TOC has its roots on a two way focus: one is on the goal and the other is on the limiting factor. Suppressing the limiting factor increase the chances of achieving the goal while encouraging the limiting factor suppresses achievement of the goal.

The theory supports pre-production planning in the manufacturing process. Pre-production involves evaluating a production process before its commencement(Hao, Soong, Yang & Wang, 2008). It is at this point that managers identifies the needs of process and puts aside corrective measures as control for the process. Similarly, the process involves formulation of alternative strategies to be applied in case the formulated process fails. During pre-production planning, a goal is set and all the possible hindrances towards the goal are identified. Once identified, their exploitation follows which leads to performance elevation of the constraint. According to Hao *et al* (2008),the elevation suppresses the effect of the constraint culminating into achievement of goals. For the goal to be achieved, the hindrances need to be solved first. Managers are responsible for designing corrective measures with the contribution of other individuals in the production process.

2.2.4 Quality Management Theory (QMT)

Quality management theory developed by Deming (1954) contributes to this study as it revolves around improving all processes, services, products and cultural workplace in a line of production by all participants to gain a long-term success attained through customer satisfaction. Deming (1954) defines QMT as a managerial approach that focuses on customers coupled with continuous improvements of activities that satisfies customer

demands. Consequently, quality management theory aims at centering all process thinking where participants contribute to the transformation of inputs to outputs until they are delivered to consumers.

Process thinking defines all the required steps in the production process while at the same time monitoring closely the unexpected variation. Richbell and Ratsiatou (2009) posit that the strength of quality management theory lies on the integration ability that brings together all components of a process for a common goal. Additionally, the integration matches the organization's strategic goals, mission and vision with quality output of products and services that fully satisfies customer.

The theory contributes to total quality management of a manufacturing process. Stensaasen, (1995) contends that the aim of every firm is to produce quality goods and services that retain current customers while at the same time attracting other customers. In total quality management, all participants need to be involved for optimal results.

2.3 Empirical Review

The section provides a discussion of past studies that contributed to the objectives of the study. The section reviews past literature on lean manufacturing and the link to supply chain performance. According to Sekaran and Bougie (2016), the review of similar studies is used along with empirical data collected. The review on literature was done on the four research variables.

2.3.1 Just In Time Production and Supply Chain Performance

Tripathi and Tiwari (2016) conducted a research on lean manufacturing practices and measurement of firm's performance. The purpose of the study was to investigate the extent to which lean manufacturing management practices affects a firm's financial performance. The central question was: How do just in time production, flexible workforce, creative thinking and Kanban system affects the lean manufacturing practices in Indian manufacturing sector? The study focused on data collected from manufacturing firms in India.

The findings of the study indicated that firms that applied lean manufacturing practices stood a better competitive position as compared to those that did not apply the lean practices. The system contributes significantly to human resource development that aims at creating a self-directed working culture and a cross functional frameworks that works jointly towards solving emerging issues in the line of production(Tripathi & Tiwari, 2016).Additionally, just in time production opens a firm's marketing share by ensuring quality products are availed to customer while at the same time minimizing wastage. The findings also revealed that just in time production ensures customer retention while attracting new customers.

Sayid (2017) conducted a study on the Implementation of Lean Manufacturing Tools in Footwear Industry of Bangladesh firms. In his study, he evaluated the effects of lean manufacturing, just in time production and single piece flow. The results of the study indicated that just in time production and performance of footwear industry had a positive link as the latter resulted to a reduction in production cycle, a decrease in the number of operators required to produce equal amount of footwear, reduction of level of reworks, reduction in wastage and reduction in lead time production. When implemented well, just in

time production enables a firm to meet market demands as it is able to produce only what is required at a particular time (Sayid, 2017).

In another study, Sumo(2015) conducted a study to establish the relationship between lean assembling practices and supply chain performance amongst automotive manufacturing firms in Kenya. The study focused on tools of lean practices applied by automotive firms which included value stream mapping, Five (5)Ss, Just in time production and Jidoka. Amongst the lean practices applied by the firms, the study found out that just in time production enabled firms to stay put in the competitive industry by ensuring demand is responded when it arise. The study concluded that just in time production influences supply chain performance in automotive firms by ensuring there are supplies only when needed thus enabling a firm to cut costs on inventories and wastage(Sumo, 2015).

Tan and Kanna(2005) conducted a study on the linkages of lean manufacturing practices on performance of supply chain and business firms. The study's main question was: How do just in time production and total quality management contributes to supply chain and firm's performance? The study concluded that just in time production as one of lean manufacturing practices, when well implemented, enables a firm to focus more on production on customer's demand rather than producing and waiting for demand to arise. The study linked acquired performance indicators such as quality production, customer retention and reduction in inventories with just in time production. This study sought to test the following null hypothesis:

H₀₁ Just in Time Production does not have a significant effect on supply chain performance of food manufacturing firms in Nairobi County, Kenya

2.3.2 Cellular Manufacturing and Supply Chain Performance

Jones and Alony(2008) conducted a study on human perception of cellular manufacturing on lean supply chain. The study focused on characteristics of cellular manufacturing and resultant contribution to supply chain performance. Jones and Alony (2008) acknowledges that adoption of cellular manufacturing in a firm is a challenging task as it involves continuous training of participants within a cell and are expected to multitask in the manufacturing process. The study appreciated the contribution of cellular manufacturing by firms as it leads to a large production output. According to the study's conclusion, cellular manufacturing enhances workmates social interactions and incentives that contribute to high output of quality production. The output contributes to supply performance by ensuring continuous production as per demand (Jones & Alony, 2008).

Gharbi (2011) conducted a study on the implementation of cellular manufacturing and its resultant effect on supply chain performance. Cellular manufacturing contributes to short delivery times, wide range of products, reduction in throughput times, reduction in material handling, reduction in set up times and reduction in production costs (Gharbi, 2011). The impact of cellular manufacturing is manifested in the supply chain performance since a firm is able to maximize on available workforce that leads to continuous production. In cellular manufacturing, a firm is able to meet unexpected rise in demand of a product due to availability of segmented workforce that ensures continuous production.

According to the findings of a study by Bansee *et al*(2007), cellular manufacturing entails complete utilization of machines in a cell to ensure maximum production. It also involves a progressive production of a product in one cell rather than awaiting for a completion of a batch. Bansee *et al*(2007) contemplates that cellular manufacturing entails a

complete configuration of a production system to achieve maximum benefit of the process. To make cellular manufacturing successful, supply chain members should be involved completely to avail required market information and supplies needed to ensure successful production process (Jones and Alony, 2008).

Creating a firm that benefits fully from cellular manufacturing calls for integration of all individuals and processes involved in the production process(Kumar, Kumar & Singh, 2014).Cellular manufacturing aims at ensuring quality products are produced that meet customers demand. Continuous training of participants ensures quality standards of products are met that competes effectively with other products in the markets. Cellular manufacturing also calls for implementation of an enabling work environment where everyone in a cell fully contributes towards success of the process. Kumar, Kumar and Singh (2014) notes that there is a need to create a good cultural work environment that accommodates participants and supports production process.This study sought to test the following null hypothesis:

H₀₂ Cellular Manufacturing does not have a significant effect on supply chain performance of food manufacturing firms in Nairobi County, Kenya

2.3.3 Pre-Production Planning and Supply Chain Performance

According to Hassan *et al*(2013), pre-production planning enables a firm to evaluate all the needs of a process and put in place corrective measures for implementation in case the process deviates from its expectation. Different firms view planning differently depending on the needs, goals and objectives of the process. In a production firm Kumar *et al*(2014) asserts that pre-production contributes to a smooth running of a process that culminates into quality products that meets specified standards. Similarly, preproduction planning plays a significant role in ensuring that better and economical goods are availed to customers irrespective of the

size of the firm. Moroz (2018) argues that whatever happens in the planning determines the progressive nature of the production planning.

Olhager and Wikner (2010) assert that production planning entails proper expedition and scheduling of work that aims at providing improved and quality services and products to customers while offering them reasonable prices and supplying and delivering at agreed timeframe. Similarly, through pre-production planning, firms are able to win customers' confidence which improves customer's relations leading to increased profits through repeat purchases and referrals.

Maguire (2012) observed that control measure of production should be formulated to respond to alteration in the planned process. A deviation in activities scheduled in production process evokes a change of the original plan and if appropriate measures are not taken, a process faces failure in completion. Production uncertainties play a significant role in preparing participants of available alternatives to cater for the uncertainty. When production process and controls are defined in the pre-production planning, participants are assured of quality products at the end of the production process (Maguire, 2012). This study sought to test the following null hypothesis:

H₀₃ Pre-Production Planning does not have a significant effect on supply chain performance of food manufacturing firms in Nairobi County

2.3.4 Total Quality Control and Supply Chain Performance

Masindetand Ogollah (2014) conducted a study on influence of total quality management practices on supply chain performance with a focus on cement manufacturing firms in Kenya. The study applied a descriptive approach which focused on influence of

management commitment, employee involvement, customer orientation and continuous improvement on supply performance as key indicators of total quality management.

From the results, Masident and Ogollah (2014) established a significant relationship between supply chain performance and all indicators of total quality management since the indicators contributed to supply chain performance of cement manufacturing firms. The results of the study recommended that cement manufacturing firms can improve their total quality management status by employing a committed managerial team, involving employees, orienting customers and enhancing a continuous improvement of firm's activities.

Fatuma (2015) carried out a research to establish quality management practices and supply chain performance in large manufacturing firms in Nairobi. Her study emphasized on implementation of quality management practices by manufacturing firms, the relationship between quality management practices and supply chain performance of manufacturing firms and challenges faced by manufacturing firms when implementing quality management practices. The study by Fatuma (2015) adopted a descriptive research design in data collection and analysis presented through descriptive and inferential statistics. The study findings indicated that large manufacturing firms that adopted quality management practices characterized by lean production, benchmarking, six sigma practice and supplier partnering stood a better competitive ground in the market. Adoption of quality management practices enables a firm to relate well with all its stakeholders which contributes to a successful accomplishment of set goals and objectives.

A study by Chang (2009) on implication of total quality management on supply chain performance indicated that survival of enterprises in competitive markets is determined by the way a firm applies managerial skills of total quality. According to Chang (2009), existing

competition hinders immediate response to customer's demand triggering adoption and implementation of total quality management in the entire production system. Adoption of a system that focuses on total quality management ensures achievement of a simplified production system that leads to achievement of high quality products that fits market demands. This translates into a continuous supply system that ensures availability of products to customers when needed and in the right specified quality. Fatuma (2015) agrees that adoption of total quality management practices translates to performance in the supply chain and enables a firm to respond to demands in the markets.

Seyed *et al* (2011) on their study on total quality management and lean manufacturing practices revealed that application of total quality management practices by manufacturing firms creates an avenue for process evaluation that enhances production process. Similarly, a lean thinking approach in production process enables a firm to capitalize on producing only what is needed in the market hence reducing wastage. The study findings concluded that adoption of a lean thinking production approach by manufacturing firms incorporates total quality management practices that enables a firm to improve its processes which translates to improved competitiveness leading to quality deliveries to end-user customers. This study sought to test the following null hypothesis:

H₀₄ Total Quality Control does not have a significant effect on supply chain performance of food manufacturing firms in Nairobi County

2.3.5 Government Regulations

Fiorino and Bhan (2013) conducted a study on the moderating role of government Environmental Regulation on Supply Chains performance by Comparing Private and Public Regulation in the USA. Adopting descriptive approach, the study established that government

regulations touching on environmental management, industry codes, product or building certification programs, and reporting or disclosure programs negatively moderated supply chain performance.

Nezakati, Fereidouni and Rahman (2016) also conducted a study to determine the moderating effect of government on the relationship between green supply chain management and performance of manufacturing firms in Malaysia. The study adopted an empirical review approach where comparisons were made between firms. The study indicated a positive moderating effect of government in promoting performance through implementing green supply chain practices. The findings implied that governments' stewardship role can be more appropriate to the GSCM in order to coordinate and integrate the supply chain activities.

Zhu and Sarkis (2007) conducted a study to establish the moderating effects of government pressures on emergent supply chain practices and performance of manufacturing firms. A moderated hierarchical regression analysis of data provided by 341 Chinese manufacturer respondents was completed incorporating three moderating factors namely market, regulatory, and competitive institutional pressures. The findings indicated that government pressure had a positive significant moderating effect on the relationship between supply chain practices and performance of the firms. It was established that the existence of normative and regulatory (coercive) pressures influences organizations to have improved environmental performance, especially when these pressures cause adoption of eco-design and green purchasing practice hence improving their performance in the process.

Mutua, Ngugi and Odhiambo (2018) conducted a study to establish the influence of lean production practices on performance of large manufacturing firms in Kenya. The study conducted a survey of all the large manufacturing firms in Kenya. The government regulations were used to moderate the relationship between lean production practices and performance and the findings indicated that government regulations improved the interaction of lean production practices with performance. It was argued that better NEMA regulations improved production practices which led to an improvement in performance.

Rucha (2018) focused on the effect of lean practices on operational performance of third party port-centric logistics firms in Kenya with the moderating effect of government regulations. The study conducted a moderated multivariate regression analysis and established a significant moderating effect of government regulations on the relationship between lean practices and operational performance. It was revealed that in-conducive government regulations greatly hurt the operations of the firms. This study sought to test the following null hypothesis:

H₀₅ Government regulations do not have a significant moderating effect on the relationship between lean manufacturing practices and supply chain performance of food manufacturing firms in Nairobi County

2.4 Critique of Literature and Knowledge Gaps

The empirical studies presented indicated conceptual, contextual and methodological knowledge gaps. The study by Tiwari and Tripathi (2016) on lean manufacturing practices on Indian manufacturing firms focused on India thus presenting a contextual knowledge gap. Similarly, the study recommended further research to be done on lean manufacturing practices and their resultant effect on performance of manufacturing firms. The study by

Gupta (2013) on operational approach to evaluate lean performance with a focus on Tyre manufacturing firms in India similarly focused on India thus presenting a contextual knowledge gap. The study by Lucato (2014) on performance of Brazilian implementation of lean manufacturing also presented a contextual knowledge gap since it was conducted in Brazil.

The study by Shahram *et al* (2011) on lean manufacturing on performance of Chinese manufacturing firms was limited to firms that had enough manufacturing experience and the findings limited generalization of the nature of manufacturing firms in China. This is a contextual knowledge gap which the study sought to fill. In Kenya, the study by Kanyanya (2013) on lean manufacturing practices on performance of organizations focused on Jidoka-Automation, Five Ss, kaizen-Continuous, Value Stream Mapping, Just in Time, Pokayoke-Error Proofing, Improvement and Kanban-Information Transparency singling other lean manufacturing indicators such as cellular manufacturing, pre-production planning and total quality control thus presenting a conceptual knowledge gap. On the other hand, the study by Weru (2012) on lean manufacturing practices and performance in large manufacturing firms in Kenya presented a contextual knowledge gap since it focused on all the large manufacturing firms while this study focuses on food and beverage manufacturing firms.

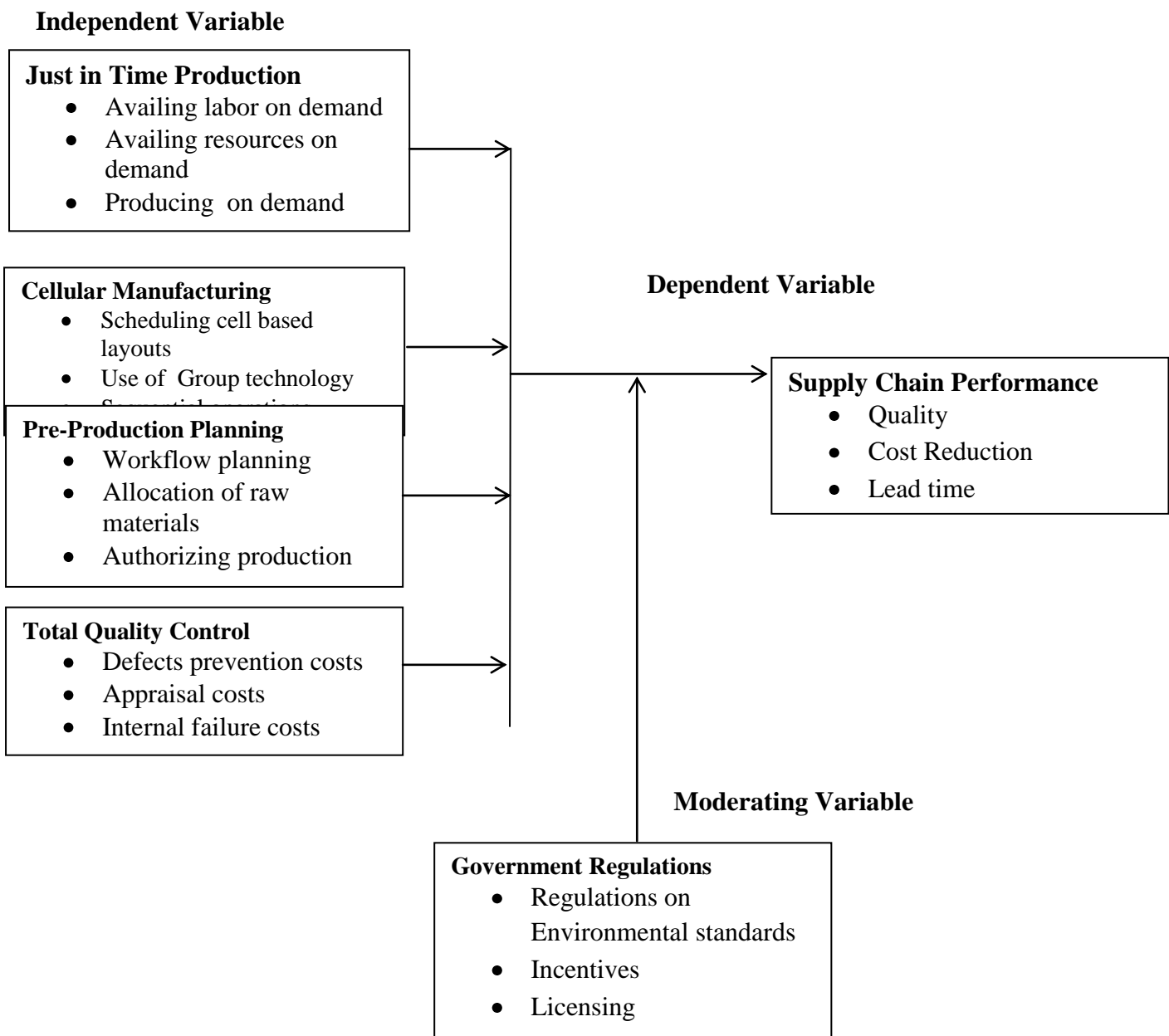
2.5 Conceptual Framework

According to Mugenda (2008), a conceptual framework comprises of variables operationalized by the researcher to achieve set goals. A variable, as stated by Mugenda (2008), is a measure that takes different values depending on the input. Conceptual framework creates link between independent and dependent variables. The framework in Figure 1 shows the link between lean manufacturing practices and supply chain performance.

The independent variables are: Just in time production, Cellular manufacturing, Pre-production planning and total quality control while the dependent variable is supply chain performance.

FIGURE 1

Conceptual Framework



2.6 Operationalization of the Study Variables

The section presents operationalization of the study variables.

TABLE 1

Operationalization of the Study Variables

Variable	Type	Indicators	Measurement Scale	Questions in the questionnaire
Just in Time Production	Independent Variable	<ul style="list-style-type: none"> • Availing labor on demand • Availing resources on demand • Producing on demand 	• Interval Scale	4 - 10
Cellular Manufacturing	Independent Variable	<ul style="list-style-type: none"> • Scheduling cell based layouts • Use of Group technology • Sequential operations 	• Interval Scale	11 - 17
Pre-production Planning	Independent Variable	<ul style="list-style-type: none"> • Workflow planning • Allocation of raw materials • Authorizing production 	• Interval Scale	18 - 24
Total Quality Control	Independent Variable	<ul style="list-style-type: none"> • Defects prevention costs • Appraisal costs • Internal failure costs 	• Interval Scale	25 - 31
Government Regulations	Moderating Variable	<ul style="list-style-type: none"> • Regulations on Environmental Standards • Incentives • Licensing 	• Interval Scale	32 - 38
Supply Chain Performance	Dependent Variable	<ul style="list-style-type: none"> • Quality • Cost Reduction • Lead time 	• Interval Scale	39 - 45

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter highlights the research methodology that was used in the study to achieve the research objectives in terms of research design, target population, sampling technique, data collection instrument, data collection procedure, reliability and validity, data analysis and presentation as well as the diagnostic tests.

3.2 Research Design

A research design is a plan, structure of investigation conceived so as to obtain answer to research questions and to control variances (Mackey & Gass, 2015). The study used a descriptive survey design. Descriptive research design according to Lewis (2015) is a design which involves a focus on a number of units with the aim of describing the problem at hand. This design was appropriate for this study because it utilizes a questionnaire as the data collection tool that saves time, expenses and the amount of quality information yielded is valid, while interviewer bias is reduced because participants complete identically worded self-reported measures.

Another justification for adoption of this research design is that it supports establishing a cause-effect relationship between variables just like the study sought to establish. Mainly, the research design supports the question “what”. Other studies that have adopted this research design are Mutua, Ngugi and Odhiambo (2018) who investigated lean manufacturing and performance of manufacturing firms in Kenya as well as Shajema (2018)

who interrogated effect of inventory control practices on performance of retail chain stores in Nairobi County, Kenya.

3.3 Target Population

A population as all items in any field of inquiry and is also known as the ‘universe’ (Taylor, Bogdan & DeVault 2015). The target population for this study comprised of the 29 Food and Beverage Firms in Nairobi County. The population comprised of all the food and beverage manufacturing firms (Appendix III). The study targeted procurement managers, production managers and operations managers from each of the 29 firms to participate in the study. The target population was therefore a total of 87 procurement managers, production managers and operations managers as shown in Table 2.

TABLE 2

Target Population

Strata	Population	Percentage
Procurement Managers	29	33.33%
Production Managers	29	33.33%
Operations Managers	29	33.33%
Total	87	100%

3.4 Sampling Technique

A sample is a small group obtained from accessible population (Lewis, 2015). Sampling is the procedure a researcher uses to gather people, places or things to study. It is the process of selecting a number of individuals or objects from a population such that the selected group contains elements representative of characteristics found in the entire group (Flick, 2015). The study conducted a census on the entire population of 29 Food and Beverage Firms in Nairobi County.

The reason why a census was appropriate is because this group is smaller than 200 units which is suitable for a census (Flick, 2015). The study targeted procurement managers, production managers and operations managers from each of the 29 firms to participate in the study hence a total of 87 respondents was targeted. A census was also suitable for this study due to the need to have in depth information as argued by Silverman (2016).

3.5 Data Collection Instruments

The study used a questionnaire as the data collection instrument. Bresler and Stake (2017) argue that well standardized and tested questionnaires are most effective elements of a structured survey. Keeping the central objective of study in mind, the study adopted closed question items that are sufficient to yield only relevant information. Questions set in likert scale form were used by the study. Likert scale is an interval scale that specifically uses five anchors of strongly disagree, disagree, neutral, agree and strongly agree. The Likert measures the level of agreement or disagreement. Likert scale is good in measuring perception, attitude, values and behaviour (Brinkmann, 2014).

A questionnaire is preferred as it makes it possible to convert responses into quantitative format for ease of data analysis using computer based software. The instrument had seven sections whereby, section A contained the general information about the respondents, Section B questions on just in time production, Section C contained questions on cellular manufacturing, Section D contained questions on pre-production planning, Section E contained questions on total quality control, Section F contained questions on government regulations while Section G contained questions on supply chain performance.

3.6 Reliability and Validity of Research Instrument

In order to minimize the possible instrumentation error and hence increase the reliability of the data collected, a pilot study was conducted to measure the research instruments reliability and validity (Smith, 2015). A pilot study was undertaken on 10% of the sample population (8 respondents) selected from other manufacturing firms to participate in the pilot study. The data from these respondents was coded and used to establish the face validity and reliability of the instrument.

Reliability measures the extent to which a research instrument is consistent. Reliability analysis was used to assess internal consistency among the variables of study. The reliability of the study measures was assessed by computing Cronbach's Alpha coefficient for all items in the questionnaire and the overall assessment was given (Quinlan, Babin, Carr & Griffin, 2018). The Cronbach's alpha coefficient ranges between 0 and 1 with higher alpha coefficient values being more reliable. A questionnaire with a good internal consistency should have high alpha coefficients. All items that had a Cronbach's alpha coefficient of 0.7 or more were considered reliable. The findings for reliability are presented in Table 3. The findings indicate that all the variables had Cronbach Alpha value above 0.7 to mean that the data was reliable.

TABLE 3

Reliability Test Results

Variable	Cronbach Coefficient	Number of Items	Decision
Just in Time Production	0.786	7	Reliable
Cellular Manufacturing	0.814	7	Reliable
Pre-production Planning	0.834	7	Reliable
Total Quality Control	0.764	7	Reliable

Government Regulations	0.818	7	Reliable
Supply Chain Performance	0.794	7	Reliable

For content validity, the questionnaire was checked for coherence, ambiguity and whether it had errors. The opinion of the supervisor and the panelists were incorporated. Previously, the questionnaire had four questions per variable but the recommendations by the supervisor after checking for content validity was to adjust the questions to seven.

3.7 Data Collection Procedure

Data collection is the precise, systematic gathering of information relevant to the research problems, using methods such as interviews, participant observations, focus group discussion, narratives and case histories (Brinkmann, 2014). The study collected data using drop and pick method. Questionnaires were dropped and picked later to enable the respondents have enough time to respond to the questionnaires. Before data collection, a letter was obtained from the school of graduate studies and research and used as an introduction in the field (Appendix I). Consent from the respondents was also sought before any engagement was done.

3.8 Data Analysis and Presentation

The questionnaires were edited for completeness and consistency to ensure that respondents have completed them as required. The collected data was coded and entered into SPSS (V.22) to create a data sheet that was used for analysis. The responses were then coded with numbers. The data collected was screened and cleaned to correct any errors. Data was analyzed using descriptive statistics involving percentages and mean scores to determine varying degrees of response-concentration regarding asset disposal practices.

In addition, regression analysis was used to determine relationship between the study's quantifiable variables. Pearson's Correlation and Multiple Regression Analysis was used to establish the relationships among the study variables. The entire statistical test was tested at 5% significance level. Responses were assigned numerical values that are consistent with numerical codes. Equation below shows the linear regression model of the independent variables against the dependent variable.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon \dots\dots\dots (i)$$

Where:

Y = Supply Chain Performance

X₁ = Just in Time Production

X₂ = Cellular Manufacturing

X₃ = Pre-production planning

X₄ = Total Quality Control

β_1 to β_4 are the beta coefficients

ε is the error term which is assumed to be normally distributed with mean zero and constant variance.

β_0 is the y intercept

In testing for the moderating effect of government regulations, the study adopted the Moderated Multiple Regression (MMR) analysis recommended by Baron and Kenny (1986). Hierarchical regression models were established as indicated below. The R square of the

regression models was then compared. To establish whether there is a significant moderating effect of government regulations, the significance of the interaction term (between government regulations and lean manufacturing practices) was used to test the hypothesis.

Table 3.3 shows a summary of the procedures for testing moderation.

TABLE 4

Moderation Decision Making Criteria

Equation	Results	Conclusion
$Y = \beta_0 + \beta_1X + \varepsilon$		No moderation
$Y = \beta_0 + \beta_2X + \beta_3Z + \varepsilon$	β_3 is significant ($p > 0.05$)	Moderating variable is an explanatory variable
$Y = \beta_0 + \beta_4X + \beta_5Z + \beta_6 X.Z + \varepsilon$	β_6 is significant ($p < 0.05$)	Moderating variable has a moderating effect

From the Table 3.3 government regulations is said to have a significant moderating effect if the beta coefficient of the interacting term (β_6) was significant (had a P-value < 0.05).

3.9 Diagnostic Tests

The regression analysis using the ordinary least square (OLS) model was assumed for this study. However, before its use, the data needed to be examined to ascertain whether it satisfied the assumptions of the model. The study hence conducted diagnostic tests to ensure that the assumptions of ordinary least square were satisfied before conducting a multiple linear regression. The tests are as follows; normality test, linearity test and multicollinearity.

3.9.1 Normality Test

A normal distribution is not skewed and is defined to have a coefficient of kurtosis of three or less. In order to assess likelihood that the data set is normally distributed,

Kolmogorov-Smirnov (K-S) Test was performed. According to Taylor, Bogdan and DeVault (2015), K-S test is the most commonly used normality test possibly because of disadvantages of other tests and that it can easily be examined using SPSS.

3.9.2 Linearity Test

Linearity means that two variables, "x" and "y," are related by a mathematical equation " $y = cx$," where "c" is any constant number. The importance of testing for linearity lies in the fact that many statistical methods require an assumption of linearity of data (the data was sampled from a population that relates the variables of interest in a linear fashion) (Bryman & Bell, 2014). The study used a scatterplot computed using statistical package for social sciences version 22 to test for linearity and then observe the resulting plot for linearity.

Linearity is displayed by the data points being arranged in the shape of an oval. If any other shape other than oval is observed, it is most likely that the population from which the data came from is not linear in terms of the variables being analyzed. Thus, if the oval shape is not observed, it is not indicative of linearity and hence the data will fail the test of linearity. In such a case, a linear regression model will not be suitable for the study.

3.9.3 Multicollinearity Test

Multicollinearity refers to excessive correlation of the predictor variables. When correlation is excessive (using the rule of thumb, $r > 0.80$), standard errors and beta coefficients become large, making it difficult or impossible to assess the relative importance of the predictor variables. The study used Variance Inflation Factor (VIF) which was applied using the threshold of 10 for severe multicollinearity. In general, the typical acceptable values are VIF less than 5 and tolerance values ($1 / VIF$) values greater than 0.2 (Dang & Pheng, 2015).

3.9.4 Homoscedasticity Test

Describes a situation in which the error term (That is, the “noise” or random disturbance in the relationship between the independent variables and dependent variable) is the same across all values of independent variables. Homoscedasticity suggests that the dependent variable has an equal level of variability for each of the values of the independent variables (Taylor, Bogdan & DeVault, 2015). A test for homoscedasticity is made to test for variance in residuals in the regression model used. If there exist equal variance of the error term, we have a normal distribution. Lack of an equal level of variability for each value of the independent variables is known as Heteroskedasticity, The Breusch-Pagan test developed by Breusch and Pagan (1979) was used to test for homoscedasticity in a linear regression model.

3.9.5 Autocorrelation Test

Autocorrelation test was conducted to ensure that the error term is not correlated. One of the assumptions of using an ordinary least square regression model is that the error term should not be correlated. To establish for this problem, Durbin Watson test was adopted. A DW statistic value between 1.5 and 2.0 indicates absence of the problem of autocorrelation.

CHAPTER FOUR

DATA ANALYSIS AND INTERPRETATION

4.1 Introduction

The main aim of this study was to establish the effect of lean manufacturing practices on supply chain performance of manufacturing firms in Kenya by focusing on food manufacturing firms in Nairobi County. The specific lean manufacturing practices considered in this study were Just in Time Production, cellular manufacturing, pre-production planning and Total Quality Control along which the study hypotheses were formulated. The study used primary data obtained from the firms to conduct both descriptive and inferential analyses. Percentages, means and standard deviation were the specific descriptive statistics used while Pearson correlation and multiple regression were the inferential statistics applied. The description of the analysis and results as well as the presentation and explanation is presented in this chapter. Charts, tables as well as figures were used to present the findings of the study.

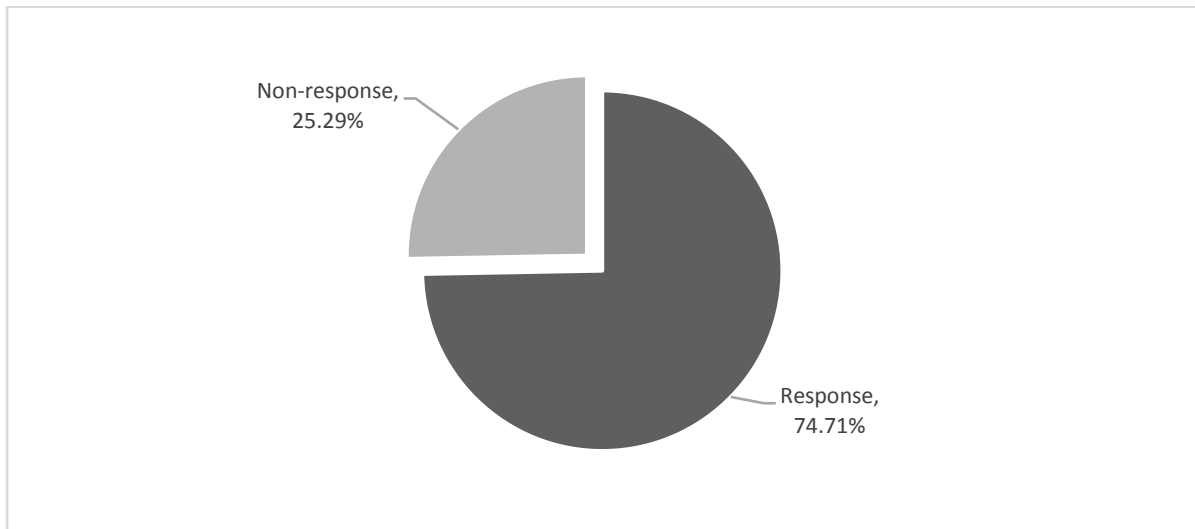
4.2 Response Rate

For the purpose of obtaining the primary data required, the study involved procurement managers, production managers and operations managers of the food manufacturing firms in Nairobi County. A total of 87 questionnaires were administered to the aforementioned and as indicated in Figure 2, the questionnaires that were completed then returned were 65. This represents a general response rate of 74.71% that is in accordance with Orodho (2009) that a response rate above 50% contributes towards gathering of sufficient data that could be generalized across the target population. Kothari (2004) also contends that a response rate of 50% or more is adequate for a descriptive study. Thus

sufficient data was gathered for analysis and generalization to establish the effect of lean manufacturing practices on supply chain performance of manufacturing firms.

FIGURE 2

Response Rate



4.3 Demographic Characteristics

The study sought to establish the characteristics of the study respondents in terms of their highest level of education, position in the firm and working experience in the food manufacturing firms in Nairobi County. The section therefore presents the results of these characteristics that are presented in the following sub-sections.

4.3.1 Highest Level of Education

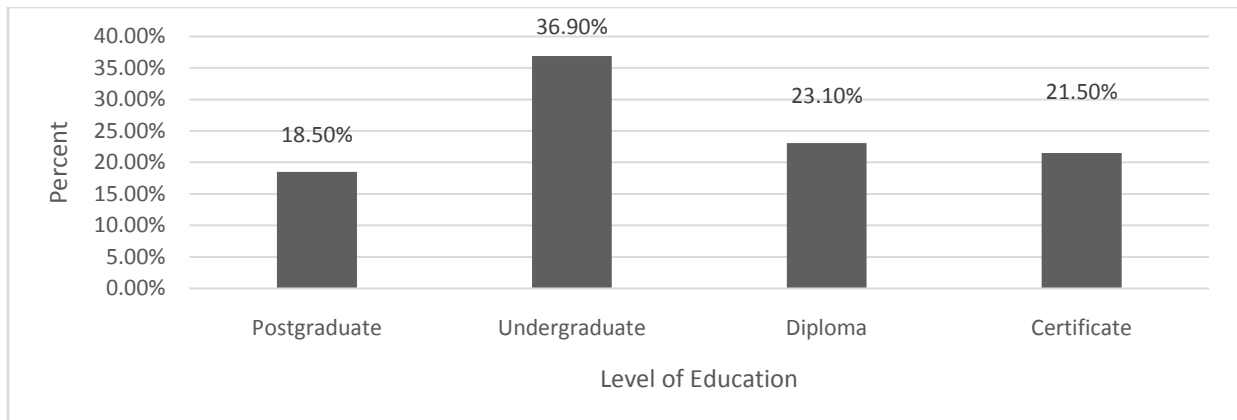
The study purposed to examine the highest level of education of the procurement, production and operations managers who were the respondents of this study. As indicated in Figure 4.2, the results of the study showed that majority of the study respondents, 36.9%, were undergraduates with a further 18.5% with postgraduate academic qualifications. The

results as depicted in figure 3 also shows that 23.1% of the respondents involved in this study had diploma academic qualifications while 21.5% had certificate level of education.

The findings imply that all the respondents involved in this study had higher level of academic qualification above secondary school and were thus appropriate for the study as they were able to comprehend and interpret the questions posed in the questionnaire. They therefore provided the study with accurate and reliable information. The finding of the study regarding highest level of education of the respondents agrees with the argument by Baruch and Holtom (2008) that high education level enhances response rate and reliability of the information provided.

FIGURE 3

Highest Level of Education



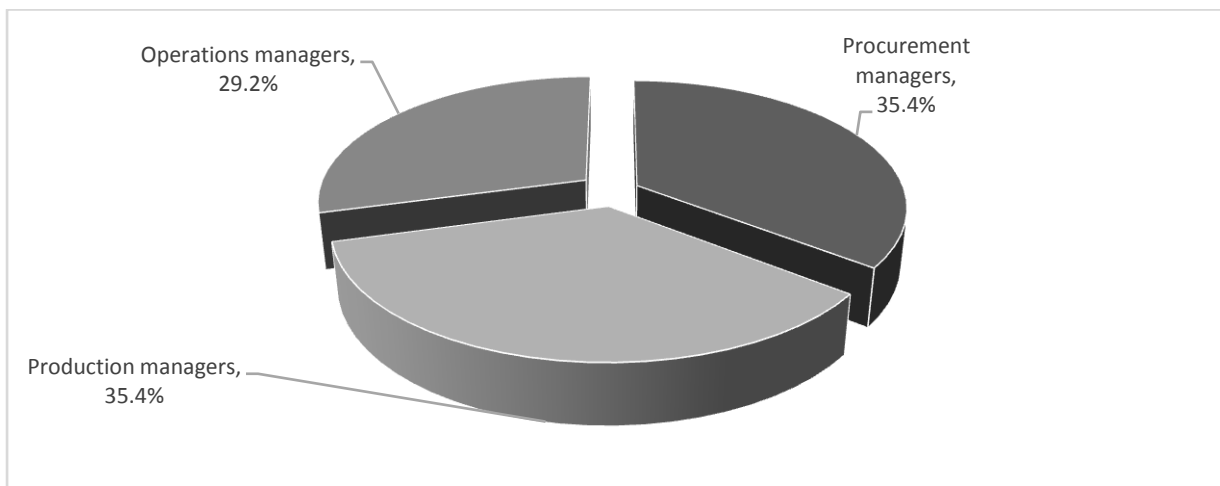
4.3.2 Position in the Firm

The study also purposed to examine the position of the procurement, production and operations managers who were sampled into the study to ensure that the data was representative of the targeted population. As indicated in Figure 4, the results of the study showed that 35.4% of the respondents were procurement managers with an equal fraction

being production managers while operation managers constituted 29.2% of the sampled population. The results in this section imply that all the departments of the firm involved in the supply chain (production, operations and procurement) were well represented in the study. Further, the findings are representative of the opinions of various employees in the firm involved in the supply chain.

FIGURE 4

Position in the firm



4.3.3 Work Experience

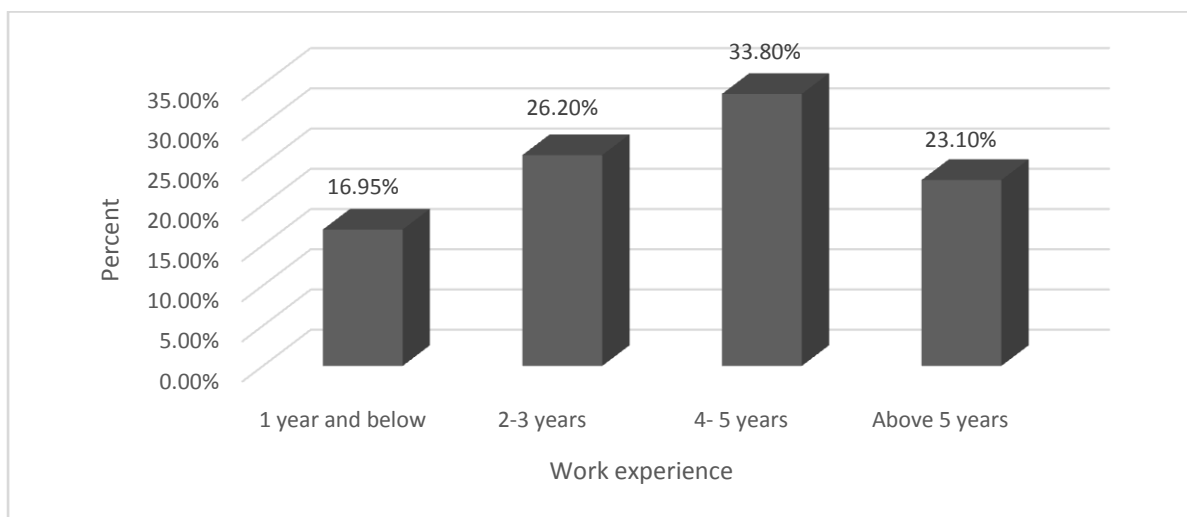
The study examined the level of work experience of the respondents and as indicated in Figure 5, the results show that those that had been in their current positions for a period between 4 and 5 years were the majority making up 33.8% of the total response rate followed by those that had been in their current positions for a period between 2 and 3 years who were 26.2% of the respondents.

The findings also indicated that a good fraction of the respondents involved in this study, 23.1%, had been in their current positions for a period above 5 years while only

16.95% of the respondents had been in their current positions in the firm for a period of less than one year. The findings imply that majority of the respondents had been in the current positions long enough as more than 56% had more than 4 years' work experience. The results also imply that the respondents had worked in the firm long enough and were therefore conversant with the lean production practices at the firm's disposal.

FIGURE 5

Work Experience



4.4 Descriptive Findings and Analysis

The study used mean and standard deviation descriptive statistics to capture the responses based on the various indicators of study variables on a Likert scale of 1-5 (5= Very Large Extent; 4 =Large Extent; 3= Moderate Extent; 2= Low Extent and 1= Very Low Extent). This section therefore presents the average responses on each of the variables whereas the standard deviation indicates the magnitude of variations in the responses.

4.4.1 Descriptive Statistics of Just in Time Production

The study tested the relationship between Just in Time Production and supply chain performance of food manufacturing firms within Nairobi County. Respondents rated various statements on Just in Time Production on the rating of 1-5 (5= Very Large Extent; 4 =Large Extent; 3= Moderate Extent; 2= Low Extent and 1= Very Low Extent). The average responses as shown on Table 5 show that majority of the respondents agreed that the company avails labor on demand in order to manage labor costs (mean = 4.08). A standard deviation value of 0.94 was an indication that the responses provided on the statement regarding availability of labor on demand for the purpose of managing costs was not highly varied among the respondents.

Majority of the participants of the study also agreed that the company avails resources on demand in order to manage wastage (mean = 4.29) where a standard deviation of 1.14 denotes that the responses provided on this statement were not highly varied. The results further showed that majority of respondents agreed that the company produces on demand in order to manage inventory costs (mean= 4.03)while majority also agreed that the company orders raw materials from the suppliers only when there is demand for production from customers (mean= 4.12). On the same note, majority of the respondents agreed that the company has simplified production design to ensure timely production (mean= 3.85). A standard deviation value of 1.29 was an indication that the responses provided on the statement regarding simplification of production design to ensure timely production was not highly varied among the respondents.

Similarly, the results of the study showed that majority of the respondents agreed that the company has multiple skill workers to ensure faster production on time (mean =3.85) and

has a daily schedule commitment to ensure faster production on time (mean =4.15). On average, a mean of 4.05 indicated that the food manufacturing firms within Nairobi County practice Just in Time production. The standard deviation of 1.08 implies the responses provided by the participants of the study were not highly varied.

TABLE 5

Descriptive Statistics of Just in Time Production

Statement	Mean	Standard Deviation
The company avails resources on demand in order to manage wastage	4.29	1.14
The company has a daily schedule commitment to ensure faster production on time	4.15	0.87
The company orders raw materials from the suppliers only when there is demand for production from customers	4.12	1.07
The company avails labor on demand in order to manage labor costs	4.08	0.94
The company produces on demand in order to manage inventory costs	4.03	0.97
The company has simplified production design to ensure timely production	3.85	1.29
The company has multiple skill workers to ensure faster production on time	3.85	1.30
Average	4.05	1.08

4.4.2 Descriptive Statistics of Cellular Manufacturing

The study also tested the association between cellular manufacturing and supply chain performance of food manufacturing firms within Nairobi County. Respondents rated various statements on cellular manufacturing on the rating of 1-5 (5= Very Large Extent; 4 =Large Extent; 3= Moderate Extent; 2= Low Extent and 1= Very Low Extent). As indicated on Table 6, majority of the respondents agreed that the company has scheduled cell based layouts for production (mean = 4.32). A standard deviation value of 0.73 was an indication that the responses provided on the statement regarding scheduled cell based layouts for production were not highly varied among the respondents. Majority of the respondents also agreed that

the company uses group technology to produce similar production (mean =4.42), the company prefers sequential production for similar products (mean =3.89) and that the company produces products of same characteristics in the same production system (mean =3.82).

The results of the study further showed that majority of the participants of the study agreed that the firm groups similar products to be manufactured based on similarity in order to adopt the same technology (mean = 4.08). On the same note, a standard deviation value of 0.87 was an indication that the responses provided on the statement regarding scheduled grouping similar products to be manufactured based on similarity in order to adopt the same technology were not highly varied among the respondents. Similarly, the findings of this study showed that majority agreed that fixed cost for producing similar products is set in order to manage production costs (mean = 4.22) and that specialized production workers are used in cellular manufacturing (mean= 4.85) with the standard deviation value of 0.44 an indication of low variation in responses provided on this statement among respondents.

On average, a mean of 4.23 indicated that majority of the respondents involved in the study agreed that food manufacturing firms within Nairobi County make use of various cellular manufacturing practices. The standard deviation of 0.92 implies the responses provided by respondents regarding cellular manufacturing were not highly varied.

TABLE 6**Descriptive Statistics of Cellular Manufacturing**

Statement	Mean	Standard Deviation
Specialized production workers are used in cellular manufacturing	4.85	0.44
The company uses group technology to produce similar products	4.42	0.98
The company has scheduled cell based layouts for production	4.32	0.73
Fixed cost for producing similar products is set in order to manage production costs	4.22	0.98
The company groups similar products to be manufactured based on similarity in order to adopt the same technology	4.08	0.87
The company prefers sequential production for similar products	3.89	1.31
The company produces products of same characteristics in the same production systems	3.82	1.10
Average	4.23	0.92

4.4.3 Descriptive Statistics of Pre-Production Planning

The study also examined the relationship between pre-production planning and supply chain performance of food manufacturing firms within Nairobi County. Respondents rated various statements on just in time production on the rating of 1-5. The average responses as shown on Table 7 show that majority of the respondents agreed that the firm plans work flow before embarking on the process of production (mean =3.75). A standard deviation value of 1.33 was an indication that the responses provided statements regarding the statement were not highly varied among the respondents.

On the same note, majority of the respondents agreed that the company assembles the necessary raw materials before commencing the production process (mean = 4.14), the company also accordingly allocates raw materials before the production process begins (mean=4.40). The findings also confirmed that majority of the respondents agreed that the company plans the work power required before commencing the production process

(mean =4.37) and that it also plans the manufacturing process before commencing the production process (mean=3.91).

Similarly, the findings of this study regarding pre-production planning showed that majority of agreed that evaluation of the production system is conducted first before starting production (mean=4.09). A Standard deviation value of 1.09 was an indication of low variation of the responses provided on this statement. Majority also agreed that production control systems are set before the production process to ensure there is no wastage (mean= 3.91). On average, the findings showed that majority of the respondents agreed that the firm conducts pre-production planning (mean = 4.08). The standard deviation of 1.04 implies the responses provided by the respondents were not highly varied.

TABLE 7

Descriptive Statistics of Pre-Production Planning

Statement	Mean	Standard Deviation
The company accordingly allocates raw materials before the production process begins	4.40	0.66
The company plans the work power required before commencing the production process	4.37	0.91
The company assembly the necessary raw materials before commencing the production process	4.14	0.95
Evaluation of the production system is conducted first before starting production	4.09	1.09
The company plans the manufacturing process before commencing the production process	3.91	1.20
Production control system are set before the production process to ensure there is no wastage	3.91	1.17
The company plans work flow before embarking on the process of production	3.75	1.33
Average	4.08	1.04

4.4.4 Descriptive Statistics of Total Quality Control

The study further tested the relationship between Total Quality Control and supply chain performance of food manufacturing firms within Nairobi County. Respondents rated various statements on Total Quality Control on the rating of 1-5 (5= Very Large Extent; 4 =Large Extent; 3= Moderate Extent; 2= Low Extent and 1= Very Low Extent). As indicated on Table 8, majority of the respondents agreed that the firm has manageable defect prevention costs related to quality planning (mean= 4.28). A standard deviation value of 0.80 implies that the responses provided were not highly varied among the respondents.

On the same note, majority agreed that the company has manageable defect prevention costs related to investment in quality related information systems (mean=4.32), has manageable appraisal costs related to test and inspection of purchased materials (mean =4.42) and quality audits (mean =3.57). The findings indicated that the company has manageable internal failure costs related to reworks (Mean=3.85) with a standard deviation of 1.08 implying that the responses provided did not vary highly among respondents.

Similarly, majority of the respondents involved in the study agreed that the company has manageable internal failure costs related to scrap (mean =3.95) and that the company has manageable external failure costs related to complains in and out of warranty (mean = 4.58). On average, majority of the respondents agreed that the company employs total quality control practices with a standard deviation value of 0.92 an indication that the responses were not highly among respondents.

TABLE 8**Descriptive Statistics of Total Quality Control**

Statement	Mean	Standard Deviation
The company has manageable external failure costs related to complains in and out of warranty	4.58	0.53
The company has manageable appraisal costs related to test and inspection of purchased materials	4.42	0.86
The company has manageable defect prevention costs related to investment in quality related information systems	4.32	0.87
The company has manageable defect prevention costs related to quality planning	4.28	0.80
The company has manageable internal failure costs related to scrap	3.95	0.98
The company has manageable internal failure costs related to reworks	3.85	1.08
The company has manageable appraisal costs related to quality audits	3.57	1.33
Average	4.14	0.92

4.4.5 Descriptive Statistics of Supply Chain Performance

The respondents were also required to rate statements on the dependent variable (supply chain performance of the food manufacturing firms) on a five point Likert scale ranging from 1-5 (5= Very Large Extent; 4 =Large Extent; 3= Moderate Extent; 2= Low Extent and 1= Very Low Extent). Based on their response, means and standard deviations were obtained and presented in Table 9. From the results of the study, majority of the respondents agreed that application of lean production practices has reduced the supply chain costs (mean= 4.15) and that use of lean production practices has improved the quality of products (mean =4.48).

On the same note, majority of the respondents agreed that application of lean production practices has reduced the supply chain order to delivery lead time (mean = 4.66) with a standard deviation value of 0.57 an indication that the responses provided did not vary highly among the respondents.

The findings of the study also showed that majority of the respondents agreed that application of lean production practices has led to improved flexibility in production (mean 3.49). Application of lean production practices has also led to improved resource utilization according to majority of respondents who agreed (mean =3.80). The results further showed that majority agreed that application of lean production practices has led to improved supply chain response time (mean =3.77). In addition, the findings indicated that majority agreed that application of lean production practices improved the firm's delivery performance (mean =4.58).

A standard deviation value of 0.5 was an indication that the responses provided on the statement regarding application of lean production practices to improve the firm's delivery performance were not highly varied among the respondents. On average, majority agreed that the firm applied various lean production practices that improved supply chain performance (mean =4.13). A standard deviation value of 0.86 implied responses provided on use of lean production practices to improve supply chain performance were not highly varied.

TABLE 9**Descriptive Statistics of Supply Chain Performance**

Statement	Mean	Standard Deviation
Application of lean production practices has reduced the supply chain order to delivery lead time	4.66	0.57
Application of lean production practices improved the firm's delivery performance	4.58	0.50
Application of lean production practices has improved the quality of products	4.48	0.50
Application of lean production practices has reduced the supply chain costs	4.15	0.81
Application of lean production practices has led to improved resource utilization	3.80	1.12
Application of lean production practices has led to improved supply chain response time	3.77	1.01
Application of lean production practices has led to improved flexibility in production	3.49	1.48
Average	4.13	0.86

4.5 Correlation Analysis

A correlation analysis was used to establish the association between the study variables. This study made use of Pearson correlation coefficient to establish the association between the variables used in the study. According to Mugenda and Mugenda (2003), a correlation analysis indicates the direction and strength of the relationship between variables and ranges from -1 to +1. The results for the correlation analysis are presented in Table 10.

The study findings showed that the association between just in time production and supply chain performance of food manufacturing firms was positive and significant. This was supported by a Pearson coefficient of 0.706 and level of significance of 0.000. This implies that an increase in just in time production practices results to an increase in supply chain performance of the food manufacturing firms within Nairobi County. This result is consistent with the finding of Tripathi and Tiwari (2016) that just in time production opens a firm's

marketing share by ensuring quality products are availed to customer while at the same time minimizing wastage and ensuring customer retention while attracting new customers.

The correlation results of this study as shown in Table 10 also indicate that cellular manufacturing and supply chain performance of the food manufacturing firms within Nairobi County are positively and significantly associated as supported by a Pearson coefficient of 0.627 and a level of significance of 0.000. The implication here is that an increase in cellular manufacturing translates to an increase in supply chain performance of food manufacturing firms. The findings concur with the argument by Gharbi (2011) that cellular manufacturing contributes to short delivery times, wide range of products, reduction in throughput times, reduction in material handling, reduction in set up times and reduction in production costs. According Gharbi (2011), the impact of cellular manufacturing is manifested in the supply chain performance since a firm is able to maximize on available workforce that leads to continuous production.

The results of this study as shown in further indicate that pre-production planning and supply chain performance of the food manufacturing firms within Nairobi County are positively and significantly associated as supported by a Pearson coefficient of 0.432 and a level of significance of 0.000. This means that an increase in pre-production planning translates to an increase in supply chain performance of food manufacturing firms. This is consistent with the argument by Hassan *et al* (2013) that pre-production planning enables a firm to evaluate all the needs of a process and put in place corrective measures for implementation in case the process deviates from its expectation. Accordingly, pre-production contributes to a smooth running of a process that culminates into quality products that meets specified standards.

The correlation results of this study also show that total quality control and supply chain performance of the food manufacturing firms within Nairobi County are positively and significantly associated as supported by a Pearson coefficient of 0.606 and a level of significance of 0.000. The implication here is that an increase in total quality control practices results to an increase in supply chain performance of food manufacturing firms. This is consistent with the study findings of Masindet and Ogollah (2014) that established a significant relationship between supply chain performance and all indicators of total quality management. The results are also supported by study findings of Fatuma (2015) which established that adoption of quality management practices enables a firm to relate well with all its stakeholders which contributes to a successful accomplishment of set goals and objectives.

TABLE 10

Correlation Analysis

		Just In Time	Cellular Manufacturing	Pre-Production Planning	Total Quality Control	Supply Chain Performance
Just In Time	Pearson Correlation	1				
	Sig. (2-tailed)					
Cellular Manufacturing	Pearson Correlation	.447	1			
	Sig. (2-tailed)	0.052				
Pre-Production Planning	Pearson Correlation	.331	0.236	1		
	Sig. (2-tailed)	0.057	0.058			
Total Quality Control	Pearson Correlation	.485	.463	0.243	1	
	Sig. (2-tailed)	0.055	0.062	0.051		
Supply Chain Performance	Pearson Correlation	.706**	.627**	.432**	.606**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	
	N	65	65	65	65	65

** Correlation is significant at the 0.01 level (2-tailed).

4.6 Regression Model Diagnostic Tests

The study conducted diagnostic tests before using an ordinary least square regression model to test the study hypotheses. This was also to ensure that assumptions of classical regressions are not violated. The normality test, linearity test, tests of homoscedasticity as well as multicollinearity were conducted before running the respective regression models. These tests have been described in the subsection.

4.6.1 Normality Test

For the purpose of testing the normality of the data, the study used Shapiro–Wilk test to detect deviation from normality due to skewness or kurtosis. The statistic in Shapiro–Wilk test ranges between -0.1 to +1.0 and the data is normal when the figures are higher than 0.05 (Razali & Wah, 2011). Accordingly, if the statistic is greater than 0.05, it implies that data is normally distributed as the null hypotheses is not rejected. The findings as presented in Table 11 show that supply chain performance of food manufacturing firms(dependent variable) was normally distributed since its significance value (0.063) is greater than 0.05.

TABLE 11

Shapiro Wilk Normality Test

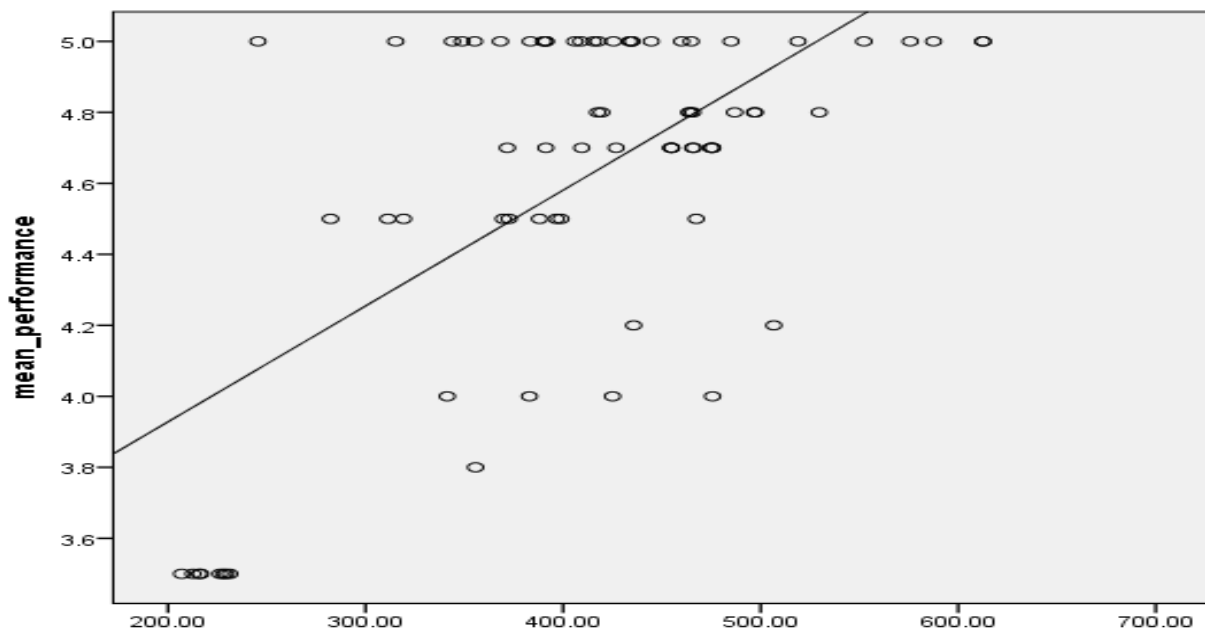
Tests of Normality						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Supply Chain Performance	0.15	65	0.001	0.937	65	0.063
a Lilliefors Significance Correction						

4.6.2 Linearity Test

Before running a regression model, the study tested for linearity of the relationship between lean manufacturing practices and supply chain performance of food manufacturing firms. The four independent variables were combined into independent variable (lean manufacturing practices) and then a plot established against supply chain performance (dependent variable). A scatter plot was adopted as shown in Figure 6. The results of the study as shown in the figure demonstrated that line fit well with the scatter assuming an oval shape denoting linearity of the relationship between the set of variables as recommended by (Fairchild, 2002).

FIGURE 6

Linearity Test of Lean Manufacturing and Supply Chain Performance



4.6.3 Multicollinearity Test

A regression analysis was conducted and the tolerance and Variance Inflation Factors (VIF) extracted for the purpose of establishing whether there was multicollinearity among predictor variables. According to Field (2009), VIF values of less than 10 denotes absence of multicollinearity which can also be confirmed by Tolerance values of above 0.1. In accordance with Field (2009) recommendations, the results as shown in Table 12 show that all the variables had VIF value of less than 10 indicating that there was no problem of multicollinearity. On the same note, Tolerance values were above 0.1 which further confirmed that there was no multicollinearity among the variables of the study.

TABLE 12

Variance Inflation Factor Test of Multicollinearity

	Collinearity Statistics	
	Tolerance	VIF
(Constant)		
Just in Time Production	0.667	1.500
Cellular Manufacturing	0.717	1.396
Pre-production Planning	0.876	1.141
Total Quality Control	0.686	1.459
Dependent Variable: Supply Chain Performance		

4.6.4 Homoscedasticity Test

One of the critical assumptions of using linear regression model is that the error term (residual) is constant among the independent variables. This study therefore conducted the Breusch-Pagan test as recommended by Warner (2008) to check for homogeneity of the error term among the independent variables. The Breusch-Pagan test states that the probability value should be greater than .05 to meet the homoscedasticity assumption. The null hypothesis of constant variance is not rejected when the significance ($\text{Prob} > \text{Chi}^2$) value is

greater than .05 (Warner, 2008). As shown in Table 13 the significance (Prob > Chi²) value was 0.0534 which is greater than .05 and hence the null hypothesis of Homoscedasticity was not rejected.

TABLE 13

Homoscedasticity Test

Breusch-Pagan / Cook-Weisberg test for Heteroskedasticity

Ho: Constant variance
 Variables: fitted values of Supply Chain Performance

Chi ² (1)	4.52
Prob > Chi ²	0.053

4.6.5 Autocorrelation Test

Autocorrelation test was conducted to ensure that the error term is not correlated. One of the assumptions of using an ordinary least square regression model is that the error term should not be correlated. To establish for this problem, Durbin Watson test was adopted. The results as presented in Table 14 indicated that the error term was not auto correlated since DW statistic was 1.566 which is within the range of 1.5 and 2 (Flick,2015).

TABLE 14

Durbin Watson Test

Durbin Watson Statistic	1.566
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4.7 Regression Model of Lean Manufacturing Practices and Supply Chain Performance

The study ran an overall ordinary least square regression model before including the moderating variable which was government regulations. An ordinary least square regression model of the form below was run.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon \dots\dots\dots (ii)$$

The model was used to test hypotheses 1 to 4.

- H₀₁ Just in Time Production does not have a significant effect on supply chain performance of food manufacturing firms in Nairobi County, Kenya
- H₀₂ Cellular Manufacturing does not have a significant effect on supply chain performance of food manufacturing firms in Nairobi County, Kenya
- H₀₃ Pre-Production Planning does not have a significant effect on supply chain performance of food manufacturing firms in Nairobi County
- H₀₄ Total Quality Control does not have a significant effect on supply chain performance of food manufacturing firms in Nairobi County

The model summary results as presented in Table 15 showed that the four lean manufacturing practices of Just in Time, cellular manufacturing, pre-production planning and Total Quality Control jointly had a strong positive influence on supply chain performance of food manufacturing firms in Nairobi County. The model summary results in Table 15 shows that R-square was 0.686 denoting Just in Time, cellular manufacturing, pre-production planning and Total Quality Control account for 68.6% of the variation in supply chain performance of the food manufacturing firms within Nairobi County. This suggests that

31.4% of the variation in supply chain performance of food manufacturing firms in Nairobi County was explained by other factors not included in the model of this study. The value of 0.686 shows that the model provides a good fit (Kumar, 2015).

TABLE 15

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.829	0.686	0.666	0.19113
a Predictors: (Constant), Total Quality Control, Pre-production Planning, Cellular Manufacturing, Just In Time Production			

In order to establish the significance of the regression model used, ANOVA test results in Table 16 was used. The P-value = 0.000 was less than 0.05 and the study interprets this to mean that the model predicted by Lean Manufacturing Practices was having a significant relationship with supply chain performance. The model significance confirms the suitability of lean manufacturing practices in predicting the aberration of supply chain performance of food manufacturing firms in Nairobi County as shown in Table 16.

TABLE 16

ANOVA (Model Significance)

	Sum of Squares	df	Mean Square	F	Sig.
Regression	4.798	4	1.2	32.836	.000
Residual	2.192	60	0.037		
Total	6.99	64			
a Dependent Variable: Supply Chain Performance					
b Predictors: (Constant), Total Quality Control, Pre-production Planning, Cellular Manufacturing, Just In Time Production					

The results as indicated in table 17, cellular manufacturing has a positive and significant effect on supply chain performance of food manufacturing firms in Nairobi County (Beta = .224, Sig = .001, < .05). This implies that increasing cellular manufacturing by one unit leads to a significant increase in supply chain performance of food manufacturing firms in Nairobi County by .224 units. Since the P-value is less than 0.05, the study rejected H_{02} at 5% level of significance to mean that cellular manufacturing has a significant effect on supply chain performance.

The results further indicated that pre-production planning has a positive and significant effect on supply chain performance of food manufacturing firms in Nairobi County (Beta = .117, Sig = .03, < .05). This implies that increasing pre-production planning by one unit leads to a significant increase in supply chain performance of food manufacturing firms in Nairobi County by 0.117 units. Since the P-value is less than 0.05, the study rejected H_{03} at 5% level of significance to mean that pre-production planning has a significant effect on supply chain performance.

The results indicated that total quality control has a positive and significant effect on supply chain performance of food manufacturing firms in Nairobi County (Beta = .196, Sig = .011, < .05). This implies that increasing total quality control by one unit leads to a significant increase in supply chain performance of food manufacturing firms in Nairobi County by .011 units. Since the P-value is less than 0.05, the study rejected H_{01} at 5% level of significance to mean that total quality control has a significant effect on supply chain performance.

4.8 Moderating Effect of Government Regulation

A regression model was run after including the moderating variable (Government Regulations). The model was of the form:

TABLE 19**Regression Model ANOVA after Moderating**

	Sum of Squares	df	Mean Square	F	Sig.
Regression	4.71	3	1.57	41.995	.000
Residual	2.28	61	0.037		
Total	6.99	64			

Dependent Variable: Supply Chain Performance
Predictors: (Constant), Government Regulations, Independent variable, Interaction variable

The model coefficients results after moderation showed that the interaction between the independent variables and moderating variable was not statistically significant (0.531), therefore government regulations did not moderate the effect of lean manufacturing practices on supply chain performance of food manufacturing firms in Nairobi County. The results are as shown in Table 20.

TABLE 20**Regression Model Coefficients after Moderating**

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	2.593	0.95		2.731	0.008
Interaction variable	0.000	0.001	-0.594	-0.63	0.531
Independent variable	0.005	0.003	1.355	1.581	0.119
Government Regulations	0.143	0.23	0.142	0.623	0.535

Dependent Variable: Supply Chain Performance

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The study examined the association between lean manufacturing practices and supply chain performance of manufacturing firms in Kenya by focusing on food manufacturing firms in Nairobi County. The specific objectives were based on the following lean manufacturing practices: Just in Time Production, Cellular Manufacturing, Pre-Production Planning and Total Quality Control. A summary of the study findings, conclusions, recommendations as well as areas for further research are all covered in this chapter.

5.2 Summary of the Findings

The general objective of this study was to examine the association between lean manufacturing practices and supply chain performance of manufacturing firms in Kenya by focusing on food manufacturing firms in Nairobi County. The specific objectives were: to establish the effect of just in time production on supply chain performance of food manufacturing firms in Nairobi County; to determine effect of cellular manufacturing on supply chain performance of food manufacturing firms in Nairobi County; to determine the effects of pre-production planning on supply chain performance of food manufacturing firms in Nairobi County; to establish the effect of total quality control on supply chain performance of food manufacturing firms in Nairobi County; and to establish the moderating effect of government regulations on the relationship between lean manufacturing practices and supply chain performance of food manufacturing firms in Nairobi County. Brief discussions of descriptive and inferential results of each of the variables of the study are presented in this section.

5.2.1 Discussion on Just In Time Production

The first objective of this study was to establish the effect of just in time production on supply chain performance of food manufacturing firms in Nairobi County. It was established that just in time production practices has positive and significant effect on supply chain performance of food manufacturing firms in Nairobi County. This result is consistent with the study finding Sayid (2017) that just in time production ensures a reduction in production cycle, a decrease in the number of operators required to produce equal amount of products, reduction of level of reworks, reduction in wastage and reduction in lead time production.

5.2.2 Discussion on Cellular Manufacturing

The second objective of this study was to examine the effect of cellular manufacturing on supply chain performance of food manufacturing firms in Nairobi County. It was established that cellular manufacturing has positive and significant effect on supply chain performance of food manufacturing firms in Nairobi County. This result is consistent with the results of Jones and Alony (2008) that cellular manufacturing enhances workmates social interactions and incentives that contribute to high output of quality production.

5.2.3 Discussion on Pre-Production Planning

The third objective of the study was to establish the effect of pre-production planning on supply chain performance of food manufacturing firms in Nairobi County. It was established that pre-production planning has positive and significant effect on supply chain performance of food manufacturing firms in Nairobi County. The results are supported by the findings of Olhager and Wikner (2010) that production planning provides improved and quality services and products to customers while offering them reasonable prices and

supplying and delivering at agreed timeframe. The results are further supported by Maguire (2012) that when production process and controls are defined in the pre-production planning, participants are assured of quality products at the end of the production process.

5.2.4 Discussion on Total Quality Control

The fourth objective of this study was to examine the effect of total quality control on supply chain performance of food manufacturing firms in Nairobi County. It was established that total quality control has positive and significant effect on supply chain performance of food manufacturing firms in Nairobi County. The results are consistent with the argument by Chang (2009) that adoption of a system that focuses on total quality management ensures achievement of a simplified production system that leads to achievement of high quality products that fits market demands.

5.2.5 Discussion on Government Regulations

The fifth objective of the study was to establish the moderating effect of government regulations on the relationship between lean manufacturing practices and supply chain performance of food manufacturing firms in Nairobi County. The results showed that government regulations did not moderate the effect of lean manufacturing practices on supply chain performance of food manufacturing firms in Nairobi County. The findings are consistent with Fiorino and Bhan (2013) who indicated that government Environmental Regulation had a significant moderating effect on Supply Chains performance of Private and Public Regulation in the USA. Similar findings compare to Nezakati, Fereidouni and Rahman (2016).

5.3 Conclusions

The study concluded that there is a positive and significant association between just in time production practices and supply chain performance of food manufacturing firms in Nairobi County. This means that an increase in just in time production practices results to a significant improvement in supply chain performance of food manufacturing firms in Nairobi County. In order of importance, availing resources on demand in order to manage wastage, daily schedule commitment to ensure faster production on time, ordering raw materials from the suppliers only when there is demand for production from customers, availing labor on demand in order to manage labor costs, producing on demand in order to manage inventory costs, simplifying production design to ensure timely production and having multiple skill workers to ensure faster production on time.

Another conclusion made by this study is that there is a positive and significant association between cellular manufacturing and supply chain performance of food manufacturing firms in Nairobi County. This means that an increase in cellular manufacturing results to a significant improvement in supply chain performance of food manufacturing firms in Nairobi County. The most important cellular practices in order of importance is use of specialized production workers, group technology to produce similar products, scheduling cell based layouts for production, fixed cost for producing similar products, grouping similar products to be manufactured based on similarity, sequential production for similar products and producing products of same characteristics in the same production systems.

The study also concluded that that there is a positive and significant association between pre-production planning and supply chain performance of food manufacturing firms in Nairobi County. This implies that an increase in pre-production planning results to a significant improvement in supply chain performance of food manufacturing firms in Nairobi County. The most important pre-production planning practices in order of importance are allocating raw materials before the production process begins, planning the work power required before commencing the production process, assembling the necessary raw materials before commencing the production process, evaluation of the production system is conducted first before starting production, planning the manufacturing process before commencing the production process, setting production control system before the production process to ensure there is no wastage and planning work flow before embarking on the process of production.

The study further concluded that that there is a positive and significant association between total quality control and supply chain performance of food manufacturing firms in Nairobi County. This implies that an increase in total quality control results to a significant improvement in supply chain performance of food manufacturing firms in Nairobi County. The most important total quality control practices in order of importance are having manageable external failure costs related to complains in and out of warranty, appraisal costs related to test and inspection of purchased materials, defect prevention costs related to investment in quality related information systems, defect prevention costs related to quality planning, internal failure costs related to scrap, internal failure costs related to reworks and appraisal costs related to quality audits.

Regarding the moderating effect of government regulations, the study concluded that government regulations does not moderate the relationship between lean production practices and supply chain performance of food manufacturing firms in Nairobi county. The findings

established that government regulations do not moderate the relationship between lean production practices and supply chain performance of food manufacturing firms in Nairobi County. This reveals that no matter the government regulations governing a food manufacturing firm, lean production practices will affect supply chain performance the same way across the manufacturing firms because the manufacturing firms are compelled to follow the regulations.

5.4 Recommendations

The study recommends that for the purpose of improving supply chain performance, food manufacturing firms should consider the use of just in time production practices such as availing labor on demand in order to manage labor costs, availing resources on demand in order to manage wastage, production on demand in order to manage inventory costs, ordering raw materials from the suppliers only when there is demand for production from customers, having a simplified production design to ensure timely production and having multiple skill workers to ensure faster production as these practices significantly increase supply chain performance of the firms.

The study recommends that in order for the food manufacturing firms to increase supply chain performance, there is need to adopt cellular manufacturing through having a scheduled cell based layouts for production, using group technology to produce similar products, prioritizing sequential production for similar products, producing products of same characteristics in the same production systems, grouping similar products to be manufactured based on similarity in order to adopt the same technology and setting fixed cost for producing similar products in order to manage production costs as these practices lead to significant increase in supply chain performance of the firms.

The study further recommends that for the purpose of improving supply chain performance, food manufacturing firms should consider the use of pre-production planning practices including planning work flow before embarking on the process of production, assembling the necessary raw materials before commencing the production process, accordingly allocating raw materials before the production process begins, planning the work power required before commencing the production process, planning the manufacturing process before commencing the production process, conduction evaluation of the production system before starting production and setting production control systems before the production process to ensure there is no wastage as these practices significantly increase supply chain performance of the firms.

The study finally recommends that in order for the food manufacturing firms to increase supply chain performance, there is need to adopt total quality control practices such as having manageable defect prevention costs related to quality planning, putting in place manageable defect prevention costs related to investment in quality related information systems, having manageable appraisal costs related to test and inspection of purchased materials, having manageable appraisal costs related to quality audits, having controllable internal failure costs related to reworks and having manageable internal failure costs related to scrap.

5.5 Areas for further Study

This study examined the relationship lean manufacturing practices and supply chain performance of manufacturing firms in Kenya by focusing on food manufacturing firms in Nairobi County. The unit of analysis of this study was therefore all food manufacturing firms in Nairobi County. However, lean manufacturing practices are not universal but differ from

one sector to another. Another study can be conducted with the same conceptual constructions and methodology to establish the relationship between lean manufacturing practices and supply chain performance of the other sectors in Kenya and to include other parts of the country.

The main objective of the study was to examine the association between lean manufacturing practices and supply chain performance of manufacturing firms in Kenya by focusing on food manufacturing firms in Nairobi County. However, from the conceptual framework and findings of the study, there are other areas that future researchers may develop interest in. For instance, the model summary results indicated that the four lean manufacturing practices of just in time, cellular manufacturing, pre-production planning and total quality control jointly accounted for up to 68.6% of the variation in SC performance of food manufacturing firms in Nairobi County. This implies that 31.4% of the variation in food manufacturing firms in Nairobi County was accounted for by other factors not covered in the model presented in this study and therefore future studies can focus on the other factors that influence supply chain performance.

REFERENCES

- Achieng, J. K. (2012). *Lean supply chain management practices at public universities in Kenya*. Unpublished Masters Project, University of Nairobi
- African Development Bank. (2014) *Eastern Africa's manufacturing sector: Promoting technology, innovation, productivity and linkages*. Tunis: AFDB.
- Agus, A., & Shukri Hajinoor, M. (2012). Lean production supply chain management as driver towards enhancing product quality and business performance: Case study of manufacturing companies in Malaysia. *International Journal of Quality & Reliability Management*, 29 (1), 92-121.
- Al-Mubarak, F., Khumawala, B., & Canel, C. (2003). Focused cellular manufacturing: an alternative to cellular manufacturing. *International Journal of Operations & Production Management*, 23 (3), 277-299.
- Alony, I., & Jones, M. (2008). Lean Supply Chains, JIT and Cellular Manufacturing – The Human Side. *Issues In Informing Science And Information Technology*, 5(4), 165-175.
- Anand, G. & Kodali R. (2008). A conceptual framework for lean supply chain and its implementation. *Journal of Value Chain Management*, 2(3), 313.
- Anvari, Alireza & Ismail, Md & Mohammad, Seyed & Hojjati, S.M.H.. (2011). A Study on Total Quality Management and Lean Manufacturing: Through Lean Thinking Approach. *World Applied Sciences Journal*. 12 (6), 45-67
- Arawati, A. (2011). Supply chain management, product quality and business performance. *International Conference on Sociality and Economic Development* 10, 98-102.
- Baron, R. M. & Kenny, D. A. (1986). The moderator- mediator variable distinction in social

- Bautista, J., & Fortuny-Santos, J. (2016). Improving “Just-In-Time, Just-In-Sequence” Delivery In First-Tier Suppliers. *Brazilian Journal Of Operations & Production Management*, 13 (3), 286.
- Bhasin, S & Burcher, P., (2006). Lean viewed as a philosophy. *Journal of Manufacturing Technology Management* 17 (5), 57-72.
- Billesbach, T. (2006).A study of the implementation of just in time in the United States.*Production and Inventory Management Journal*, 32 (3), 1-4.
- Borac N., Milovanovic G. & Andjelkovic A, (2010). *Lean Production and Six Sigma Quality in Lean Supply Chain Management*: presented to Ministry of Science and Technological Development of the Republic of Serbia.
- Bresler, L., & Stake, R. E. (2017).Qualitative research methodology in music education.In *Critical Essays in Music Education* (113-128).Routledge.
- Brinkmann, S. (2014).Interview.In *Encyclopedia of critical psychology* (1008-1010).Springer New York.
- Bryman, A., & Bell, E. (2014). *Research methodology: Business and management contexts*. Oxford University Press Southern Africa.
- Ceniga, P., & Šukalová, V. (2014).Application of the Theory of Constraints in Supply Chain. *Applied Mechanics and Materials*, 708 (7) , 13-19.
- Chopra, S. and Meindl, P. (2011), *Supply Chain Management*, Prentice-Hall, Englewood Cliffs, NJ.
- Dang, G., & Pheng, L. S. (2015).Research methodology.In *Infrastructure Investments in Developing Economies* (135-155).Springer, Singapore.

- Fatuma, A. (2015). *Quality management practices and supply chain performance of large scale manufacturing firms in Kenya*. Unpublished Masters Project, University of Nairobi
- Fiorino, D., & Bhan, M. (2013). Environmental Regulation with Supply Chains: Comparing Private and Public Regulation. *Prime Journals*, 6 (7), 34-56
- Flick, U. (2015). *Introducing research methodology: A beginner's guide to doing a research project*. Sage Publishers.
- GoK. (2015). *Kenya Vision 2030: A Globally Competitive and Prosperous Kenya*. Government of Kenya, National Economic and Social Council (NESC). Nairobi, Kenya
- Hamedi, M., Esmailian, G., & Ismail, N. (2011). Developing Capability-Based Virtual Cellular Manufacturing Systems and Comparison with Capability-Based Classical Cellular Manufacturing Systems. *Applied Mechanics and Materials*, 110 (116), 3938-3946.
- Hao, Q., Soong, B., Yang, Z., & Wang, D. (2008). Earliness/tardiness production planning by JIT philosophy for job-lot manufacturing systems. *Production Planning & Control*, 9(2), 181-188.
- Hassan Zadeh, A., Afshari, H., & Ramazani Khorshid-Doust, R. (2013). Integration of process planning and production planning and control in cellular manufacturing. *Production Planning & Control*, 25(10), 840-857.
- Hong, J. (1995). The effects of manufacturing lead time and process quality in a multi-process production system. *Production Planning & Control*, 6(4), 311-319.
- KAM (2016), Kenya Association of Manufacturers (2015/2016). Edition Directory.

KAM (2016), Kenya Association of Manufacturers (2015/2016).Edition Directory.

Kenya institute of management (2009).*Fundamentals of Management Research Methods*.
Nairobi: Macmillan Kenya Limited.

Kenya National Bureau of Statistics.(2016) *Economic Survey 2016*.
http://www.knbs.or.ke/index.php?option=com_phocadownload&view=category&download=862:economic-survey-2016&id=107:economic-survey-publications&Itemid=1181

Kimani, M. W. (2013). *Lean Supply Chain Management in Manufacturing Firms in Kenya*. Unpublished MBA project, University of Nairobi.

KIPPRA, (2013).*Kenya Economic Report 2013: Creating an Enabling Environment for Stimulating Investment for Competitive and Sustainable Counties*. Nairobi: KIPPRA.

KPMG International, (2015).*China Outlook 2015*. Retrieved from<http://www.kpmg.com>

Kumar, R. & Kumar, V. (2012). Lean manufacturing: elements and its benefits for manufacturing industry. *Proceedings of the National Conference on Trends and Advances in Mechanical Engineering*, YMCA University of Science & Technology

Kumar, R., Kumar, V., & Singh, S. (2014).Role of lean manufacturing and supply chain characteristics in accessing the manufacturing performance. *Uncertain Supply Chain Management*, 2(4), 219-228.

Kushwaha G.S (2012). Operational Performance through Supply Chain Management Practices, *International Journal of Business and Social Science*, 3 (2), 89-97

Lee, Hau L. & C. Billington C. (2010). Designing Products and Processes for Postponement, in Management of Design: *Engineering and Management Perspectives*. Kluwer Academic Publishers, Boston, 105-122.

Levinson, M. (2015). U.S. *Manufacturing in International Perspective*. Congressional Research Service: Informing the Legislative Debate Since 1914. Retrieved from <https://fas.org/sgp/crs/misc/R42135.pdf>.

Lewis, S. (2015). Qualitative inquiry and research design: Choosing among five approaches. *Health promotion practice*, 16 (4), 473-475.

Mackey, A., & Gass, S. M. (2015). *Second language research: Methodology and design*. Routledge.

Maguire, S. (2012). Special Issue – Production Planning & Control: Service Science. *Production Planning & Control*, 23(7), 477-479.

Magutu, P., O (2013). *Supply Chain Strategies, Technology and Performance of Large Scale Manufacturing Firms In Kenya*, Unpublished Masters Project, University of Nairobi

Margaret, M. (2013). *Value chain management practices and supply chain performance of large manufacturing firms in Nairobi*. Unpublished Masters Project, University of Nairobi

Masindet, E. & Ogollah, K. (2014). Influence of Total Quality Management Practices on Supply Chain Performance of Cement Manufacturing Firms in Kenya. *European Journal of Business Management*, 1 (11), 181-197.

Moroz, E. (2018). Computer aided manufacturing processes using Lean Management and Lean Manufacturing methods. *Mechanik*, (7), 535-537.

- Mugenda, A. G. (2008). *Social science research: Theory and principles. Nairobi: Applied.*
- Muhammad, B. H. (2014). *Supply chain management: Practices, performance and its impact on business performance.* Unpublished M. Sc Thesis of the University of Utara,.
- Mutua, M., Ngugi, P., & Odhiambo, R. (2018). Influence of Lean Production Practices on Performance of Large Manufacturing Firms in Kenya. *Journal of International Business, Innovation and Strategic Management*, 1(8), 58-76.
- Mutua, M., Ngugi, P., & Odhiambo, R. (2018). Lean Manufacturing and Performance of Manufacturing firms in Kenya. *Journal of International Business, Innovation and Strategic Management*. 8(5), 45-56
- National Association of Manufacturers (2015). *Facts About Manufacturing* in the United States. Retrieved from <http://www.nam.org/Newsroom/Facts-About-Manufacturing>.
- Nezakati, H., Fereidouni, M. A., & Rahman, A. A. (2016). An Evaluation of Government Role in Green Supply Chain Management through Theories. *International Journal of Economics and Financial Issues*, 6(65), 76-79.
- Nyaga, G. N., Whipple, J. M. & Lynch, D. F. (2010). Examining Supply Chain Relationships: Do Buyer And Supplier Perspectives on Collaborative Relationships Differ? *Journal of Operations Management*, 28 (2), 101–114.
- Okello, J. O., & Were, S. (2014). Influence of supply chain management practices on performance of the Nairobi Securities Exchange's listed, food manufacturing companies in Nairobi. *International Journal of Social Sciences and Entrepreneurship*, 1(11), 107-128
- Olhager, J. (2010). The role of the customer order decoupling point in production and supply chain management. *Computers in Industry*, 61(9), 863-868

- Olhager, J., & Wikner, J. (2010). Production planning and control tools. *Production Planning & Control*, 11 (3), 210-222.
- Omondi, D.O. (2008). *Application of lean thinking to business process management .Case study of Kenya Revenue Authority*. Unpublished MBA Project, University of Nairobi
- Ondiek, G. O. & Kisombe, S. M. (2012). *Lean manufacturing tools and techniques in Industrial operations*. Unpublished MBA Project, University of Nairobi
- Overseas Development Institute. (2016) *Developing Export-Based Manufacturing In Sub-Saharan Africa*. London: ODI
- Paneru, N. (2011). *Implementation of Lean Manufacturing Tools in Garment Manufacturing Process Focusing Sewing Section of Men's Shirt*, Doctoral dissertation, Oulu University of Applied Sciences.
- Panneerselvam, R. (2014). *Research methodology*. PHI Learning Pvt. Ltd..
- Power, D. (2005). Supply chain management integration and implementation: A literature review. *Supply Chain Management*, 10(3), 252–263.
- Quinlan, C., Babin, B., Carr, J., & Griffin, M. (2018). *Business research methods*. South Western Cengage.
- Ralescu.D. (2009). Management application of system theory. *Proceedings of the IEEE*, 68 (7), 943-944
- Rand, G. (2011). Just-in-Time Manufacturing in Perspective. *Journal of the Operational Research Society*, 44 (7), 734-735.

- Reichhart, A. & Holweg, M. (2007). Creating the customer-responsive supply chain: a reconciliation of concepts. *International Journal of Operations and Production Management*, 27(11), 1144-1172.
- Republic of Kenya, (2015). *Economic Survey 2015*. Nairobi, Kenya: Kenya National Bureau of Statistics.
- Richbell, S., & Ratsiatou, I. (2009). Establishing a shared vision under total quality management: Theory and practice. *Total Quality Management*, 10(4-5), 684-689.
- Rucha, K. M. (2018). *Lean Practices and Operational Performance of Third Party Port-Centric Logistics Firms in Kenya*, Doctoral dissertation, JKUAT COHRED.
- Sayid Mia, M. (2017). Implementation of Lean Manufacturing Tools in Footwear Industry of Bangladesh. *Aspects in Mining & Mineral Science*, 1(1), 90-134
- Sekaran, U., & Bougie, R. (2016). *Research Methods for Business*. New York: Wiley.
- Shajema, I. D. I. (2018). Effect of Inventory Control Practices on Performance of Retail Chain Stores In Nairobi County, Kenya. *Journal of International Business, Innovation and Strategic Management*, 1(2), 23-56
- Silverman, D. (Ed.). (2016). *Qualitative research*. Sage.
- Smith, J. A. (Ed.). (2015). *Qualitative psychology: A practical guide to research methods*. Sage.
- Stensaasen, S. (1995). The application of Deming's theory of total quality management to achieve continuous improvements in education. *Total Quality Management*, 6(5), 579-592.

- Sumo, J. (2015). *Lean practices and supply chain performance among automotive assembling firms in Kenya* (Masters). University of Nairobi, Unpublished Masters Project
- Tarboda, J. (2015). *South Africa GDP Annual Growth Rate*. Retrieved from <http://www.tradingeconomics.com/south-africa/gdp-growth-annual>.
- Taylor, S. J., Bogdan, R., & DeVault, M. (2015). *Introduction to qualitative research methods: A guidebook and resource*. John Wiley & Sons.
- Thatte, A.A. (2016). *Competitive advantage of a Firm through Supply Chain Responsiveness and Supply Chain Management Practices*, Published PhD Dissertation, University of Toledo
- Tripathi, N., & Tiwari, S. Lean Manufacturing Practices and Firms Performance Measurement-A Review Paper. <https://www.researchgate.net/publication/308960626>.
- Tsuchiya, S. (2010). *Quality maintenance: Zero defects through equipment management*. Productivity Press, Cambridge, MA
- Tupa, J. (2014). Performance measurement for efficient lean management: theory and case study. *International Journal of Lean Enterprise Research*, 1(2),116.
- Vore, R. (2002). Competitive manufacturing through total productive maintenance. Semiconductor Manufacturing Science Symposium. ISMSS 1992, IEEE/SEMI International, June 15-16, pp. 85-9.
- Weru, P. (2018). *Lean manufacturing practices and performance of large scale manufacturing firms in Nairobi, Kenya*. Unpublished Masters Project, University of Nairobi


World Bank (2016) *Kenya Economic Update*. Washington, DC: World Bank.

Zhu, Q., & Sarkis, J. (2007). The moderating effects of institutional pressures on emergent green supply chain practices and performance. *International journal of production research*, 45(18-19), 4333-4355.

Zuckerman, A. (2014). *Supply Chain Management: Operations 06.04* (Express Exec), (1st ed.). Publisher: Capstone.

APPENDICES

Appendix I: Data Collection Letter

	<p>Thika Road, Nairobi P.O. Box 50005-00200 Nairobi Kenya Plot Line: +254 20 8039488/9 Tel: +254 20 2537942 Fax: +254 20 8563077 Mobile: +254 734 088022, 718 088022 Email: ica@kca.ac.ke Website: www.kca.ac.ke</p>
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KCA/USGS/MBAs/May.19/11

May 15, 2019

To whom it may concern,

Dear Sir/Madam,

RE: FREDRICK JUMA ONGARO REG NO: 17/01369

It is my distinct pleasure to introduce to you Mr. Fredrick Ongaro who is a student in our institution pursuing a Master of Business Administration specializing in Procurement and Supplier Management at the School of Business and Public Management.

Fredrick is conducting a research on a topic titled: *"Effect of Lean Manufacturing Practices On Supply Chain Performance of Manufacturing Firms in Kenya: A Case of Food Manufacturing Firms in Nairobi County"* which is part of the requirements of the program he is pursuing. The research as well as the data procured thereof shall be used for academic purposes only.

Any assistance accorded to him is highly appreciated.

In case of further inquiry, do not hesitate to contact the undersigned.

Yours faithfully,



Dr. Nyambé Mutsaers
Dean, School of Graduate Studies & Research

Appendix II: Questionnaire

Section A: General Information

1. Highest Level of Education

Postgraduate Undergraduate Diploma
 Certificate Secondary

2. Position

Procurement Manager Production Manager Operations Manager

3. Work Experience

1 year and below 2-3 years 4- 5 years Above 5 years

Section B: Just in Time Production

Kindly indicate the extent to which your company practices the following just in time production practices based on a scale of 1-5 where 5= Very High Extent; 4 = High Extent; 3= Moderate Extent; 2= Low Extent and 1= Very Low Extent

No	Statements	1	2	3	4	5
4	The company avails labor on demand in order to manage labor costs					
5	The company avails resources on demand in order to manage wastage					
6	The company produces on demand in order to manage inventory costs					
7	The company orders raw materials from the suppliers only when there is demand for production from customers					
8	The company has simplified production design to ensure timely production					
9	The company has multiple skill workers to ensure faster production on time					
10	The company has a daily schedule commitment to ensure faster production on time					

Section C: Cellular Manufacturing

Kindly indicate the extent to which your company practices the following cellular manufacturing practices based on a scale of 1-5 where 5= Very High Extent; 4 = High Extent; 3= Moderate Extent; 2= Low Extent and 1= Very Low Extent

No	Statements	1	2	3	4	5
11	The company has scheduled cell based layouts for production					
12	The company uses group technology to produce similar products					
13	The company prefers sequential production for similar products					
14	The company produces products of same characteristics in the same production systems					
15	The company groups similar products to be manufactured based on similarity in order to adopt the same technology					
16	Fixed cost for producing similar products is set in order to manage production costs					
17	Specialized production workers are used in cellular manufacturing					

Section D: Pre-Production Planning

Kindly indicate the extent to which your company practices the following pre-production planning practices based on a scale of 1-5 where 5= Very High Extent; 4 = High Extent; 3= Moderate Extent; 2= Low Extent and 1= Very Low Extent

No	Statements	1	2	3	4	5
18	The company plans work flow before embarking on the process of production					
19	The company assembly the necessary raw materials before commencing the production process					
20	The company accordingly allocates raw materials before the production process begins					
21	The company plans the work power required before commencing the production process					
22	The company plans the manufacturing process before commencing the production process					
23	Evaluation of the production system is conducted first before starting production					
24	Production control system are set before the production process to ensure there is no wastage					

Section E: Total Quality Control

Kindly indicate the extent to which your company practices the following total quality control practices based on a scale of 1-5 where 5= Very High Extent; 4 = High Extent; 3= Moderate Extent; 2= Low Extent and 1= Very Low Extent

	Statements	1	2	3	4	5
25	The company has manageable defect prevention costs related to quality planning					
26	The company has manageable defect prevention costs related to investment in quality related information systems					
27	The company has manageable appraisal costs related to test and inspection of purchased materials					
28	The company has manageable appraisal costs related to quality audits					
29	The company has manageable internal failure costs related to reworks					
30	The company has manageable internal failure costs related to scrap					
31	The company has manageable external failure costs related to complains in and out of warranty					

Section F: Government Regulations

Kindly indicate the extent to which the following government regulations affects the company operations on a scale of 1-5 where 5= Very High Extent; 4 = High Extent; 3= Moderate Extent; 2= Low Extent and 1= Very Low Extent

No	Statements	1	2	3	4	5
32	Government regulations on environmental standards affects the company operations					
33	Provision of government incentives for certain production activities affects the company operations					
34	The licensing procedures affects the company operations					
35	The requirements from Kenya Association of Manufacturers regarding operations					
36	Government regulations on the type of production activities to focus on affects the company operations					
37	Government regulations on taxes (fiscal policy) affects the company operations					
38	Government regulations on access to financial assistance (credit)					

No	Statements	1	2	3	4	5
	on affects the company operations					

Section G: Supply Chain Performance

Kindly indicate the extent to which you agree with the following statements on supply chain performance of the company on a scale of 1-5 where 5= Very High Extent; 4 = High Extent; 3= Moderate Extent; 2= Low Extent and 1= Very Low Extent

No	Statements	1	2	3	4	5
39	Application of lean production practices has reduced the supply chain costs					
40	Application of lean production practices has improved the quality of products					
41	Application of lean production practices has reduced the supply chain order to delivery lead time					
42	Application of lean production practices has led to improved flexibility in production					
43	Application of lean production practices has led to improved resource utilization					
44	Application of lean production practices has led to improved supply chain response time					
45	Application of lean production practices improved the firm's delivery performance					

Appendix III: List of Food and Beverage Firms in Nairobi County

Africa Spirits Ltd	Crown Beverages LTD	Honey Care Africa	Premier Food Industries Limited
Afrimac Nut Company	Czarnikow Sugar (EA) Ltd	Italian Gelati & Food Products Ltd	Pride Industries Ltd
Agri Pro-Pak Limited	Danone Baby Nutrition Africa and Overseas	Luma Stores & Supplies Enter. Ltd	Promasidor (Kenya) Ltd
Agricultural & Veterinary Supplies Ltd (Agrivet)	Del Monte Kenya Ltd	Mafuko Industries Ltd	Pwani Oil Products Ltd
Alliance One Tobacco (K) Ltd	Diamond Industries Ltd.	Mama Millers Limited	Rafiki Millers Ltd.
Almasi Beverages Ltd	Doinyo Lessos Creameries Ltd.	Manji Food Industries Ltd	Razco Limited
Alpha Fine Foods Ltd.	DPL Festive Ltd.	Mayfeeds Kenya Ltd	Sahara Venture Capital Company Ltd
Alpine Coolers Ltd.	Dutch Waters Ltd.	Melvin Marsh International	Sameer Agriculture & Livestock (Kenya) LTD
Aquamist Ltd.	East African Breweries Ltd.	Menengai Oil Refineries Ltd	SBC Kenya Limited
Bakex Millers Ltd	East African Sea Food Ltd.	Meru Greens Horticulture Ltd	Selecta Kenya Gmbh & Co. .KG
Bidco Africa Ltd	Eastern Produce Kenya Ltd (Kakuzi)	Meru Water & Sewerage Services	Sigma Supplies Ltd
Bio Food Products Limited	Eldoret Grains Ltd.	Milly Fruit Processors Ltd	Simply Foods Ltd
Brava Foods	Elekea Ltd.	Mini Bakeries (Nbi) Ltd	South Nyanza Sugar Company
Breakfast Cereal Company K Ltd (Formerly Weetabix)	Elle Kenya Ltd.	Mjengo Limited	Spice World Ltd
Broadway Bakery Ltd	Equator Bottlers Ltd.	Monwalk Investment Ltd	Stawi Foods and Fruits Limited
Brookside Dairy Ltd	Erdermann Co. (K) Ltd.	Morani Limited	Sweet Rus Limited
Buffalo Millers	Europack Industries Limited	Mount Kenya Bottlers Ltd	Trufoods Ltd
Bulto Foods Ltd.	Excel Chemicals Ltd	Mzuri Sweets Ltd	Umoja Flour Mills Ltd
Bunda Cakes Feeds Ltd	Farmers Choice Ltd	Nairobi Bottlers Ltd	Unga Group Ltd
Bunge East Africa Limited	Frigoken Ltd	Nairobi Flour Mills Ltd	United Millers Ltd

Butali Sugar Mills Ltd	General Mills East Africa Ltd.	NAS Airport Services Ltd	Valley Confectionery Ltd
C. Dormans Ltd.	Giloil Company Ltd.	Nestle Kenya Ltd	Valuepak foods
Candy Kenya Ltd	Global Fresh Ltd	Njoro Canning Factory (Kenya) Ltd	Vava Coffee Ltd
Capel Food Ingredients	Global Tea Commodities (K) Ltd.	Norda Industries Ltd	Vinepack Ltd
Capwell Industries Ltd.	Gonas Best Ltd.	Olivado EPZ Limited	W. E. Tilley (Muthaiga) Ltd
Centrofood Industries Ltd.	Grain Bulk Handlers	Palmhouse Diaries Ltd	Winnie's Pure Health
Chemelil Sugar Company Ltd.	Green Forest Foods Ltd.	Patco Industries Limited	Wrigley Company (E.A.) Ltd
Coastal Bottlers Ltd.	Happy Cow Ltd.	Pearly LLP	Xpressions Flora Ltd
CoffTea Agencies	Highlands Mineral Water Co. Ltd	Pembe Flour Mills Ltd	Zheng Hong (K) Limited

Source: Kenya Association of Manufacturers (2018)