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THE INFLUENCE OF LEAN SIX SIGMA ON OPERATIONAL PERFORMANCE OF JUICE MANUFACTURING FIRMS IN NAIROBI METROPOLITAN AREA

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ADMISSION NUMBER: 125321/2020

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION AT STRATHMORE UNIVERSITY

STRATHMORE UNIVERSITY BUSINESS SCHOOL

STRATHMORE UNIVERSITY

NAIROBI, KENYA

September 2022

DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the dissertation contains no material previously published or written by another person except where due reference is made in the dissertation itself.

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Nicholas O. Oyottoh

Approval

The dissertation of Nicholas O. Oyottoh was approved by the following:

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Dr. Tabitha Waithaka

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ABSTRACT

Organizations are operating in quite a volatile environment driven by stiff competition, customers with low brand loyalty and continuously increasing input prices while consumers are not willing to take a price increment from any supplier. Most organizations are therefore looking for systems, strategies and process that can make them compete in the market place. One of the ways organizations strive to address competitive challenge and improve performance is rolling out continuous improvement practices such as Six Sigma, and Lean. The key point of concern is whether the implementation of lean six sigma results in any improvement in performance. There are gaps in literature as the results are quite varied where some organizations see benefits while others see no benefits and the extreme end of the benefits continuum some organizations see negative impact on their performance after implementing the lean six sigma. In the literature, there was also varied geographical spread in the study with literature showing a bias towards the studies being done in developed world. The objective of this study was to assess the influence of Lean Six Sigma on operational performance of Juices manufacturing firms in Nairobi metropolitan area. This specifically involved establishing the influence of Coordination, TPM, Employee Involvement and Statistical Process Control on operational performance of Juice manufacturing firms in Nairobi Metropolitan area. This study was anchored on two theories namely dynamic capability theory and knowledge based theory. The study adopted positivism research with a descriptive research design. The primary data was collected by administration of semi-structured questionnaire targeting 78 respondents from the 13 juice manufacturing firm in the Nairobi Metropolitan area. The study made use of MS Excel as well as R as tools to analyze the primary data collected. The descriptive statistics and correlation analysis on the relationship between the dependent and the independent variables showed that the four predictor variables (Coordination, Employee involvement, Total productive maintenance, and Statistical process control) had statistical significant influence on the operational performance. The limitations of the study included the cross-sectional approach of research design and thus, the results are to be interpreted within such period. Therefore, future studies could consider longitudinal studies and results compared, other limitations included the regional focus of Nairobi Metropolitan areas as well as the industry of focus which was the juice firms within the Nairobi metropolitan area.

ACKNOWLEDGEMENTS

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DEDICATION

To my family, my wife Celeste and kids Sam and Nate, you are my Angels and any man's dream and wish in this life; lots of love for you.

Would also like to dedicate this work to David Eames, a crucial and never ending supporter and cheerleader. Basil Gadzios for being the pillar that you are; thank you.

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ABBREVIATION AND ACRONYMS

DMAIC – Define, Measure, Analyze, Improve and Control

6δ - Six Sigma

QM system – Quality Management system

MBNQA - Malcolm Baldrige National Quality Award

GDP – Gross domestic product

OEE - Overall Equipment Effectiveness

TPM – Total Productive Maintenance

SEF – Swift Even Flow

OFE – Operation Flow effectiveness

DEFINITION OF KEY TERMS

Continuous improvement- involves carrying out incremental and continuous changes to the current processes and practices to improve product or service performance for long-lasting changes in organizations leading to its survival and growth (Wickramasinghe & Chathurani, 2021)

Six Sigma (6δ) - this is a continuous improvement methodology that focuses on process waste elimination through reduction of process variability. (Hudnurkar et al., 2019)

Operations performance - the internal performance relating to the following elements, waste and cost reduction, quality improvement, flexibility and productivity. (Raval et al., 2020)

Cp - process capability index based on the ratio of the spread of a frequency distribution to the width of the specification (Oakland & Oakland, 2019)

CpK - A process capability index based on both the centering of a frequency distribution and the ratio of the spread of the distribution to the width of the specification (Oakland & Oakland, 2019)

Overall Equipment Effectiveness (OEE)- is a term coined by Seiichi Nakajima in the 1960s to evaluate how effectively a manufacturing operation is utilized

Overall Equipment Effectiveness = Availability × Performance Efficiency × Quality Rate

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CHAPTER ONE:

INTRODUCTION

1.1 **Background of the study**

The world is increasingly becoming a global village with the resultant effect of products or services produced in one continent easily shipped and consumed in another continent. globalization coupled with democratization of technology, has fostered and environment where competition keeps growing significantly across all business categories therefore providing consumers with a vast array of product and service options (Hooi & Leong, 2017). These two forces, globalization and democratization of technology, have had the unintended consequences of making the consumer extremely unpredictable in expectation as they, consumers, demand high quality yet low priced products and services, with the resultant effect in making business environment very dynamic and turbulent. (Iwao & Marinov, 2018a); (Kharub et al., 2019a);(Hooi & Leong, 2017).

With the rapid increase in globalization, democratization of technology, and the subsequent increase in competition across the various business segments and categories, organizations are looking for strategies, systems and processes to remain competitive in the global market place (Kharub et al., 2019a). Gonzalez & Martins, (2016) posits that organizations need to promote continuous improvement of their productive process to compete effectively in the globalized market place.

Continuous improvement as a concept has various definitions though there seem to be some underlying themes such as incremental, and sustained company-wide strategy to ensure success and survival of the organization. Wickramasinghe and Chathurani (2021) define it in terms of what it does (incremental and continual changes to existing practices) and the why (survival and growth). The writers posit that Continuous improvement (CI) involves carrying out incremental and continuous changes to the current processes and practices to improve product or service performance for long-lasting changes in organizations leading to its survival and growth. Eaidgah et al. (2016a, p. 193) however looks at the concept from the who is involved (whole organization), and how it progresses (evolutionary) perspective, and therefore define continuous improvement as a culture of sustained improvements involving all employees and progresses through an

evolutionary improvement hence it is incremental. Sraun and Singh, (2017) defines Continuous Improvement as a paradigm/viewpoint (philosophy) of improvement initiatives that reduces failure. Other authors define Continuous improvement as the systematic effort to seek out and apply new ways of doing work i.e. actively and repeatedly making process improvements (Gutierrez-Gutierrez & Jiju, 2020); (Iwao & Marinov, 2018b). Gonzalez and Martins, (2016) define Continuous improvement as a process of incremental, focused and continuous innovation, involving the entire organization. Continuous improvement is therefore a company-wide process and culture of continuous, focused and consistent incremental innovation (Singh & Singh, 2015).. The fundamental message in all the above definitions is that Continuous improvement is a process of continuously learning, implementing and sustaining systems, processes and strategies that enable the organization to effectively and efficiently meet, the performance objectives of its stakeholders. This study will adopt the Wickramasinghe and Chathurani (2021) definition of continuous improvement.

There are various continuous improvement practices that have been pointed out in literature for example, Kumar et al.,(2018) speak to continuous improvement practices such as Total Quality Management (TQM), Continuous Improvement (CI), Six Sigma, Total Productive Maintenance (TPM), Toyota Production System (TPS), Lean Manufacturing. Eaidgah et al., (2016b) lists continuous improvement practices such Six Sigma, Lean Production, Balanced Scorecard and Lean Six Sigma, and each of these practices emphasize a particular philosophy and focus area in the business. Alvarado-Ramírez et al., (2018) also calls out total quality management, Six Sigma, reengineering, strategic management, and Kaizen.

This research work therefore picked out the following practices from the above literature Total Quality Management (TQM), Continuous Improvement (CI), Six Sigma, Total Productive Maintenance (TPM), Toyota Production System (TPS), Lean Manufacturing, Lean Six Sigma and Kaizen. It was however notable that the most popular continuous improvement practice that most business apply are lean and Six Sigma (Albliwi et al., 2014), such as the implementation of Lean Six Sigma in the banking sector in Kenya (Ndaita et al., 2015), and in a structured review of lea six sigma in various industrial sectors, (M. Singh & Rathi, 2019) identified that most of the Lean Six Sigma implementations are in service sector than manufacturing sector. There was also very

clear limitation in the publications of the factors that lead to lean Six Sigma failure. (Albliwi et al., 2014).

Based on the fact that Lean and Six Sigma were the most popular continuous improvement practices and the number of publications on the failures were also very low, this study therefore focused on Lean Six Sigma.

1.1.1 Lean Six Sigma

Lean Six Sigma is a methodology that maximizes shareholder value by achieving the fastest rate of improvement in customer satisfaction, cost, quality, process speed and invested capital. (George, 2002). Lean six sigma is a methodology that relies on collaborative effort to improve performance through systematic elimination of waste by applying both Six Sigma and Lean to eliminate the eight wastes; time, inventory, motion, waiting, over production, over processing, defects, and skills. (Poornima Charantimath, 2017b). The key lean principles according to Womack and Jones, (2003) are Specify value, Identifying the value stream, Flow, pull, and Seeking perfection. Specify value needs to be from the customers' view-point, the key thrust of this principle is that a firm must have a deep understanding of what the customer values and strive to make a product that meets the customers' problem to be solved at a specific price and time. This therefore meant that, organizations applying Lean thinking should avoid producing products then try to find a market for them rather they should start with what the customer wants than what's convenient for the firm (Womack & Jones, 2003); (Shah & Naghi Ganji, 2017a). With regards to Identifying the value stream, the concept looks at the organization of the entire value chain activities and actions to meet the demand as per the specified value above, meaning, how are we organizing all the inputs to meet the value that the customer demanded at a specific price and time. (Womack & Jones, 2003); (Shah & Naghi Ganji, 2017a).

On the principle of Flow, the primary concern was how can we design work to move from one process step to the next while reducing all non-value add activities. This principle therefore looked at people, process as well as culture (Womack & Jones, 2003) ;(Shah & Naghi Ganji, 2017a). Pull systems are designed such that they eliminate or significantly reduce overproduction by concentrating on only what customers require or need and at the time of requirement and need. This is achieved through reduction of time and waste making the Supply Chain to be transparent thus reducing uncertainty. (Womack & Jones, 2003); (Shah & Naghi Ganji, 2017a). The concept

of Seeking perfection “is not all about quality but it includes producing what the customers want, at the right time, at the right price and with minimum waste (Womack and Jones, 1996). This implies that improvement cycle ought to be continuous and it should certainly not end (Melton, 2005).” (Shah & Naghi Ganji, 2017a) ;(Womack & Jones, 2003)

The above principles are designed to work through six components Flow (FLOW), Total productive maintenance (TPM), Employee involvement, pull systems (PULL), reduced setup time (SETUP), and use of statistical process control (SPC) (Wincel & Kull, 2016).

Flow core idea on this is designing processes or systems such that work or activities flow smoothly in a well synchronized manner. The ultimate objective is to ensure that good or services are provided as and when needed (Womack & Jones, 2003). To facilitate the flow concept, we need machines that are in good working condition, Total Productive Maintenance, the primary objective of this component is that to ensure that machines are always in very good running conditions so that production runs uninterrupted to meet both the FLOW as well as PULL goals. (Womack & Jones, 2003). Although we could have a well-designed flow and machines are in good working conditions, problems in processes and operations will always occur, Employee involvement, the process of working and improving the processes and systems depend highly on employee and Lean thinking espouses the full involvement of employees to solve process and system problems as they arise. (Wincel & Kull, 2016).

Pull Systems this works in tandem with the flow system, the principle is to ensure good and services are only produced when a customer requests for it. The design if the system to facilitate this level of coordination applies tools like Kanban which is basically a signal card calling for release of a product or service into the next phase hence can be classified as coordination. The scheduling as well as takt time are usually the pacemaker of the operations (Womack & Jones, 2003). Reduced setup time in as much as Total productive maintenance above is concerned about the condition of the machine, the SETUP segment is concerned with ensuring changeovers take the shortest time possible so that production is never interrupted. This component applies tools like SMED (single minute exchange of die) meaning that the changeover time should be in single digits i.e. less than 10 minutes (Womack & Jones, 2003). Finally, Statistical process control, is the application of statistical tools and techniques to assess, adjust and improve the process to ensure that it is producing the right quality and quantity of product or services. Using SPC, to enable

process control and capability analysis evaluate process control and stability both short term and long term. (Wincel & Kull, 2016).

Literature review showed that organizations implementing lean six sigma observe operational performance improvement. Noori and Latifi, (2018) studied the impact of solving a process variation problem relating to the shaft of motor vehicles for a large car manufacturing firm in Iran. The project set a target of improving grinding process output from 27% to 93.3%. After implementation of the improvement project, the firm saw a significant reduction in defect and a cost saving of $40,000 and a resulting improvement in customer satisfaction levels (Noori & Latifi, 2018). Desai and Shaikh, (2018) also showed significant improvement in a small and medium enterprises in India's ceramic sector in the manufacture of insulators. The researchers found a significant reduction in the insulator rejection rate during high voltage testing from 0.5% to 0.1% with a resultant improvement of the sigma level from 4.4 to 5.0 sigma. This resulted in reduction in rework cost, scrap cost total amount coming to round about Indian Rupee of 480,0000 as well as improved customer satisfaction. Other studies by Uluskan and Oda, (2020), on Six Sigma project in a household appliance manufacturing systems showed a process performance improvement of the sigma level from 3.1 to 4.4 with resultant reduction in alignment defects which constituted 67.7% of the overall alignment defects. (Uluskan & Oda, 2020)

In as much as some companies experienced improvement of their organization performance, controverting studies by (Sony et al., 2019), showed that application of lean six sigma to improving customer satisfaction, reducing defects, minimize inventory, reduce cycle time, reducing waste, reducing non-value-added activities had very low success rate. The study further stated that up to 70 percent Lean and Six Sigma initiatives failed and while referencing (Ringen and Holtskog, 2013), the study stated that one in three continuous improvement projects failed. In the health care sector, 62 percent Lean and Six Sigma initiatives have failed (Glasgow et al., 2010). Jiju and Sony, (2020) quantified the failure rates of those continuous improvement initiatives and specifically in that case for Six Sigma initiatives, and found over 60% of the projects failed to deliver any benefit (Jiju & Sony, 2020).

Literature review by Albliwi et al., (2014), of failure in different industries, the review found 56 papers published on Lean, Six Sigma and Lean Six Sigma failure in different sectors: manufacturing, services, public, health care and higher education. These studies were conducted

in various countries, including the USA, the UK, Brazil, Denmark, Australia and some Asian countries. This study picked out that the number of recorded studies reviewing project failure was quite low totaling to 30 papers (18 on Lean and 12 on Six Sigma). One pilot survey study by Jiju et al., (2019) on 42 Brazilian manufacturing firms for the reasons of failure for process improvement projects, the paper found that there was moderate rate of failures, which costed companies several millions of dollars especially for big organizations. (Jiju et al., 2019)

Regarding the regional focus on implementation of Six Sigma, studies by Schmidt et al. (2018) supported the notion that six sigma studies were focused mainly in the developed countries. This therefore suggested opportunities in studying the impacts of implementation in the developing world "Actually, Six Sigma in developing countries has not being explored as much as in developed contexts (Alsmadi et al., 2012; Cauchick Miguel and Andrietta, 2010). Although a considerable amount of research about Six Sigma had been conducted in North America and US-based global companies such as GE and Motorola, only a few studies had been carried out in global companies outside the USA (Pisani et al., 2009; Tlapa et al., 2016)." (Schmidt et al., 2018)

1.1.2 Operational performance

Oyewobi et al. (2015) indicated that the jury on the definition of the term organizational performance was still out as most of the studies and literature were still inconclusive though they posited that performance relates to measurement of how an individual, a team, a process level or the organization achieved its goals. They expounded further that, performance tends to be relative as, it is measured against the expectation of the stakeholder as well as performance against other players of interest. Oyewobi et al. (2015), separated two key concepts of effectiveness as an element of performance connotes the degree to which stakeholder requirement is achieved, while efficiency, measures how well the organization utilized its resources and capabilities economically to meet stakeholders needs. (Oyewobi et al., 2015).

In as much as the organization performance was quite an inconclusively defined topic, scholars such as Udofia et al. (2021) provided some element such productivity, profitability, efficiency and customer satisfaction that could be used to measure organization performance. They also pointed out that when performance is poorly measured, it led to poor competitive positioning and resulted in a lack of sustainable competitive advantage (Udofia et al., 2021). Organization performance has therefore become a very central issue of organizational survival and consequently all efforts to

sustain robust performance does take on a strategic and top level focus and requires application of continuous improvement practices (Muganyi et al., 2019).

From the above study by Udofia et al. (2021), one of the key measure of organization performance was productivity, defined as the output of the organization from all its inputs in the pursuit of its strategic objectives. Productivity is such an important organizational measure in reducing cost, improving income and therefore and generating profits (Cyril and Singla, 2020). Udofia et al., (2021) further explained that there was a link between productivity and a firm's efficiency and effectiveness without which, there was no achievement of organizational goals especially in manufacturing firms (Udofia et al., 2021). Dvouletý and Blažková, (2021) posited that Organizational productivity had a massive impact on the level of value created (customer satisfaction) as well as value extraction (the organization internal efficiency) hence the organization becoming a low cost producer; a position of strong strategic competitive advantage. Kharub et al., (2019b) posited that, an organization was said to be a low-cost producer, if it sold its products at average industry prices and yet earns a profit higher than its competitors earn, or may sell at a price below average to gain significant market share. Value extraction is about ensuring that the firm is efficient enough to not waste large amounts of the value it captures before passing it to its stakeholders (Larréché, 2008). Alaloul et al., (2021) asserted that productivity improvement improves income and reduces total cost of construction projects for instance. Literature review indicated that determining the operational productivity level required identifying suitable lean manufacturing practices and setting systems that allowed for quick setup that would by extension reduce the waiting time hence lead times therefore reducing waste (Ong et al., 2021). Raval et al., (2020) segregated organizational performance into financial and operational performance metrics. They defined the operations performance as the internal performance relating to the following elements, waste and cost reduction, quality improvement, flexibility and productivity.

Studies by Sraun and Singh, (2017), expounded on this concept "Most Kaizen strategic implementation goals include productivity, work-in-process, floor space, throughput, lead-time, set-up time, part travel time, per cent on-time delivery, defect rate, throughput and product design measures such as price, product line diversity, etc. Kosandal and Farris, (2004). According to Khan, (2011) Kaizen reduces waste in areas such as inventory, waiting times, transportation,

worker motion, employee skills, over production, excess quality and in processes. It improves space usage, product quality, use of capital, communications, production capacity and employee retention"

The Malcolm Baldrige National Quality Award links the following specific performance metrics to lean and Six Sigma in their criteria Profitability increases, Capability increases, Higher inventory turns, Lower employee turnover rates, Improved lead times, Increased throughput, Increased customer satisfaction, Increased sales, Improved responsiveness, Increased market knowledge, Increased competitiveness, and Increased capacity (Schutta, 2006). The Malcolm Baldrige National Quality Award gives a heavy weighting to quality and operational results under pillar 6 (process management) of its assessment (Hart and Bogan, 1992). The above propositions and findings by Raval et al., (2020), Sraun and Singh, (2017) and Khan, (2011) resonated quite well with the Malcolm Baldrige National Quality Award metric specifically the operational performance metrics of Increased capacity, Improved Responsiveness, Improved lead times, Increased throughput and Higher inventory turns. This study therefore adopted the following operational performance metrics, Increased capacity, Improved Responsiveness, Improved lead times, Increased throughput and Higher inventory turns, in line with the Malcolm Baldrige National Quality Award (MBNQA)

1.1.3 Juice Manufacturing Sector in Kenya

The global manufacturing value add is highly skewed toward the developed world and China with Africa contribution less than 2% of the global manufacturing value add and the growth rate of the African output was well below 1% while the Global output grew at 12% (KPMG Advisory Services and Kenya Association of Manufacturers, 2021). In Kenya, manufacturing contracted for two consecutive quarters of 2020 by 3.9% and 3.2% in the second and third quarters of 2020, respectively dropping from 191Billion to 183Billion. KPMG Advisory Services and Kenya Association of Manufacturers, (2021). Besides the contraction, the Competitive Industrial Performance (CIP) Index data from United Nations Industrial Development Organization (UNIDO) ranked Kenya's manufacturing sector's competitiveness at position 115 out of 152 countries in global manufacturing dropping 104 in 2010 and 2011 which was driven by the drop in the global manufacturing value add (MVA) and by extension a drop in the manufactured exports. (Kenya Association of Manufacturers, 2021).

The manufacturing sector in Kenya had been significantly hit with the Covid pandemic and most manufacturing companies had to reprioritize for survival. Prior to the Covid pandemic the three top priorities for most manufacturers were increase profitability, increase revenue and increase domestic market share. However, the immediate post Covid priorities were distilled to almost a survival mode and the top three focus were reducing costs, retaining jobs and improving cash flow, which were to be achieved through the key strategy of increasing domestic's market share. (KPMG Advisory Services and Kenya Association of Manufacturers, 2021). The manufacturing sector had been identified as priority sector in realization of the big 4 agenda to accelerate growth, create jobs and reduce poverty (Strathmore University & SYSPRO, 2019). In as much as there was a decline in the sector, it was the third in share of wage employment after education and agriculture, forestry and fishing (Kenya national Bureau of statistics, 2021). The 3.8% growth in manufacturing had trailed the GDP growth of 5.7% over the period 2013 and 2016 where it's contribution to the GDP in 2016 was a meagre 9.2% (Strathmore University & SYSPRO, 2019).

Out of the Policy Recommendations, in the KPMG Advisory Services and Kenya Association of Manufacturers, (2021) report, two of the recommendations were of significant relevance with regards to continuous improvement environment. The first one related to cost reduction and second related to addressing cash flow especially concerning inventory management, which speaks to lean thinking. Based on the above findings from Kenya Association of manufacturing, the focus on cost reduction and cash flow management spoke to the urgent need for improvement in the productivity, reduction of waste as well as lead-time reduction within the manufacturing sector. This therefore meant that for manufacturing sector to remain afloat there was need for them to embrace lean six sigma.

In as much as the manufacturing sector has seen contraction, there are segments within manufacturing that is growing at a relatively fast rate and juice industry is one such growing segments, it is estimated to grow at CAGR (cumulative annual growth rate) of 9.1% for the period 2020 and 2025 (n.d.). In the Manufacturing in Kenya Under the 'Big 4 Agenda' A Sectoral Deep-dive Report, the association states that the horticultural sector as well as post processing is a high opportunity area and can accommodate organizations from small scale, to large organizations. The sector though high potential is marred by several challenges such as Lack of a prompt payment regulation which creates cash flow issues and stagnates growth, lack of a level playing field for

local manufacturers and foreign investor therefore asymmetric market and High cost of credit (Kenya Association of Manufacturers, 2018). With the massive growth opportunities and the constraints set by the challenges, this segment forms a good research opportunity to reduce the impact of these challenges. One challenge that Lean Six Sigma can help address is working capital management an area that seems to stagnate growth.

1.2 **Problem statement**

The literature reviewed points to mixed findings where some organizations see benefits in implementing the programs while other organizations see no benefits whatsoever, referencing to the study by, M. Singh and Rathi, (2019), the implementation of Lean six sigma is focused mainly in service sector and finally most studies are carried out of the developed world context. The current study therefore intended to establish the influence of Lean Six Sigma on operational performance within the juice manufacturing firms in the Kenyan context specifically Nairobi Metropolitan area

Continuous improvement programs have been implemented in many businesses across the globe especially in the manufacturing sector to improve the productivity (input to output ratio), reduce cost while at the same time, improve customer satisfaction (Sodhi et al., 2020). Studies on a can Food Supplier in Germany, by Sanchez-Rebull et al (2020), showed that implementing Six sigma resulted in an improvement of business performance indicators. In the local Kenyan context, implementation of Lean Six Sigma in the banking sector showed some business benefits after implementation of lean six sigma. The finding of this study was that implementation of lean six sigma in the bank's operations division had positive impact on both operational and cultural performance (Ndaita et al., 2015)

Scholars, Gutierrez-Gutierrez and Jiju, (2020), found out that there was no consensus on the positive effects of implementation of Six Sigma initiatives both short term and long terms delivery of results. There was little knowledge on the relationship between Continuous Improvement initiatives and organizational strategic long-term benefits, such as environmental adaptation or obtaining sustainable competitive advantages (Gutierrez-Gutierrez & Jiju, 2020). Sraun and Singh, (2017) posited that not all promised good results occurred as, some did have a negative impact on the organization performance. Additionally, Kumar et al., (2018) found out that firms that implemented QM system(s) did not outperform the firms which did not implement any QM

systems while some organizations had mixed results and difficult implementation. Albliwi et al., (2014) recognized that there were very few studies on the failure of the continuous improvement practices. Empirical studies by Raval et al., (2018) in the implementation of Six Sigma showed a high inclination of studies being carried out in the developed countries and for developing countries, the focus was within India and Malaysia.

1.3 **Research Objectives**

This section captured the study's main and specific objectives.

1.3.1 Main Objective

The main objective of this study was to assess the influence of Lean Six Sigma on operational performance of Juices manufacturing firms in Nairobi metropolitan area.

1.3.2 Specific Objectives

i. To establish the influence of coordination on operational performance of Juice manufacturing firms in Nairobi Metropolitan area
ii. To establish the influence of Total Productive Maintenance on operational performance of Juice manufacturing firms in Nairobi Metropolitan area.
iii. To establish the influence of employee involvement on operational performance of Juice manufacturing firms in Nairobi Metropolitan area.
iv. To establish the influence of statistical process control on operational performance of Juice manufacturing firms in Nairobi Metropolitan area.

1.3.3 Research questions

i. What is the influence of Coordination on operational performance of Juice manufacturing firms in Nairobi Metropolitan area?
ii. What is the influence of Total Productive maintenance on operational performance of Juice manufacturing firms in Nairobi Metropolitan area?
iii. What is the influence of employee involvement on operational performance of Juice manufacturing firms in Nairobi Metropolitan area?
iv. What is the influence of statistical process control on operational performance of Juice manufacturing firms in Nairobi Metropolitan area?

1.4 **Significance of the study**

The study was to be of importance to the following stakeholders, policy makers in organizations, the findings of this research was to provide valuable inputs into policy formulation process. Management of organization planning to implement Lean Six Sigma; the process of implementing any continuous improvement initiative is quite resource intensive and therefore tends to divert important resources both financial and human at implementation. Future researchers in the field Operations Management, Quality Improvement and Continuous improvement. This Research was to add to the available body of knowledge in the area of quality and process improvement in the field of Operations management.

Other stakeholders include, Continuous improvement consultants who need to justify the implementation benefits of lean six sigma. The results of the study were to provide evidence for consultants on the financial and strategic importance of implementation of the Continuous improvement programs. Strathmore University, could design a course or consultancy services in process/continuous improvement programs based on the outcome of the research.

The research shall therefore be published in the Strathmore research database for access with any institutions or individuals that might need to apply the results of the findings. The researcher as an Operations management practitioner shall use the findings in interviews, participation in debates as well as conference presentations. The above are just few ways in which the study shall be disseminated.

1.5 **Scope of the study**

This study aimed to examine the business performance impact of implementing process improvement in the Kenyan business environment with special focus in the business units operating within Nairobi metropolitan area. The study will focus on the Juice sectors in Nairobi Metropolitan area.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

This chapter reviewed literature on the influence of continuous improvement practices on operational performance. The chapter shall present the theoretical foundation of the study linking the two theories behind the study to the topic under the current study. Additionally, this chapter covers conceptual framework, research gap summary, operationalization of the study variables and chapter summary**.**

2.2.Theoretical Foundation

This study was anchored on two theories namely Dynamic capability theory, and Knowledge based theory.

2.2.1. Dynamic capability theory

David Teece, Gary Pisano, and Amy Shuen originated this theory. Dynamic capabilities refers to the ability of a firm to maintain and adapt the capabilities that are the basis of its competitive advantage (Besanko et al., 2016). According to Teece, Picaso and Shuen (1997), Dynamic capabilities theory looks at how organizations adapts and maintains the critical capabilities that are foundations of their competitive advantage so as to sustain over time the competitive advantage in the turbulent business environment. The stronger the dynamic capabilities of a firm, the easier if can quickly and effectively realign its resources to effectively meet the changing needs of the otherwise the organization stands the risk of being (Besanko et al., 2016)

"Dynamic capabilities are called "first-order" capabilities because they refer to intentionally changing the product, the production process, the scale, or the markets served by a firm (Winter, 2003)" (Miles, 2012). In other words, beside the usual capabilities that exists within the organizations like labor, machines et cetera, which are classified according to Winters (2003), as zero level capabilities, since everyone can acquire from the market, as a business operation, the strength of the organization is how well they have put together the interaction amongst the zero level capability to now form the organizational process or overall business capability that now becomes the competitive advantage hence the term first order capability hence dynamic capability. The organization can consistently change the level and type of interactions amongst the zero level

capabilities as the market demands and expectations change to sustain its competitive advantage. it is imperative to also observe other segregation of capabilities from an effectiveness and efficiency lenses as explained by Helfat et. Al (2007). They defined them as either technical or dynamic capabilities.

Technical capabilities are primarily concerned with efficiency, how well an activity is being performed whereas dynamic capability is concerned with whether the right activity is being performed and they refer to this latter capability as evolutionary which somewhat agrees with other definitions around it being adapted based on the changes in the turbulent markets. (Augier & Teece, 2009). The fact that dynamic capabilities are evolutionary, they tend to be path dependent rather than revolutionary, this therefore means that the organization has to build on what resources (zero order and first order) they already have to improve on its competitive positioning in as much as they are adapting to the changes in market condition (Besanko et al., 2016). Continuous improvement can therefore be looked at as an effective means to improve how the business has been deploying its zero order capabilities (technical capabilities) to meet her dynamic capability challenges. Argote (1999), could not have summarized it better in the following definition of dynamic capabilities, "Dynamic capabilities are learned and stable patterns of behavior through which a firm systematically generates and modifies its way of doing things, so that it can become more effective (Macher & Mowery, 2009; Zollo & Winter, 2002). For example, operating routines develop from the accumulation of experience through the repeated execution of similar tasks over time (Argote, 1999)." (Miles, 2012).

There are several criticisms for Dynamic capability theory just to mention a few, lack of consistent definition of the term dynamic capabilities. Second is that the theory does not explain the reasons for success or failure for organization, third is the difficulty in measuring the dynamic capabilities and lastly is that there are several ways of responding to a changing environment and dynamic capabilities is just one of them which circles back to the second reason above (Miles, 2012, pp. 91–93).

Dynamic capabilities theories thus form a very robust basis for assessing the value that any continuous improvement program brings into the sustainability of an organizations competitive advantage. The theory provides a foundation of which to base any changes that the organization implements to its process in the name of adapting to the changes in the business environment for

instance customers' demands for lower cost products, how does the organization configure her processes to get that to customers through the continuous improvement journey.

2.2.2 Knowledge based theory

This theory's origin is unclear but has been brought forth into the realm of academia by authors like Kathleen Conner and Prahalad (1996). The idea of the knowledge based theory of the firm "is that organizations exist in the way that they do because of their ability to manage knowledge more efficiently than is possible under other types of organizational structures. (Conner, 1991; Kogut & Zander, 1992, 1993, 1996; Conner & Prahalad, 1996; Foss, 1996; Grant, 1996a, 1996b; Madhok, 1996; Nahapiet & Ghoshal, 1998; Nickerson & Zenger, 2004)" (Miles, 2012)

Knowledge is one concept that has been confused under normal usage, the confusion between, data, information and knowledge is quite common so it is vital to define the term knowledge.

Davenport and Prusak (1998) define knowledge as follows - Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and, is applied in the mind of the knower. In organizations, it often becomes embedded in not only documents or repositories but also organization routines, processes, practices and norms. (Davenport & Prusak, 1998).

Based on the definition above, it follows therefore that Organizations are born, grow and survive by how well they acquire, keep, grow or develop and finally exploit knowledge. The existing and competitive advantage of an organization therefore relies heavily at how efficient and effective they create and manage knowledge better than their competitors (Miles, 2012). The key thrust of this theory is that to sustain the competitive advantage, then the organization must be constantly evolving as the business environment evolve meaning, it has to be a learning organization. "The competitive landscape for the organizations is continuously changing, forcing organizations to change, adapt, unlearn and learn to survive and grow. This constant process of change and renewal is imperative to sustain competitive advantage." (Bhaskar & Mishra, 2017).

As the world moves into a primarily knowledge based economy, the ability of institution to even identify a competitive advantage will be defined by how well the can manage knowledge and source for resources that can optimize usage of knowledge. "In response to performance threats

such as those driven by technological change and competition, firms must frequently assess and modify their resource capabilities. Barney (1991) defines a firm's resources as "all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by the firm to conceive of and implement strategies that improve its efficiency and effectiveness".

Managers have two major decision variables that they should adopt as the optimization model and these are process change (technology acquisition, procedural change) and workforce knowledge acquisition as proposed by Carrillo and Gaimon (2004). These two decision variables should then feed into developing solutions that reflects the dynamics of the markets as customers' problem to be solved (customer value proposition). How well a firm can address customer problem to be solved in a unique and sustainable way will thus be highly influenced by knowledge management. "It has been argued that the value a firm attach to knowledge (the content and structure of it and the means of collecting and controlling it) significantly affects its ability to innovate and solve problems (Leonard-Barton, 1992, 1995). For example, firms that value creativity, innovation, and knowledge sharing would be expected to come up with more innovative solutions than firms that do not hold such values" (Woiceshyn & Falkenberg, 2008).

The Dynamic capabilities theory, would not sufficiently cover the issue of continuous improvement and organization performance if the impact of knowledge based theory is not considered. Employee must first be rigorously trained (workforce knowledge acquisition) on tools of continuous improvement, once the employees are trained and embark on the continuous improvement journey they create new knowledge as they change and reconfigure processes (procedural change) to make them as effective as practically possible. The process improvement sustainability steps in Six Sigma for example occurs at Control and is executed by development of new operating procedures and training of staff in the new improved process thus creating new knowledge. This theory becomes the glue that binds continuous improvement and performance ensuring sustainability of the improvements (Chugani et al., 2017).

2.3 Empirical Review

The empirical review involved examination of relevant literature that relates to the components of lean six sigma and firms' operational performance.

2.3.1 Coordination and Operational Performance

Coordination involves the combination of pull systems working in tandem with the flow system, to ensure alignment between customer demand and production (Womack & Jones, 2003). Flow is the progressive achievement of tasks along the value stream so that a product proceeds from design to launch, order to delivery, and raw materials into the hands of the customer with no stoppages, scrap, or backflows whereas pull is a system of cascading production and delivery instructions from downstream to upstream activities in which nothing is produced by the upstream supplier until the downstream customer signals a need (Womack & Jones, 2003b). These two of the six components of lean manufacturing aligns the entire value chain to ensure that waste is eliminated as FLOW and PULL generate the continuous movement from raw material to customer; FLOW establishes the mechanisms, and PULL matches production with demand (Wincel & Kull, 2016a). As stated above since Pull Systems works in tandem with the flow system, the principle is to ensure good and services are only produced when a customer requests for it, these two components can be looked at together as controllers of process inventory demand (Womack & Jones, 2003)

Leonardo et al., (2017) studied the impact on pull systems in a Brazilian real manufacturing environment and the result showed a significant improvement in the operation performance of the facilities. Some of the key metrics that saw improvement were an expressive reduction in forecast errors, decrease in levels of inventory; improvement in delivery times; reduction in workforce in process; and especially increase in the level of customer service and improvement in the quality and reduction of product defects due to wrong assembly or change of components during production.

Afy-Shararah and Rich, (2018) studying the operations flow effectiveness (OFE) in British high value manufacturing and identified six design elements; holistically aligned operations strategy, a synchronizing communications system, a partner-like supply chain relationship, a controlled technical system, an empowered social system and an adaptive and evolving learning and improvement system that would drive effective operations flow thus driving operations performance of the organization. Onofrei and Fynes, (2019) state that the theory of SEF (swift even flow) holds that the performance for any production system rises with the speed by which materials flow through the process, and it falls with increases in the variability associated with the flow. They further expound that productivity is subject to the speed and variability of the process

flow, which basically means that productivity increases at the same rate as the speed materials flow through the process with as minimal inconsistency in the flow of goods throughout the firm.

2.3.2 Total Productive Maintenance (TPM) and Operational Performance

Total productive maintenance refers to a series of methods, originally pioneered by Nippondenso (a member of the Toyota group), to ensure that every machine in a production process is always able to perform its required tasks so that production is never interrupted, Womack and Jones, (2003b) while *Setup* time reduction contributes to the correct production mix and schedule by enabling smaller lot size manufacturing, increasing the responsiveness to changing customer needs (Wincel & Kull, 2016a). Quick setup times aid the FLOW and PULL interaction by maximizing productive uptime.

Bataineh et al., (2019) posited that the successful implementation of Total Productive Maintenance had a significant impact on organization performance in metrics such as production cost as well as improvement in overall equipment effectiveness (OEE) resulting in doubling of sales revenues and tripling in profits. In looking at the case of implementation of Total Productive Maintenance in a bottling facility in Kuwait, the organization after a nine-month period saw an improvement in 1) Efficiency of the Glass line was increased by 34 percent (from 55.1 to 74.18 percent). (2) Line availability was increased by 13 percent (from 68.6 to 77.51 percent). (3) Output quality was the least to change from 99.82 to 99.87 percent (0.05 percent). However, this corresponded to a significant 27.8 percent reduction in the percentage of parts defective from 1,800 to 1,300 ppm. (4) The OEE increased by 62.6 percent (from 35.27 to 57.42 percent), thus achieving the 50 percent target set by KSCC.

Vaz et al., (2021) in their study of the value of Total PM in Portuguese companies highest degree of implementation in the Portuguese industry, exceeding 70% of planned maintenance and education and training. The scholars found that Total Productive Maintenance practices produced a positive impact on the operational performance of the respondent companies. The positive operational performance was especially seen with productivity being the dimension with a higher degree of impact and costs the dimension that suffered a lesser impact from the implementation of Total Productive Maintenance practices. Singh and Singh, (2019) noted that in as much as over 300 firms in India have rolled out Total Productive Maintenance to counter the highly competitive manufacturing environment, round about 105 to 110 has seen satisfactory result with

implementation of Total Productive Maintenance and they further stated that very little information exist regarding Total Productive Maintenance initiatives toward harnessing core competencies in the organizations.

In as much as Total Productive Maintenance had an impact especially on improving the Overall Equipment Effectiveness (measured by Availability, Performance rate and quality rate) especially the availability arm of OEE, reduction in set up time hence quick changeovers which was a vital part of the production lead time of any product and so affect overall product cost (J. Singh et al., 2018). Shorter setup has the following impact to the production system; make feasible the production of smaller lots, reduce setup scrap, decrease setup labor cost, make production system flexible, reduce product lead time, enhance productivity and utilization of assets, and reduce manufacturing cost. In their study of the impact of reducing set up time by application of SMED (Single minute exchange of die), in XYZ firm. The firm experienced setup time of forging press reduced from 209.36 to 167.09 min, other activities related with setup also reduced from 30 to 12 min, increase in production from 2,430,000 to 2,500,956, indicating 70,956 pieces of crankshaft annually and increased profit worth around Rs 1,809,378. In as much as Setup time stands out as a component of lean, its objective with TPMs are to ensure machine is always in the production phase ready to manufacture the firms produce and this is evidenced by the performance indicators that firms observe (J. Singh et al., 2018)

2.3.3 Employee Involvement and Operational Performance

According to Cavallone and Palumbo, (2021) employee involvement describes organization members are encouraged and enabled to contribute to achieving organizational goals and continually improving the organization. This call for empowerment to shape decisions and engage in problem solving to improve the organizational viability. (Cavallone & Palumbo, 2021). The employee involvement calls for higher needs for training to equip them with better skills to address business challenges thus advancing organizational processes and practices (Cavallone & Palumbo, 2021). Jha et al., (2019) applying the Social Exchange Theory suggests that when employee and employer abide by certain “rules” for an extended duration, there evolves a relationship of mutual trust, loyalty, and commitment. when employees receive support in the form of economic and socioemotional resources, they feel indebted to respond with repayment to the organization. The

response and repayment from the employees come in the form of engagement in the organization and this in the long run tend to drive better organization performance. (Jha et al., 2019)

Bashar et al., (2022) posited that Employee engagement is positively correlated with organizational performance and provides a competitive advantage. The scholars further elaborated that employee involvement acts as a differentiator between lean and non-lean firms and the human resource management have a direct impact on organizational performance. “Some empirical studies have identified a significant relationship between HRM practices and firm’s performance in terms of firm’s productivity” (Bashar et al., 2022). The study by Bashar et al., (2022), in apparel manufacturers in Bangladesh showed a significant direct and indirect impact if employee involvement (people management) on organization performance. The scholars further referenced a research study conducted in the Spanish ceramic industry which confirmed that the level of lean implementation was linked with the level of employee engagement, employee training and employment security.

Lasrado and Kassem, (2020) in their study found out that implementing transformational leadership styles and effective involvement culture practices, managers can expect to realize improvements in organizational excellence, particularly in business results. This means that involving employee has a significant influence on improvement in organizational performance. The same findings were also reported by, Cavallone and Palumbo, (2021), though in their analysis they establish the impact of training and motivation on the employee involvement on commitment to organizational excellence. AlMazrouei, (2021), also established the relationship between empowering leadership and job performance and calls out the partial mediating role organizational commitment on the two variables meaning that employee involvement drivers organizational commitment which in effect drives the employee’s performance and by extension improves the overall organization performance. In the 232 employees in IT sector, researcher found there existed a significant association between employee voice and organizational effectiveness (Jha et al., 2019). Research on the impact of employee involvement and organizational performance can be seen even in service industry such as hospitals where researchers also established the relationship in studying 4702 employees in 33 UK hospitals. (Bosak et al., 2017)

2.3.4 Statistical Process Control and Operational Performance

This concept is usually attributed to Dr. Walter Shewhart a statistician at Bell Lab who recognized that industrial processes themselves could yield data, which, through the use of statistical methods, could signal that the process was in control or was being affected by special causes (causes beyond the natural, predictable variation) (Goetsch & Davis, 2016). Statistical process control (SPC) is a statistical method of separating variation resulting from special causes from variation resulting from natural causes in order to eliminate the special causes and to establish and maintain consistency in the process, enabling process improvement (Goetsch & Davis, 2016). Saleh et al., (2018) while investigating the impact of the hard TQM practices on operational performance found out that Statistical Process Control had statistically significant relationship with operational performance as one dimension. They posited that collecting information such as defect rate, break down, schedule compliance and plant productivity involves using control charts and statistical methods to detect and prevent problems from moving into the next operation step hence fool-proofing the operation so they may operate correctly. In other studies by Abdul Halim Lim et al., (2017) on SPC implementation in UK food manufacturing industry, the scholars found that non-SPC Food Manufacturing Companies, SPC companies were observed to have higher performance levels, which is especially significant in terms of waste reduction, product consistency, customer complaints, defect rates, productivity, and rework percentage.

2.4 Summary of Research gaps

As seen in the empirical review above, there were several studies linking implementation of Continuous improvement programs such as Six Sigma, and Lean manufacturing with improvement in organization performance, the results however were varied. As seen from the above-mentioned studies for instance Lamine and Lakhal, (2018) and Ndaita et al., (2015) organizations positively related the implementation of Continuous improvement with improvement in business performance results. In the literature review on the Investigation of the green impact of Lean, Six Sigma and Lean Six Sigma shows that Lean Six Sigma is also giving positive impact on the performance not just for operational performance but also environmental performance (Chugani et al., 2017)

On the other hand, some studies for example Sraun and Singh, (2017) and Kumar et al., (2018) showed that implementation of Continuous improvement programs such as Six Sigma had

negative impact on organizational performance, at best they saw no process improvement hence only loose resource spent on implementation while other saw quite a huge negative performance. These inconsistent results provided a rich area of study to fill the knowledge gap. Further review of empirical studies by Raval et al., (2018) and Schmidt et al. (2018) showed that Continuous improvement programs had been implemented across most of the continents however, most of these studies were focused on developed countries specifically North America and Europe. In developing Countries, the studies had been focused mainly in the India and Asian subcontinent. This therefore provided a fertile research opportunity to understand the influence of Continuous improvement practices on organizational performance in developing markets.

Table 2.1 Summary of research gaps

Source; Researcher (2022)

Author	**Title of Study**	**Findings**	**How current study fills gap**
Sanchez-Rebull et al (2020)	Six Sigma for improving cash flow deficit: A case study in the food can manufacturing industry.	The findings showed an improvement in working capital specifically Accounts payable process in a Can manufacturer, after Six sigma project implementation	The current study will focus on verifying the nature of relationship of the study variables in a developing world (African) context
Wickramasinghe and Wickramasinghe, (2016)	Effects of continuous improvement on shop-floor employees' job performance in Lean production: The role of Lean duration	The study findings showed Process improvement and improvements in job performance in Sri Lanka textile industry	The current study will focus on verifying the nature of relationship of the study variables in African context
(Ndaita et al., 2015)	The implementation of Lean Six Sigma concept at national bank of Kenya-operation division	The study notes improvements in business operations key performance indicators	The current study will focus on verifying the nature of relationship of the study variables in African context

Table 2.1 Summary of research gaps Continued

Author	Title of Study	Findings	How current study fills gap
Ochieng, (2021)	LEAN MANUFACTURING PRACTICES AND SUPPLY CHAIN PERFORMANCE OF SUGAR MANUFACTURING FIRMS IN WESTERN KENYA	The study showed an improvement in supply chain performance of sugar companies in Western Kenya	The current study will focus on verifying whether relationship is nature of relationship in a Nairobi Metropolitan area but also in Juice industry
Sraun and Singh, (2017)	Continuous improvement strategies across manufacturing SMEs of Northern India: An empirical investigation.	The findings showed both negative and positive impact of implementation of continuous improvement on organization performance	This research will expand on this and bring in the developing economies context focusing in Nairobi Metropolitan area
Kumar et al., (2018)	Impact of quality management systems on firm performance	The findings showed a mixed results in terms of the relationships between continuous improvement practices implementation and organization performance	The current study will focus on verifying the nature of relationship of the study variables in African context
Jiju et al., (2019)	A study into the reasons for process improvement project failures: Results from a pilot survey	The study noted a moderate failures in process improvement costing companies several millions of dollars	The current study will focus on verifying the nature of relationship of the study variables in African context

Table 2.1 Summary of research gaps Continued

Author	Title of Study	Findings	How current study fills gap
Gutierrez-Gutierrez and Jijju, (2020b)	Continuous improvement initiatives for dynamic capabilities development: A systematic literature review	The systematic literature review showed no performance benefit both short term and strategic	The current study will focus on verifying the nature of relationship of the study variables in African context
Albliwi et al., (2014)	Critical failure factors of Lean Six Sigma: A systematic literature review	The study noted the low level of satisfaction in the aerospace industry with Six Sigma	The current study will focus on verifying the nature of relationship of the study variables in African context
Schmidt et al. (2018)	Deploying Six Sigma practices to General Electric subsidiaries in a developing economy: An empirical analysis.	The study noted that most studies are conducted in the developed world and companies like GE are striving to move the continuous improvement initiatives to developing countries	Current study focuses on the African Continent specifically Nairobi Metropolitan area in Kenya
Raval et al., (2018).	Revealing research trends and themes in Lean Six Sigma: From 2000 to 2016.	The study noted the low level of studies conducted out of developed world, the study also notes that in the developing world, most studies are conducted in Asia	Current study focuses on the African Continent specifically Nairobi Metropolitan area in Kenya

2.5 Conceptual framework

The conceptual framework shows the relationship between the independent and dependent variables namely continuous improvement practices and organization performance as shown below.

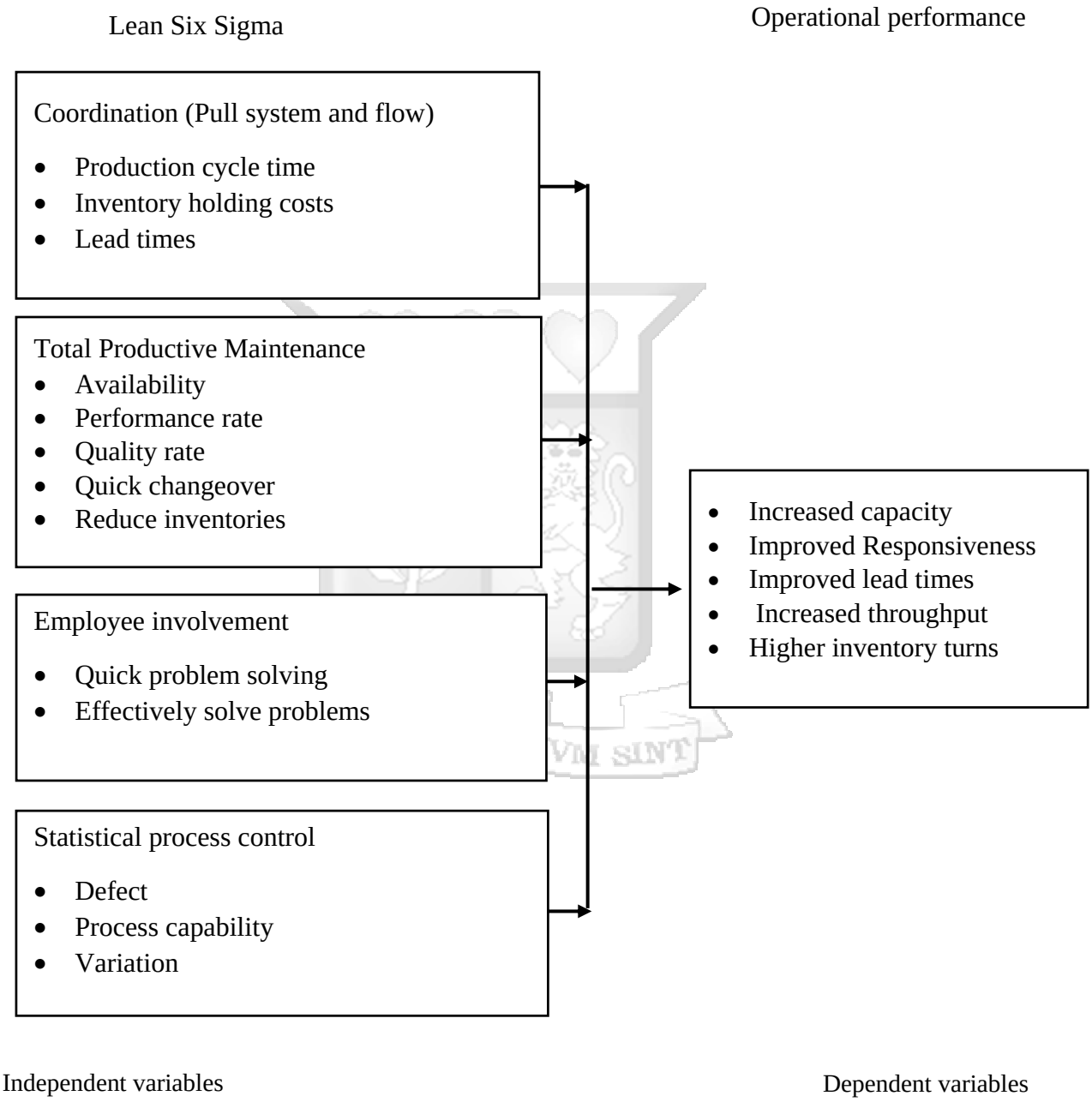


Figure 2.1: Conceptual framework

Source; Researcher (2022)

2.6 Operationalization of variables

The main objective of this study was to study the influence of continuous improvement practices specifically six sigma implementation on performance specifically productivity improvement. The table below shows the operationalization of the study variables.

Table: 2.2: Operationalization of study variables

General Variable	Variable	Indicator	Measurement	Supporting literature
Independent	Coordination	• Production cycle time • Inventory holding cost • Lead times	Likert scale	(Womack & Jones, 2003)
	Total Productive Maintenance	• Availability • Performance rate • Quality rate • Quick changeover • Reduce inventories	Likert scale	(Wincel & Kull, 2016)
	Employee involvement	• Quick problem solving • Effectively solve problems	Likert scale	(Wincel & Kull, 2016)
	Statistical process control	• Defect • Process capability • Variation	Likert scale	(Oakland & Oakland, 2019)
Dependent	Operational performance	• Increased capacity • Improved responsiveness • Improved lead times • Increased throughput • Higher inventory turns	Likert scale	(Sraun & Singh, 2017)

Source; Researcher (2022)

2.7 Chapter Summary

In this chapter, the study evaluated the relevant theoretical literature on the two theories that underpin this study that is dynamic capabilities theory, and knowledge theory as well as empirical literature relating to the study variables namely lean six sigma components and operational performance. A conceptual framework was also provided as well as the operationalization of the study variables.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1.Introduction

This chapter examines the research design that the study adopted, it also explained the population of the study and presented methods of how data will be collected, analyzed and presented to answer the research question while sticking to the ethical guidelines of any research process. Data quality relating to reliability and validity will also be covered in this section.

3.2 Research philosophy

Research philosophy refers to a system of beliefs and assumptions about the development of knowledge (Saunders et al., 2015a), it is therefore a basic set of beliefs that guide action (Creswell & Creswell, 2018). There are five research philosophies applicable to business and management research namely positivism, critical realism, Interpretivism, postmodernism and pragmatism. (Saunders et al., 2015a). This study employed positivism research philosophies. Positivism philosophy advocates for examining research phenomena in their original context and allows quantitative statistical analysis to be employed in making research inferences (Saunders et al., 2015a).

3.3 Research design

Research design is the framework by which a researcher gathers analyses and presents the research data. In other words, research design is the general plan that shall be employed to answer the research question (Saunders et al., 2015b). A research design can also be looked at as a blueprint or plan for the collection, measurement, and analysis of data, created to answer your research questions (Sekaran & Bougie, 2016).

This study employed a descriptive research design. Descriptive research is meant to gain an accurate profile of events, persons or situations (Saunders et al., 2015b). Descriptive studies are often designed to describe characteristics of objects, events, or situations. Descriptive research is either quantitative or qualitative in nature. (Sekaran & Bougie, 2016).

3.4 Population of the study

The population refers to the entire group of people, events, or things of interest that the researcher wishes to investigate. It is the group of people, events, or things of interest for which the researcher wants to make inferences (based on sample statistics) (Sekaran & Bougie, 2016). The population of the study consisted of 13 juice manufacturing firms as registered by Kenya Bureau of Standard within the Nairobi Metropolitan area (Nairobi, and surrounding counties of Kajiado, Kiambu, Machakos, and Murang'a) as at March 2022.

3.5 Sampling Design

Sampling can be divided into two broad categories random and non-random sampling and random sampling does allow for the data to be subjected to statistical analysis (Bajpai, 2011). There are several non-random sampling methods for selecting samples from population and these are Quota sampling, convenience sampling, judgement sampling, and snow ball sampling techniques are some of the commonly used nonrandom sampling techniques (Bajpai, 2011)

The study adopted a judgmental sampling technique. The reason why the study applied the judgmental sampling was to be able to choose the respondents who had knowledge that the study was seeking; the study was focused on the lean six sigma experts namely, Operations Manager/ Production Managers, Continuous improvement project coordinators, Procurement Managers, Quality Assurance Managers, Finance Managers and Continuous improvement project implementation Team members, who understand continuous improvement and therefore could assess the benefits of the lean six sigma on the operational performance of their firms. Since there are 13 organizations under study, (see appendix A2) and the anticipated six roles mentioned above, the total population will therefore be 78.

3.6 Data Collection Methods

In this study, research instrument for primary data collection was a semi structure questionnaire (Appendix B) with various sections. Sections A looked at general information relating to the respondent profile, section B looked at Lean Six Sigma and operational performance, Section C focused on Operational performance. The questionnaire was developed by distilling out from literature the fundamental driving measures of each of the study variables such as the core six sigma capability

and Lean Manufacturing measures such as OEE (Overall Equipment effectiveness)

The questionnaire was administered using well-trained research assistant, while complying to the strict social distancing rules which are being strictly enforced across most business. In line with the fact that most organizations are still very hesitant to allow in person visit to their facilities due to the various Covid protocols, the questionnaire was administered through sending google form link and then waited for response from the respondents.

The researcher before commencement of the data collection process, ensured that all the relevant approval from Strathmore University ethical, National Commission for Science, Technology and Innovation as well as a proper introductory letter from Strathmore University to facilitate the data collection.

3.7 Data Analysis and Presentation

The researcher ensured that data collected was edited, coded by assigning of a numerical or alphanumeric value to represent the responses before analysis is commenced on. Excel and R were the software used to analyze the data once the data was encoded into analyzable format and inputted into the analysis application. In analyzing quantitative data, the study used descriptive statistics, mainly measures of central tendency (mean), measures of dispersion (standard deviation), to gauge the level of agreement of the respondents. Regression analysis was also used to establish the relationship between the independent and dependent variables, mainly lean six sigma and operational performance. The independent variable was considered to be statistically significant whenever the p value was less than the critical p value at 0.05 level of significance meaning $p < 0.05$ and F statistic is higher that F critical at 0.05 level of significance, since we have 78 data points, in the case of single variable the degree of freedom was 1 for regression (numerator) and 76 for residual (denominator) the critical F shall be 0.68, the critical F value for all variables the degree of freedom was 5 for regression (numerator) and 73 for residual (denominator), was 0.53. This therefore means that if F is greater than 1 and p value is less than 0.05 then the results are statistically significant. According to statistical rule of thumb, the correlation will be considered strong if the R value is greater than 0.7

The study estimated the following regression model

$$\mathbf{OP=\alpha+ \beta_1X_1 + \beta_2 X_2 + \beta_3 X_3+ \beta_4X_4+ \varepsilon\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots Equation\ 3.1}$$

Where,

OP is the Operational Performance of Juice manufacturing firms in Nairobi Metropolitan area

$\mathbf{X_1}$ is the Coordination

$\mathbf{X_2}$ is the Total Productive Maintenance

$\mathbf{X_3}$ is the Employee Involvement

$\mathbf{X_4}$ is the Statistical Process Control

$\boldsymbol{\alpha}$ is the Y intercept

$\boldsymbol{\varepsilon}$ is the estimated error of the overall model

β_1- β_4 is coefficients of the independent variables

3.8 Research Quality

The research quality was ensured through assessing the reliability of the research instruments as well as validity of the instrument.

3.8.1 Reliability of the research instruments

Reliability refers to replication and consistency, this basically means the ability of another researcher undertaking the same research and getting the similar results. The key drive is to reduce if not to eliminate both researcher and participant errors and biases. (Saunders et al., 2015b). To improve on the reliability of the data collected and ensuring that the intended respondents are filling out the questionnaires, the researcher administered the questionnaire by use of well-trained Research assistants. To test for the reliability of the research instrument in the current study, Cronbach's Alpha coefficient was used and any value equal to or greater than 0.7 is considered as an acceptable indicator of internal consistency (Saunders et al., 2015a, p. 714). See below computations and summary tables.

Table 3.3: Reliability Tests Results

Case Processing Summary			
		N	%
Cases	Valid	12	100.0

	Excluded	0	.0
	Total	12	100.0

Source: Survey Data (2022)

Table 3.4: Reliability Tests Results: Reliability Statistics

Variable	N	Items	Statistics	Verdict
Coordination	12	7	0.70358	Accepted
Total Productive Maintenance	12	8	0.744874	Accepted
Employee Involvement	12	6	0.703297	Accepted
Statistical process control	12	6	0.785774	Accepted
Operational performance	12	6	0.819512	Accepted

Source: Survey Data (2022)

The Cronbach alpha was above 0.7 for each of the study variable and this qualifies based on the Cronbach alpha decision rule that the figure should be both positive and greater than 0.7 hence the instrument can be considered reliable.

3.8.2 Validity of the study

Validity refers to the appropriateness of the measures used, accuracy of the analysis of the results and generalizability of the findings. This meant that the instruments would assess the correct phenomenon that was appropriate and achieve the intended metrics. It therefore followed that the results could be generalized to other circumstances (Saunders et al., 2015b). Statistical methodology was applied to test the causal relationship.

To ensure validity of the study, a pilot study was undertaken. Piloting the research instrument helped with refining the questionnaire so respondents face no challenges while answering the questions and recording of the data besides enabling the researcher to assess the questions' validity and the likely reliability of the data that would be collected both for individual questions and, where appropriate, scales comprising a number of questions (Saunders et al., 2015b, p. 473). The researcher sent out an initial sample of the questionnaire to a selected group of 12 people in the population of interest as pilot and computed the Cronbach alpha as tabulated since all were above the 0.7 it signified validity against the research objectives.

3.9 Ethical Considerations

This study was undertaken with necessary precautions in place to ensure that all ethical issues are at the fore before, during and after the research. The critical ethical issues revolve especially around privacy protection for both data and personnel; the researcher sought informed consent of the respondent to participate and quit at any point during the research. Respondents who participated in the research were communicated to that the data collected was for academic purposes only and the data collected shall be used to this end only. The researcher ensured that confidentiality was observed by the fact that respondents remained anonymous and therefore did not require them to state their positions and expanded the range of the age groups. Lastly, the research did ensure that all collected survey data were safely stored and is not utilized for any other purposes and access is only for authorized personnel.

All necessary approvals were sought to carry out this study; National Commission for Science Technology and Innovation (NACOSTI), ethical approval from Strathmore university, and an introductory letter from Strathmore University which described the researcher's full name, the institution of study and the purpose of the survey.

VT OMNES VNVM SINT

CHAPTER FOUR

DATA ANALYSIS, FINDINGS AND INTERPRETATION

4.1.Introduction

This chapter entails the data analysis, the presentation and interpretation of the results. This study aimed to assess the influence of Lean Six Sigma on operational performance of juices manufacturing firms in Nairobi metropolitan area. The present data were collected by means of questionnaires and examined to answer the question communicated in the problem statement.

4.2 Response Rate

The study had a sample of 78 individuals within 13 firms in Nairobi Metropolitan area. A total of 78 questionnaires were completed using the Google doc translating to 100% response rate as depicted in Figure 4.1 below.

Table 4.1: Survey response rate

Particulars	**Frequency**	**Percentage**
Responded	78	100%
Did Not respond	0	0%
Total	**78**	**100%**

Source: Survey Data (2022)

The good response rate can be attributed to the conciseness of the questionnaire, use of technology (Google docs) which made it easier for the respondents to make the response.

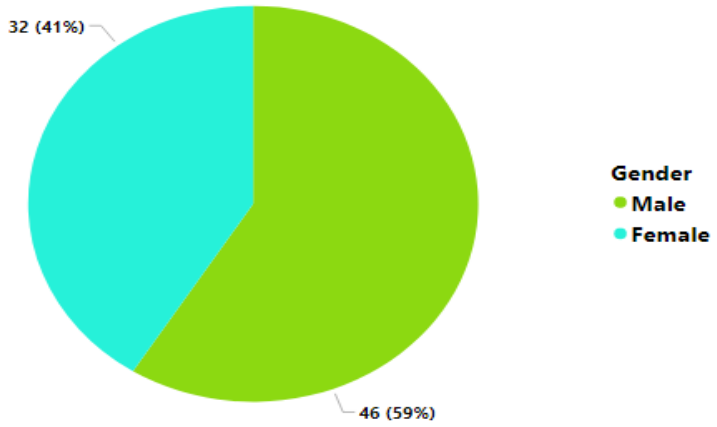
4.3 Demographic profile

The study required the respondents to provide information concerning their gender, their age-bracket, highest level of education attained by respondent, number of years in ranges the respondent has worked with organization at the time of survey, the department/function in which the respondent worked and their position/designation held by the respondent within the organization.

4.3.1 **Gender of the respondent**

The gender of the respondents was requested in order to allow to understand the gender distribution in the sampled firms' workforce and if that might have any dimension on results. Gender distribution is displayed below.

Figure 4.1: Gender of respondents



Source: Survey Data (2022)

Table 4.2: Gender of respondents

Gender of respondents		
Gender	***Frequency***	***Proportion***
Male	46	59%
Female	32	41%
Other	0	0%
Sample Size	**78**	

Source: Survey Data (2022)

The table 4.2 above as well as the summarizes the gender of the respondents with majority 59% male and 41% females, signifying a dominant male perspective on the findings meaning a bias from a gender perspective. Whether this affected the responses would be a good research question for further studies.

4.3.2 Age bracket of the respondents

The study showed that majority of the respondent were in the age bracket of 36 to 50 years a relatively mature workforce with relatively robust experience and this is corroborated by the fact that more than 50% have spent more than 3 years in the current organization.

Table 4.3: Age group of respondents

Age Group of respondents		
Age Group	***Frequency***	***Proportion***
18-35 years	16	21%
36-50 years	49	63%
Above 50 years	13	17%
Sample Size	**78**	

Source: Survey Data (2022)

The age group signifies that the respondents were mature enough to comprehend and respond fairly well to the study questions.

4.3.3 Education level of the respondent

The table below summarizes the academic attainment of the respondents with majority 45% having college diploma followed by 37% attaining undergraduate degrees. In as much as almost 17% had no tertiary education, the questionnaire was relatively understandable and with the help of the research assistance to clarify any question. The demographic academic level meant they could fairly comprehend the influence of lean six sigma on the operational performance.

Table 4.4: Education level of respondents

Education Level of respondents		
Education Level	***Frequency***	***Proportion***
College Diploma	35	45%
Undergraduate Degree	29	37%
No Diploma	13	17%
Post Graduate Degree	1	1%
Sample Size	**78**	

Source: Survey Data (2022)

4.3.4 Respondents tenure with the organization

As shown on table 4.5 below, more than 92% of the respondent have spent more than one year at the organization, and about 50% having spent above 3 years within he organizations, it implies that the respondents have good insights and knowledge to respond to the questionnaire on the influence of lean six sigma on the Operational performance.

Table 4.5: Duration respondent has worked with organization

Duration in the organization		
Duration	***Frequency***	***Proportion***
1-2 years	33	42%
3-5 years	23	29%
6-8 years	8	10%
Below 1 year	6	8%
8-10 years	5	6%
Over 10 years	3	4%
Sample Size	**78**	

Source: Survey Data (2022)

4.3.5 Department of the respondent

As can be seen in table 4.6 below, the spread in terms of department of the respondent is 74% Operations team (Logistics, Manufacturing and Procurement) and 13% executives with Finance at 8%. The respondents are in departments/functions which interact with Lean Six Sigma as well as in departments/functions that they can clearly and easily assess the influence of lean six sigma on the operational performance.

Table 4.6: Department of the respondent

Department of respondents		
Department	***Frequency***	***Proportion***
Logistics	25	32%
Manufacturing	22	28%
Procurement	11	14%
Executive Team	10	13%
Finance	6	8%
Other Departments	4	5%
Sample Size	**78**	

Source: Survey Data (2022)

4.4 Descriptive statistics

This section will provide descriptive statistics and regression analysis for each study variables.

4.4.1 Influence of Coordination on Operational Performance of Juice manufacturing firms in Nairobi Metropolitan area

The first objective of the study was to establish the influence of coordination on Operational performance of juice manufacturing firms in Nairobi Metropolitan area. This was done on a Likert scale of 1-5, where 5= strongly agree, 4= Agree, 3= Moderately Agreed, 2= Disagree and 1= Strongly Disagree. The frequencies and percentages of responses are as illustrated in Table 4.6 while the means and standard deviations are illustrated in table 4.7.

Table 4.7: Influence of coordination: Descriptive statistics:

Statement	**Mean**	**Std**
In our organization, we are constantly looking for ways to reduce our cycle time	4.321	0.8753
In our organization, we have a process of measuring throughput	4.449	0.6770
In our organization, variability in throughput is quickly addressed when it falls below a specified level	4.333	0.7673
Our organization processes strive to match demand with supply	4.359	0.7891
In our organization, all operators understand our constraint resource	4.295	0.7405

Our organization's Inventory holding cost is carefully managed to reduce working capital	4.167	0.8831
Our organization has implemented processes and procedures to reduce lead times	4.513	0.7332

Source: Survey Data (2022)

From the study findings, 38 out of 78 (49%) respondents agreed and a further 35 out of the 78 (45%) respondents strongly agreed to the statements that; Our organization processes strive to match demand with supply (mean=4.359, std = 0.7891). They also agreed that the organization's inventory holding cost is carefully managed to reduce working capital as shown by 49% of respondents with a mean of 4.167 and standard deviation of 0.8831. On the other hand, less than 5% of respondents disagreed that the organization has good coordination.

Table 4.8: Regression analysis for the relationship between coordination and operational performance

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.5774[a]	.3335	.3247	.4971
a. Predictors: (Constant), Coordination				

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	10.46	1	10.459	38.03	.000[b]
	Residual	20.90	76	0.275		
	Total	31.36	77			
a. Dependent Variable: Operational performance						
b. Predictors: (Constant), Coordination						

Coefficients[a]						
		Unstandardized Coefficients		**Standardized Coefficients**		
Model		**B**	**Std. Error**	**Beta**	**t**	**Sig.**
1	(Constant)	1.5696	.4971		3.157	.000
	Coordination	.7021	.1139	.5774	6.167	.000
a. Dependent Variable: Operational performance						

Source: Survey Data (2022)

From the regression analysis results in table 4.8, the analysis represents the simple correlation between operational performance (dependent variable) and coordination (independent variable). It indicates that there exists a high degree of correlation between coordination and operational

performance**.** The value of R square = 0.3335 indicates how much of the total variation in the operational performance (dependent variable) are explained by coordination (independent variable). In this case, 33.35% of the variation in the operational performance (dependent variable) are accounted for by coordination (independent variables). The value of adjusted R square = 0.3247 (32.47%) represents the total variation in operational performance (dependent variable) as explained coordination (independent variable) if population data were to be used. Furthermore, the study findings indicate that the regression model predicts the dependent variable (operational performance) significantly well given that p-value (sig) =0.000<0.05 significance level. This indicates that the regression model is a good fit for the data, that is, it significantly predicts the outcome variable (operational performance) as both F and p value surpass their critical values. The coefficients of the regression model provide the necessary information to predict operational performance from coordination. The R value of 0.5774 shows a moderate strength as it is below 0.7.

Operational performance = **1.5696** + **0.7021** Coordination

4.4.2 Influence of Total Productive Maintenance on Operational Performance of Juice manufacturing firms in Nairobi Metropolitan area.

The second objective of the study was to establish the influence of total productive maintenance on Operational performance of Juice manufacturing firms in Nairobi Metropolitan area. This was done on a Likert scale of 1-5, where 5= strongly agree, 4= Agree, 3= Moderately Agreed, 2= Disagree and 1= Strongly Disagree. The means and standard deviations (std) are as illustrated in table 4.9

Source: Survey Data (2022)

Statement	Mean	Std
Our organization has implemented effective maintenance practices to improve machines uptime	4.531	0.6188
In our organization, basic machine tightening and lubrication is done by the machine operator	4.372	0.8391
Our organization has implemented effective process control to improve process output	4.295	0.6666
Our organization has a process for identifying the root cause of process rejects/reworks	4.397	0.9022
Our organization has a process for addressing the root cause of process rejects/reworks	4.321	0.9327
Our organization continuously seeks ideas to reduce machine set-up time	4.474	0.8014
Our organization constantly seek ways to improve response time in all our operations	4.378	1.0622
Our organization has implemented practices that ensures right inventory levels for the demand	3.462	1.0222

Source: Survey Data (2022)

From the study findings, most of the respondents strongly agreed that total productive maintenance has influenced organization operation performance. The majority of the respondents, 47 out of 78 (60%) strongly agreed that; the organization continuously seeks ideas to reduce machine set-up time (mean = 4.378, std = 1.0622) as shown by study results in table 4.9. Study results indicate that 45 out of 78 (57%) strongly agreed that the organization has a process for identifying the root cause of process rejects/reworks (mean = 4.397, std = 0.9022). Most of the respondents also agreed that the organization has implemented effective process control to improve process output (40 out of 78, 51%) with a mean of 4.295 and a standard deviation of 0.6666.

Table 4.10: Relationship between total productive maintenance and Operational performance

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.6663[a]	.444	.4367	0.4660
a. Predictors: (Constant), Total productive maintenance				

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	13.92	1	13.924	60.69	.000[b]
	Residual	17.44	76	.229		
	Total	31.36	77			
a. Dependent Variable: Operational performance						
b. Predictors: (Constant), Total productive maintenance						

Coefficients[a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	1.0075	.4660		2.162	.000
	Total Productive Maintenance	.8516	.1093	.6663	7.790	.000
a. Dependent Variable: Operational performance						

Source: Survey Data (2022)

From the regression analysis results in table 4.10, the analysis represents the simple correlation between Operational performance (dependent variable) and total productive maintenance (independent variable). It indicates that there exists a high degree of correlation between total productive maintenance and Operational performance**.** The value of R square of 0.444 indicates how much of the total variation in the Operational performance (dependent variable) are explained by total productive maintenance (independent variable). In this case, 44.4% of the variation in the Operational performance (dependent variable) are accounted for by total productive maintenance (independent variables). The value of adjusted R square = 0.4367 (43.67%) represents the total

variation in Operational performance (dependent variable) as explained total productive maintenance (independent variable) if population data were to be used. The coefficients of the regression model provide the necessary information to predict Operational performance from total productive maintenance. Additionally, the results show that total productive maintenance is statistically significantly to the model given the p-values 0.000 less than 0.05 significance level and the F statistic is greater than the critical F statistic. The R value of 0.6663 shows a moderate strength as it is below 0.7.

Operational performance = **1.0075** + **0.8516** Total productive maintenance

4.4.3 Influence of Employee Involvement on Operational Performance of Juice manufacturing firm in Nairobi Metropolitan area.

The third objective of the study was to establish the influence of employee involvement on Operational performance of firms in Juice industry in Nairobi Metropolitan area. Metropolitan area. This was done on a Likert scale of 1-5, where 5= strongly agree, 4= Agree, 3= Moderately Agreed, 2= Disagree and 1= Strongly Disagree. The means and standard deviations (std) are as illustrated in table 4.11

Table 4.11: Influence of Employee Involvement: Descriptive statistics

Statement	Mean	Std
Our organization has delegated problem solving to the operators/people experiencing the problem	4.423	0.6936
In our organization, we track the number of process problems resolved by the operators	4.321	0.8753
In our organization shop floor employee have been trained on effective problem solving tools	4.449	0.6770
Our organization has implemented effective problem solving in its processes	4.333	0.7673
In our organization, we track repeat problems to test effectiveness of our problem solving	4.359	0.7891
In our organization, we have a clear problem escalation protocol	4.295	0.7405

Source: Survey Data (2022)

Study findings, indicate that most of the respondents strongly agreed that employee involvement has influenced organization operation performance. The majority of the respondents, 41 out of 78 (53%) strongly agreed that; the organization shop floor employee have been trained on effective

problem solving tools (mean = 4.449, std = 0.6770) as shown by study results in table 4.11. Study results indicated that 40 out of 78 (51%) strongly agreed that the organization has delegated problem solving to the operators/people experiencing the problem (mean = 4.423, std = 0.6936). Most of the respondents also agreed that the organization, we have a clear problem escalation protocol (38 out of 78, 49%) with a mean of 4.295 and a standard deviation of 0.7405.

Table 4.12: Relationship between employee involvement and Operational performance

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.6199[a]	.3843	.3762	.4737
a. Predictors: (Constant), Employee involvement				

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	12.05	1	12.050	47.43	.000[b]
	Residual	19.31	76	0.254		
	Total	31.36	77			
a. Dependent Variable: Operational performance						
b. Predictors: (Constant), Employee involvement						

Coefficients[a]						
		Unstandardized Coefficients		**Standardized Coefficients**		
Model		**B**	**Std. Error**	**Beta**	**t**	**Sig.**
1	(Constant)	1.3748	0.4737		2.902	.000
	Employee involvement	.7422	.10708	.6199	6.887	.000
a. Dependent Variable: Operational performance						

Source: Survey Data (2022)

Table 4.12 shows regression analysis results. The analysis represents the simple correlation between Operational performance (dependent variable) and employee involvement (independent variable). The value of R square = 0.3843 indicates how much of the total variation in the Operational performance (dependent variable) are explained by employee involvement (independent variable). In this case, 38.43% of the variation in the Operational performance (dependent variable) are accounted for by employee involvement (independent variables). The value of adjusted R square = 0.3762 (37.62%) represents the total variation in Operational performance (dependent variable) as explained employee involvement (independent variable) if

population data were to be used. The study findings also indicate that the regression model predicts the dependent variable (Operational performance) significantly well given that the p-values 0.000 less than 0.05 significance level and the F statistic is greater than the critical F statistic. This indicates that the regression model is a good fit for the data, that is, it significantly predicts the outcome variable (Operational performance). The coefficients of the regression model provide the necessary information to predict Operational performance from employee involvement. The R value of 0.6199 shows a moderate strength as it is below 0.7.

Operational performance = **1.3748** + **0.7422** Employee involvement

4.4.4 Influence of Statistical Process Control on Operational performance of Juice manufacturing firms in Nairobi Metropolitan area.

The fourth objective of the study was to establish the influence of statistical process control on Operational performance of firms in Juice industry in Nairobi Metropolitan area. This was done on a Likert scale of 1-5, where 5= strongly agree, 4= Agree, 3= Moderately Agreed, 2= Disagree and 1= Strongly Disagree. The means and standard deviations (std) are as illustrated in table 4.13

Table 4.13: Influence of statistical process control: Descriptive statistics

Statement	Mean	Std
Our organization has implemented processes to reduce/eliminate process defects/errors	4.513	0.6188
Our organization has implemented procedures to reduce/eliminate process defects/errors	4.372	0.8391
Our organization has clearly defined process capability metrics such as CP or CPK that the organization is pursuing	4.295	0.6666
Our organization has clearly defined actions to be undertaken whenever consistent process performance variation occurs	4.397	0.9022
Our organization has implemented a structured project approach to continuous process improvement	4.231	0.9327
Our organization ensures there is minimal variation in process output	4.474	0.8014

Source: Survey Data (2022)

Study findings indicate that most of the respondents strongly agreed that statistical process control has influenced organization operation performance. The majority of the respondents, 47 out of 78 (60%) strongly agreed that; organization ensures there is minimal variation in process output (mean = 4.474, std = 0.8014). In addition, 45 out of 78 (57%) strongly agreed that; the organization has clearly defined actions to be undertaken whenever consistent process performance variation occurs (mean = 4.372, std = 0.8391) as shown by study results in table 4.13. Study results indicate that 44 out of 78 (56%) strongly agreed that the organization has implemented processes to reduce/eliminate process defects/errors (mean = 4.513, std = 0.6188). Most of the respondents also agreed that the organization has clearly defined process capability metrics such as CP or CPK that the organization is pursuing (40 out of 78, 51%) with a mean of 4.295 and a standard deviation of 0.6666.

Table 4.14: Relationship between statistical process control on Operational performance

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.665[a]	.4434	.4361	.42659
a. Predictors: (Constant), Statistical process control				

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	13.90	1	13.90	60.54	.000[b]
	Residual	17.46	76	0.23		
	Total	31.36	77			
a. Dependent Variable: Operational performance						
b. Predictors: (Constant), Statistical process control						

Coefficients[a]						
		Unstandardized Coefficients		**Standardized Coefficients**		
Model		**B**	**Std. Error**	**Beta**	**t**	**Sig.**
1	(Constant)	1.32105	.42659		3.097	.000
	Statistical process control	.74903	.09627	.665	7.781	.000
a. Dependent Variable: Operational performance						

Source: Survey Data (2022)

Table 4.14 shows regression analysis results. The analysis represents the simple correlation between Operational performance (dependent variable) and statistical process control (independent variable). The value of R square = 0.4434 indicates how much of the total variation

in the Operational performance (dependent variable) are explained by statistical process control (independent variable). In this case, 44.34% of the variation in the Operational performance (dependent variable) are accounted for by statistical process control (independent variables). The value of adjusted R square = 0.4361 (43.61%) represents the total variation in Operational performance (dependent variable) as explained statistical process control (independent variable) if population data were to be used. The study findings also indicate that the regression model predicts the dependent variable (Operational performance) significantly well given that the p-values 0.000 less than 0.05 significance level and the F statistic is greater than the critical F statistic. This indicates that the regression model is a good fit for the data, that is, it significantly predicts the outcome variable (Operational performance). The coefficients of the regression model provide the necessary information to predict Operational performance from statistical process control. In addition, the results provide information showing whether employee involvement is statistically significantly to the model. The R value of 0.665 shows a moderate strength as it is below 0.7.

Operational performance = **1.32105** + **0.74903** Statistical process control

4.4.5 Operational Performance

Table 4.15: Operational performance: Descriptive statistics

Statement	**Mean**	**Std**
Our organization capacity has increased after implementation of continuous improvement initiatives	4.590	0.6730
Our organization responsiveness has improved as the root causes for deviations are identified and addressed	4.526	0.8787
Our organization lead times have improved as the root causes for variations are identified and addressed	4.756	0.5626
Our organization has put in place process management and control measures to ensure sustainability of continuous improvements	4.641	0.7891
Our organization throughput has increased	4.526	1.0029
Our organization sells inventory in a timely manner	4.641	0.8054

Source: Survey Data (2022)

Study findings show that 66% (54 out of 78) respondents strongly agreed that their organization responsiveness has improved as the root causes for deviations are identified and addressed with a mean of 4.526 and a standard deviation of 0.8787. The majority of the respondents, 61 out of 78 (74%) strongly agreed that; organization sells inventory in a timely manner (mean = 4.641, std = 0.8054). In addition, 63 out of 78 (81%) strongly agreed that; the organization lead times have improved as the root causes for deviations are identified and addressed (mean = 4.756, std = 0.5626) as shown by study results in table 4.15. Study results indicate that 59 out of 78 (76%) strongly agreed that the organization has put in place process management and control measures to ensure sustainability of continuous improvements (mean = 4.641, std = 0.7891). 69% of respondents also agreed that the organization responsiveness has improved as the root causes for deviations are identified and addressed.

Table 4.21: Overall relationship between Coordination (X_1), Total productive maintenance (X_2), Employee involvement (X_3), Statistical process control X4 and Operational performance (Y)

Model Summary[b]					
Model		**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**Durbin-Watson**
1		.402	.367	2.74065	1.862
a. Predictors: (Constant), Coordination, Total production maintenance, Employee involvement, Statistical process control					
b. Dependent Variable: Operational performance					

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	16.058	4	16.308	19.15	.000[b]
	Residual	15.303	73	0.210		
	Total	31.361	77			
a. Dependent Variable: Organization operational performance						
b. Predictors: (Constant), Coordination, Total production maintenance, Employee involvement, Statistical process control						

Model		**Unstandardized Coefficients**		**Standardized Coefficients**		
		B	**Std. Error**	**Beta**	**t**	**Sig.**
1	(Constant)	0.64867	.4739		1.369	.000
	Coordination	.59490	.3763	.5774	1.581	.000
	Total production maintenance	.59430	.2833	.6663	2.098	.000
	Employee involvement	.82388	.3631	.7422	2.269	.000

	Statistical process control	.09841	.2410	.665	0.408	.000
a. Dependent Variable: Operational performance						

Source: Survey Data (2022)

The value of R square = 0.512 indicates how much of the total variation in the Operational (dependent variable) are explained by X_1, X_2, X_3 and X_4 (independent variables). In this case, 51.2% of the variation in the Operational (dependent variable) are accounted for by X_1, X_2, X_3 and X_4 (independent variables). On the other hand, Adjusted R square = 0.4853 represents the total variation in Operational (dependent variable) as explained by X_1, X_2, X_3 and X_4 (independent variables) if population data were used. The study findings in table 4.21 indicate that the regression model predicts the dependent variable (Operational) significantly well given that p-value (sig) 0.000 < 0.05 significance level and F statistic is greater than critical F statistic. The R value of 0.402 shows is relatively weak as it is below 0.5. This indicates that the regression model is a good fit for the data, that is, it significantly predicts the outcome variable (Operational performances). These results provide the necessary information to predict how Operational performances are affected by coordination, total productive maintenance, employee involvement and statistical process control. Furthermore, the results also provide information showing whether X_1, X_2, X_3 and X_4 contribute statistically significantly to the model. Thus, the model can be precisely written as follows:

Operational performance = **0.64867** + **0.59490**Coordination + **0.5943** Total production maintenance + **0.82388** Employee involvement + **0.09841** Statistical process control

From this model, it can be seen that the independent variables (coordination, total production maintenance, employee involvement and statistical process control) contribute positively towards Operational performance. The independent variables contribution is statistically significantly given the p-values 0.000 less than 0.05 significance level and the F statistic is greater than the critical F statistic.

4.5 Conclusion

Based on the above data as analysed, the study shows that there is a statistically significant influence of Lean six sigma implementation on the Operational performance at 95% confidence

interval (5% level of significance) and the linkage can be summarized by the linear equation explaining the relationship of the independent variables (Coordination, Total production maintenance, Employee involvement and Statistical process control) and the dependent variable (Operational performance)

Operational performance = **0.64867 + 0.59490**Coordination **+ 0.5943** Total production maintenance **+ 0.82388** Employee involvement + **0.09841** Statistical process control**.**

4.6 Chapter summary

In this Chapter, the influence of coordination, total production maintenance, employee involvement statistical process control on Operational performance were assessed. The study findings from the simple linear regression models indicated that total productive maintenance is the most impactful on Operational performance. From the multiple regression the study established that coordination, total production maintenance, employee involvement and statistical process control significantly contribute to Operational performance.

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CHAPTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1. Introduction

This chapter presents the summary of study findings, conclusion, the organizational and policy recommendations and suggestions for future research in line with same study topic. The summary findings are presented as per study objectives. The main objective of this study was to assess the influence of Lean Six Sigma on Operational performance of Juices manufacturing firms in Nairobi metropolitan area. The study specific objectives study were to establish the influence of coordination on Operational performance of Juice manufacturing firms in Nairobi Metropolitan area, to establish the influence of Total Productive maintenance on Operational performance of Juice manufacturing in Juice industry in Nairobi Metropolitan area, to establish the influence of employee involvement on Operational performance of firms in Juice industry in Nairobi Metropolitan area and to establish the influence of statistical process control on Operational performance of firms in Juice industry in Nairobi Metropolitan area.

5.2 Summary of the findings

The study finds a statistically significant influence of the independent study variables namely Coordination, Total Productive Maintenance, Employee Involvement and Statistical process control on the dependent variable namely Operational performance. The findings support the idea that implementing Lean Six Sigma does have a significant impact on operational performance hence competitive advantage.

5.3 Discussion of the findings

This section is presentation of the discussion of the findings according to the specific objectives of the study.

5.3.1 **The influence of coordination on Operational performance of Juice manufacturing firms in Nairobi Metropolitan area**.

The study investigated the influence of coordination on operational performance of juice manufacturing firms in Nairobi metropolitan area and established that there is a positive and statistically significant relationship between the coordination and operational performance. These

finding are supported by Kumar et al., (2012) who established that proper coordination had the effect of lowering the bull whip effect due to demand variability in the supply chain hence ensures proper inventory levels are held at the right location and the right quantities. The bull whip effect is an indication of poor understanding and linkage between demand and supply, the development of capability to understand demand and match the capacity to fulfill the demand is an indicator of development of structures and systems within the organization to flex to her resources according to changes in the market dynamics hence dynamic capabilities, the learning process is the realms of knowledge based theory.

In the local Kenyan context, Ochieng, (2021) studying the lean manufacturing practices in the 11 sugar manufacturing companies in western Kenya provided similar conclusion that implementation of Lean practice had a positive and significant impact on supply chain performance. The results showed that the two lean manufacturing practices under study that is Just in Time and Total Quality Control jointly had a strong positive influence on supply chain performance of sugar manufacturing firms in Western Kenya. (Ochieng, 2021).

Similar findings are mentioned by Taylor, (1999) who, from analysis using computer simulation on the impact of the various work in progress drives (push, pull and hybrid push/pull) displays the significant benefits in financial terms of these drives. In as much as this study looked at the coordination as an aggregation of flow and pull, studies by Thoumy et al.,(2022) calls out that flow has the least impact on operational performance hence partially contradicts the finding of this study and would form a basis of a good study. In summary, this study identifies coordination as having a statistically significant influence on operational performance of the study firms.

5.3.2 The influence of Total Productive Maintenance on Operational Performance of Juice manufacturing in Nairobi Metropolitan area.

The study investigated the influence of Total productive maintenance on operational performance of juice manufacturing firms in Nairobi metropolitan area and established that there is a positive and statistically significant relationship between the Total productive maintenance and operational performance. This finding makes intuitive sense especially in manufacturing sector where machine uptime is a significant determinant of availability of good quality product. When machines reliability is improved, promise to customer can be kept, work schedules can easily be planned and inventory holding can easily be managed. The finding in this study is in line with studies by Modgil

and Sharma, (2016) who showed that Total productive maintenance have a significant impact on operational performance of firms especially if it is implemented with Total quality management, in their study of an Indian pharmaceutical industry, where they found that Total Productive Maintenance practices impacted cost, capacity utilization, defect reduction, delivery, quality as well as minimizing work in progress inventory and some other benefits is that it impact significantly R&D, product innovation and technology management. Similar findings are reported by Sahoo and Yadav, (2018) who also report that after implementation of Total productive Maintenance, the financial, manufacturing and workplace performance showed significant improvement and positive trends with each advanced level meaning that as the maturity of the implementation occurs, more benefits are seen since Total Productive Maintenance improved machine and shop-floor productivity with significant benefits of having a safer working environment. In the roll out of Total Productive Maintenance, there are pillars (Focused Improvement, Autonomous Maintenance, Quality Maintenance, Planned Maintenance, Early Equipment Maintenance, Training and Education, Safety, Health and Environment, and Office TPM) that drive the process of implementation. These pillars are premised on having a strong capability at most levels of the organization; take for instance, Autonomous Maintenance pillar requires the machine operator can do simple machine "fixing", things like tightening, lubrication and cleaning, this calls for proper management of and excellent transfer of technical knowledge to the machine operator. With the basic maintenance moved away from the technical team they can then focus on the other two pillars, Planned Maintenance and Early Equipment Maintenance. Planned Maintenance is basically where the operator now fixes the technical parts of the machine that are beyond the capability of the machine operator. Early Equipment Maintenance structured process focusing on reducing the complexity associated with the real-time operation and maintenance of equipment, this is achieved by the technicians now getting involved with design as well as manufacture of the equipment that meets the needs of the organization. These pillars, Autonomous Maintenance, Planned Maintenance and Early Equipment Maintenance are enabled by Training and Education pillar which is focused on development of capacity and capability and this drive both the knowledge acquisition (knowledge based theory) and overall positioning of the firm improves due to better machines, capable people and effective problem solving through the focused improvement pillar.

5.3.3 The influence of Employee Involvement on Operational Performance of Juice manufacturing firms in Nairobi Metropolitan area.

Hooi and Leong, (2017b), in their study calls out the fact that the in as much as Total Productive maintenance allows for an environment that fosters continuous improvement and operations performance improvement, it does not influence top management leadership and maintenance organization. Top management roles and commitment are critical in the early stage to determine the master plan and initiate the implementation of the whole program and after implementation, most of the activity are primarily driven by the shop-floor and this speaks to the importance of employee engagement in operations performance improvement.

This study acknowledges the statistically significant influence of employee involvement in operational performance of manufacturing firms. This study finding is in agreement with Modgil and Sharma, (2016), finding that it is crucial to increase the skills, knowledge, and technical training enables firms to achieve competitive advantage through improvement of the operational performance of the firm as aptly put by the two scholars. Hanna et al., (2000) in their study striving to link operational and environmental improvement through employee involvement further supports the finding in this study where their results show a positive relationship between employees involvement and operational and environmental performance. The study findings are further supported by Wickramasinghe and Wickramasinghe, (2016) who provided evidence of improvement in job performance in the Sri Lankan textile industry. The result of the study showed a statistically significant positive relationship of continuous improvement and job performance of the shop-floor employees based on seven performances metric relevant to this industry. In this study, the scholars, Wickramasinghe and Wickramasinghe, (2016) also picked the importance of duration of implementation of continuous improvement program on performance. The duration was driven by "Organizing manufacturing processes according to Lean production requirements demands behavior that facilitates continuous improvements in the way work is carried out" by extension their learning that had taken place therefore driving better performance than in those with lower duration.

There are other studies that point to a possibility of employee involvement negatively impacting the operations performance of the firms especially considering that lean is premised on knowledgeable workers who solves the problems in their work areas. Serenko, (2019), points to

the tendency of employees who either provide wrong knowledge (14% - 14.6%) or those who conceal knowledge (26.6% to 35.7%), this means therefore that in as much as involving employees has the impact of improving the operations performance, two possibilities arises from the knowledge sabotage, first is that wrong problems are solved when wrong information is provided or problems are not solved if hidden or partially solved as some crucial information is concealed hence operational performance is affected. Some of the above mentioned are concerned by knowledge sabotage, Analoui, (1995) however, speaks to the possibility of sabotage by employees that includes but not limited to destruction, inaction and wastage all of which go against the spirit and intent of continuous improvement. This controverting studies, point to the dangers of employee involvement in lean six sigma or any other continuous improvement program.

Employing workers into the organization creates the zero order capability, as employees learn the operations and develop operative capabilities (first order capabilities) they get better at what they do and therefore create the core capabilities (second order capabilities) which strengthen the organizational competitive positioning. As the employee get involved in solving more difficult emerging challenges, their skill sets improve and they can easily respond to changing market dynamics hence can be considered to have developed the third order capabilities which are what organizations require for renewal (dynamic capabilities). The progression from one level of capability from zero order through to the third orders can only be enabled by acquisition of knowledge hence underpinned by Knowledge based theory.

5.3.4 The influence of Statistical Process Control on Operational Performance of Juice manufacturing firms in Nairobi Metropolitan area

Lean is organized in such a manner that the elements support each other, due to the fact that employees are supposed to solve process problems in their areas of work, they should be provided with a toolkit that allows them to fully understand the nature and extent of the problem and this is exactly what statistical process control does. The use of SPC facilitates performance monitoring and enables meaningful problem-solving dialogues to be established (Morgan & Dewhurst, 2007).

This study finds a statistically significant influence of statistical process control on operational performance of the juice firms, this is also intuitively sensible as the quality of any improvement is dependent on the quality of root cause analysis and identification as well as quality of the solution. Properly implemented statistical quality control involving thorough training of shop-floor

employee and allowing for them to solve the problems means that effective problem solving is happening and this by extension builds the foundation for process improvement hence better operational performance of the firms.

Abdul Halim Lim et al., (2017b) in their study on the statistical process control implementation in the UK food industry found out that successful implementation of statistical process control is linked to process performance improvement as well as continuance of the performance improvement. Brimson, (2004) in his seminal paper stop cane dancing and integrate statistical process control in your process based management systems speaks good results masking problems structural wastes (crises and routine) which occurs because organizations do not solve the root cause of problems. He proposes that use of statistical process control can significantly improve operational performance through measuring hence reduction of variations, reduce process rejection, improvement of process capability. All these proposals are in line with the finding of this study that statistical process control influences operational performance of firms.

Statistical Process Control fundamentally helps with improvement in the understanding of process gaps and process variations. The effect of identifying problems before they do occur due to mapping of the process output, also does boost the quality of solution in the event that problems do arise. With the employees managing and improving the process though the use of SPC tools, better knowledge is acquired hence reinforcing the competitive positioning of the firm as the organization strives to manage the knowledge better that her competitors (knowledge based theory).

5.4 Conclusion

The study findings on the first objective is that coordination has a significant positive influence of operational performance of juice manufacturing firms in Nairobi metropolitan area. This is in line with other studies however, in some of the studies coordination Flow is shown as not significantly influencing the operational performance and this would be a good research opportunity for future researchers. It is however of note that organizations should seriously work through their coordination as it does set the tempo for other operations, and therefore influencing how well other elements are executed.

Study finding on the second objective points to the importance of keeping machines in a well maintained operating condition hence total productive maintenance. This second objective also does have a positive significant influence on operational performance. It is imperative to have proper maintenance systems and structures to ensure higher machine uptime and this include initiatives like single minute of dies to reduce changeover times. While employing Total productive maintenance, it is vital that the simple maintenance jobs are moved to the operator (autonomous maintenance) and the more technical jobs and modifications which falls under the following TPM Pillars (Focused Improvement, Preventative Maintenance, and Early Management of New Equipment) moved to the technical people. This therefore means that the quality of the teams' must be very high meaning high level of training and employee involvement. Employee involvement therefore also has a positive and significant influence on the operational performance of firms. This is primarily driven by the fact that they are constantly learning and solving problems as they emanate. The level of involvement is such that the operational problems like tightening, cleaning and lubrication of the machine as well as resolving any quality issue to improve the overall equipment effectiveness which is a function of machine availability, quality and speed (performance efficiency). To allow employees to resolve all the process challenges, they apply the statistical toolkit as provided by the statistical process control, which is the last variable of the study and as per the findings in the study, it does have a positive and significant influence on the operational performance of firms.

The Lean Six Sigma tool kit come with the four elements that are the independent study variables and since each in its own accord has a positive and significant influence on the operational performance of the firm, it is tempting and in practice firms do implement one or two of the elements independently but from the study, the organization is bound to obtain better operational performance if all the elements in entirety are implemented as they tend to complement and reinforce each other if implemented as a full bundle.

5.5 Recommendations of the study

The recommendation of the study has policy, managerial and theoretical implications.

5.5.1 Policy Implications

The study recommends that organizations implementing Lean Six Sigma should strive to roll out all the elements as they seem to have a reinforcing influence on each other in their effect on the

Operational performance. It is not uncommon to see some organizations only roll out one or two of the element of Lean Six sigma such as Total Productive Maintenance or Statistical process control but the study recommends a wholesome Lean Six sigma implementation. This study also does recommend that learning institutions especially teaching courses on operations management to develop programs covering lean six sigma and emphasize the practical benefits of rolling out the full lean six sigma in the operations if the implementing organization is to see significant benefits of the program.

5.5.2 Managerial Implications

Garratt, (2010) posits that policy is the highest level of organization thought and should therefore drive managerial behavior and thinking. As discussed on the policy implication above, once the policy is set that institution will pursue the Lean Six Sigma with all the elements, this study recommends that the structure of implementation to ensure success should always first start with proper change management to facilitate employee buying as employee engagement is a key success factor in the implementation. Fundamentally, the study findings corroborate the idea that for organization to remain competitive, they should continuously improve the skills of their employees, a key premise in the practical application of knowledge based theory, to enable them reconfigure the processes and systems to ensure that the organization is always attuned to changing customer needs, which is can basically be summarized as improving the dynamic capability of the organization. As highlighted in the literature review above, managers have two fundamental decision variables; process change and workforce knowledge acquisition. If organizations are to improve their competitive position through their operational performance improvements, then managers need to continuously seek means to embed Lean Six Sigma in their operations.

5.5.3 Theoretical Implications

Corley & Gioia, (2011) posit that theoretical contribution should be distilled into two dimensions originality (incremental or revelatory) and utility (scientific or practical). This means that, any research contribution to the theoretical base must bring in some incremental knowledge or reveal new knowledge from an originality perspective but must also have some utility or simply put value in either scientific sense or practical application. This study finding has shown that lean six sigma approach as a construct of improving Operational performance (practicality). The study notes that lean six sigma framework when adopted wholesome tend to drive the overall operational

performance of the organization (incremental as it adds to other studies that already exist). These findings are crucial contribution to operations management as well as the two theories underpinning this study that is, dynamic capability theory and knowledge based theory. The knowledge acquired in the process of implementation and the tools that have been learnt when applied builds up to new capability that hence drives the overall Operational performance. We see that as organization implement lean six sigma, several good things do occur. First, there is throughput increment which also causes capacity increment, secondly by applying the tools in the lean six sigma toolbox, we see opportunities for process problems and their root causes identification and resolution increase and this in essence support build sustainability in the improvements.

5.6 Limitations of the study

The study had certain limitations. Firstly, the study adopted a cross-sectional approach of research design and thus, the results are to be interpreted within such period. Its disadvantage is the lack of observance of results over a period of time to observe trends only possible with longitudinal studies.

Furthermore, this study focused on influence of lean six sigma on juice firms within the Nairobi metropolitan area, the operation and realities of other industries might be significantly different from the juice firms and also other geographical areas within the same juice industry might be have different operations are realities hence the findings might not be applicable in either of those circumstance; different industries or different geographies.

The main respondents for this study were staff involved with lean six sigma implementation and as such would naturally be familiar with the influence of lean six sigma on Operational Performance.

5.7 Suggestions for other studies

The study was a being cross sectional, lacked the benefit of duration on the impact of the independent study variables on the dependent variable, longitudinal studies may be considered in future and results over time. The study limited itself to juice manufacturing firms within the Nairobi metropolitan areas of Kenya, thus a further study could be considered in other counties and countries and compare the results. Additional study could consider involving other participants, especially those not involved with lean six sigma implementation but can fairly assess

its impact on the Operational performance., and finally, the respondents profile was particular male dominated and would be of interest to understand how this gender bias impacted the results hence an opportunity for additional research.

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APPENDICES

APPENDIX A1: LETTER OF INTRODUCTION

To the respondent

Dear Sir/Madam,

RE: REQUEST TO COLLECT DATA

Greetings,

My name is Nicholas Oyottoh, a student at Strathmore University and currently pursuing a Master's degree in Business Administration.

I am undertaking a study on the Influence of Lean Six Sigma on organizational performance as a partial fulfilment of the requirement for the Master's degree. For this reason, I kindly request you to provide the necessary information that is required for the purposes of solving the research problem for this study. Your assistance and cooperation in filling out the questionnaire attached will be highly appreciated. All the data received will be regarded with utmost confidentiality and will be used for the purpose of this study only.

Kind regards,

Nicholas O. Oyottoh

APPENDIX A2: FIRMS IN THE STUDY

Company Name	Physical address	Town Name	CATEGORY
DEL MONTE KENYA LTD	OLOITIPTIP ROAD-THIKA	THIKA	LARGE
PREMIER FOODS LIMITED	BABA DOGO RD, RUARAKA	NAIROBI	LARGE
AGRI PRO-PAK LTD	MUGUGA	NAIROBI	LARGE
HERBAL GARDEN LIMITED	MASHIARA PARK, LORESHO	NAIROBI	LARGE
PILGRIM HOLDINGS LIMITED	JUJA	RUIRU	LARGE
LAKI LAKI LIMITED	RED HILL (MO-LITO FARM)	NAIROBI	SMALL
BRAVA FOOD INDUSTRIES LTD	ATHI RIVER OFF MOMBASA ROAD	NAIROBI	LARGE
BIDCORO AFRICA LTD	OFF KIAMBU ROAD - BIDCO INDUSTRIAL PARK	THIKA	LARGE
KEVIAN KENYA LTD - THIKA TOWN	THIKA TOWN	THIKA	LARGE
BERRY SPHERE LTD	OFF EASTERN BYPASS	NAIROBI	SMALL
CORE FOODS LIMITED	OLD MSA ROAD, MLOLONGO	MLOLONGO	MEDIUM
SYEDNA M. BURHANUDDIN LTD	KIAMBU ROAD	KIAMBU	MEDIUM
MUNTAQIM GENERAL TRADING LIMITED	ATHI RIVER	NAIROBI	MEDIUM

Source; Kenya Bureau of Standard database (2022)

APPENDIX A3: PARTICIPANT INFORMATION AND CONSENT FORM

SECTION 1: INFORMATION SHEET

Investigator: Nicholas Oyottoh

Institutional Affiliation: Strathmore Business School (SBS)

Research Topic: THE INFLUENCE OF LEAN SIX SIGMA ON ORGANIZATIONAL PERFORMANCE IN MANUFACTURING FIRM IN NAIROBI METROPOLITAN AREA

Initials of Participant: ..... Gender: .....

Place of Work: .....

Contact Address: .....

Interview Location: ……

SECTION 2: INFORMATION SHEET–THE STUDY

2.1: Why is this study being carried out?

To assess the influence of Lean Six Sigma on Operational performance of Juices manufacturing firms in Nairobi metropolitan area.

2.2: Do I have to take part?

No. Taking part in this study is entirely optional and the decision rests only with you. If you decide to take part, you will be asked to complete a questionnaire to get information on data literacy levels of managers and how they influence their decision making in the Kenyan textile industry. If you are not able to answer all the questions successfully the first time, you may be asked to sit through another informational session after which you may be asked to answer the questions a second time. You are free to decline to take part in the study from this study at any time without giving any reasons.

2.3: Who is eligible to take part in this study?

Primarily managers from Juice manufacturing firms in Nairobi metropolitan area. Specifically, managers of Kenya Bureaus of standards registered juice manufacturing companies located within Nairobi Metropolitan area.

2.4: Who is not eligible to take part in this study?

Anyone below the age of 18 years

2.5: What will be taking part in this study involve for me?

You will be approached by the researcher and requested to take part in the study. If you are satisfied that you fully understand the goals behind this study, you will be asked to sign the informed consent form (this form) and then taken through a questionnaire to complete.

2.6: Are there any risks or dangers in taking part in this study?

There are no risks in taking part in this study. All the information you provide will be treated as confidential and will not be used in any way without your express permission.

2.7: Are there any benefits of taking part in this study?

The information will be used to improve research in the area of continuous improvement and organizational performance and inform policy makers, academicians and other stakeholders in the area of study. Therefore, as a manager in the Juice industry in Kenya, your input in this study will have benefits for the common cause of improving and enhancing lean six sigma application.

2.8: What will happen to me if I refuse to take part in this study?

Participation in this study is entirely voluntary. Even if you decide to take part at first but later change your mind, you are free to withdraw at any time without explanation.

2.9: Who will have access to my information during this research?

All research records will be stored in securely locked cabinets. That information may be transcribed into our database, but this will be sufficiently encrypted, and password protected. Only the people who are closely concerned with this study will have access to your information. All your information will be kept confidential.

2.10: Who can I contact in case I have further questions?

You can contact me, Nicholas O. Oyottoh, at Strathmore Business School, or by e-mail Nicholas.oyottoh@stathmore.edu, or by phone. 0728518379. You can also contact my supervisor, Dr. Tabitha Waithaka at the Strathmore Business School, Nairobi or on phone number 0722793036, or by e-mail twaithaka@strathmore.edu. Or Strathmore University Institutional Scientific and Ethical Review Committee(SU-ISERC) Secretariat on phone numbers +254 (0) 703-034000/200/300 OR +254 (0) 730-734000/200/300.

I, _____, have had the study explained to me. I have understood all that I have read and have had explained to me and had my questions answered satisfactorily. I understand that I can change my mind at any stage.

Please tick the boxes that apply to you.

Participation in the research study

- ☐ I AGREE to take part in this research
- ☐ I DO NOT AGREE to take part in this research

Storage of information on the completed questionnaire

- ☐ I AGREE to have my completed questionnaire stored for future data analysis
- ☐ I DO NOT AGREE to have my completed questionnaire stored for future data analysis

Participant's Signature:

Date: _____/_____/_____

DD / MM / YEAR

Participant's Name: _____ Time: _____ /_____

_____

(Please print name) HR / MN

I ……. certify that I have followed the SOP for this study and have explained the study information to the study participant named above, and that s/he has understood the nature and the purpose of the study and consents to the participation in the study. S/he has been given opportunity to ask questions which have been answered satisfactorily.

Investigator's Signature:

Date: _____/_____/_____

_____

APPENDIX B: QUESTIONNAIRE.

The below questionnaire is intended to gather data for the study to answer the research questions. There are 3 sections in this questionnaire. It is my sincere appeal to respondents to respond to all the questions honestly and adequately. Choose by ticking (√) in the box next to answer of your choice.

Part A: General Information

1. What is your gender?

☐ Male ☐ Female ☐ Others

If others, kindly state gender ……..…

2. What is your age group?

☐ 18-35 ☐ Above 50

☐ 36- 50

3. What is your highest level of education attained?

☐ Primary School ☐ Undergraduate Degree

☐ Secondary School ☐ Post Graduate Degree

☐ College Diploma ☐ Others

If others, kindly state the level ……..…

4. How long have you been in the organization?

☐ Below 1 year ☐ 6 - 8 years

☐ 1 - 2 years ☐ 8 - 10 years

☐ 3 - 5 years ☐ Over 10 years

5. Which department/function do you work?

☐ Manufacturing ☐ Procurement

☐ Logistics ☐ Finance

 Executive Team Other department/function

If other department/function, kindly state the department….....

PART B: Lean Six Sigma

i. Lean Six Sigma

This sections relates to Lean Six Sigma with specific focus on coordination, Total Productive Maintenance, Employee Involvement and Statistical Process Control.

Please indicate with **(√)** the extent you agree with the following statements concerning Lean Manufacturing.

Where: (5 - Strongly agree, 4 - Agree, 3 - Moderately Agreed, 2 - Disagree and 1 - Strongly Disagree)

Statement					
Coordination	**1**	**2**	**3**	**4**	**5**
In our organization, we are constantly looking for ways to reduce our cycle time					
In our organization, we have a process of measuring throughput					
In our organization, variability in throughput is quickly addressed when it falls below a specified level					
Our organization processes strive to match demand with supply					
In our organization, all operators understand our constraint resource					
Our organization's Inventory holding cost is carefully managed to reduce working capital					
Our organization has implemented processes and procedures to reduce lead times					

Total Productive Maintenance	1	2	3	4	5
Our organization has implemented effective maintenance practices to improve machines uptime					
In our organization, basic machine tightening and lubrication is done by the machine operator					
Our organization has implemented effective process control to improve process output					
Our organization has a process for identifying the root cause of process rejects/reworks					
Our organization has a process for addressing the root cause of process rejects/reworks					
Our organization continuously seeks ideas to reduce machine set-up time					
Our organization constantly seek ways to improve response time in all our operations					
Our organization has implemented practices that ensures right inventory levels for the demand					

Employee involvement	1	2	3	4	5
Our organization has delegated problem solving to the operators/people experiencing the problem					
In our organization, we track the number of process problems resolved by the operators					
In our organization shop floor employee have been trained on effective problem solving tools					
Our organization has implemented effective problem solving in its processes					
In our organization, we track repeat problems to test effectiveness of our problem solving					
In our organization, we have a clear problem escalation protocol					

VT OMNES VNVM SINT

Statistical process control	1	2	3	4	5
Our organization has implemented processes to reduce/eliminate process defects/errors					
Our organization has implemented procedures to reduce/eliminate process defects/errors					
Our organization has clearly defined process capability metrics such as CP or CPK that the organization is pursuing					
Our organization has clearly defined actions to be undertaken whenever consistent process performance variation occurs					
Our organization has implemented a structured project approach to continuous process improvement					
Our organization ensures there is minimal variation in process output					

PART C: Organizational performance

Please indicate with **(√)** the extent you agree with the following statements concerning organizational performance

Where: (5 - Strongly agree, 4 - Agree, 3 - Moderately Agreed, 2 - Disagree and 1 - Strongly Disagree)

Statement					
Operational performance	**1**	**2**	**3**	**4**	**5**
Our organization capacity has increased after implementation of continuous improvement initiatives					
Our organization responsiveness has improved as the root causes for deviations are identified and addressed					
Our organization lead times have improved as the root causes for variations are identified and addressed					
Our organization has put in place process management and control measures to ensure sustainability of continuous improvements					
Our organization throughput has increased					
Our organization sells inventory in a timely manner					

APPENDIX C: STRATHMORE UNIVERSITY RESEARCH AUTHORIZATION LETTER

Ole Sangale Rd, Madaraka Estate,
P.O Box 59857 00200, Nairobi, Kenya.
Cell: +254 703 414/6/7, Twitter: @SBSKenya
Email: info@sbs.ac.ke or visit www.sbs.strathmore.edu

Strathmore UNIVERSITY
BUSINESS SCHOOL

Tuesday, July 12, 2022

To whom it may concern.

RE: FACILITATION OF RESEARCH – NICHOLAS OCHIENG OYOTTOH

This is to introduce Nicholas Ochieng Oyottoh who is an MBA student at Strathmore University Business School, admission number MBA/125321/20. As part of our MBA Program, Nicholas is expected to do applied research and to undertake a project. This is in partial fulfilment of the requirements of the MBA course. To this effect, he would like to request for appropriate data from your organization.

Nicholas is undertaking a research paper on "***The Influence of Lean Six Sigma On Organizational Performance of Juice Manufacturing Firms in Nairobi Metropolitan Area***." The information obtained from your organization shall be treated confidentially and shall be used for academic purposes only.

Our MBA seeks to establish links with industry, and one of these ways is by directing our research to areas that would be of direct use to industry. We would be glad to share the findings with you after the research, and we trust that you will find them of great interest and of practical value to your organization.

We appreciate your support, and we shall be willing to provide any further information if required.

Yours sincerely,

Caroline Tiara,
Manager – MBA Programs.

Strathmore Business School is a Proud member of:
Association of African Business Schools AABS
EFMD
AACSB

APPENDIX D: STRATHMORE UNIVERSITY RESEARCH ETHICAL APPROVAL LETTER

Strathmore UNIVERSITY

25th July 2022

Mr Oyottoh Nicholas
nicholas.oyottoh@strathmore.edu

Dear Mr Oyottoh,

RE: The Influence of Lean Six Sigma on Organizational Performance of Juice Manufacturing Firms in Nairobi Metropolitan Area.

This is to inform you that SU-ISERC has reviewed and **approved** your above SU- **master's** research proposal. Your application reference number is **SU-ISERC1437/22.** The approval period is **25th July 2022 to 24th July 2023.**

This approval is subject to compliance with the following requirements:

i. Only approved documents including (informed consents, study instruments, MTA) will be used
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by SU-ISERC.
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to SU-ISERC within 48 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to SU-ISERC within 48 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions.
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vii. Submission of an executive summary report within 90 days upon completion of the study to SU-ISERC.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology, and Innovation (NACOSTI) https://research-portal.nacosti.go.ke/ and obtain other clearances needed.

Yours sincerely,

for: **Dr Ben Ngoye,**
Secretary; SU-ISERC

Cc: Prof Fred Were,
Chairperson; SU-ISERC

STRATHMORE UNIVERSITY INSTITUTIONAL SCIENTIFIC AND ETHICAL REVIEW COMMITTEE
(SU-ISERC)
25 Jul 2022
Email:ethicsreview@strathmore.edu
P.O BOX 59857-00200
NAIROBI-KENYA

APPENDIX E: NACOSTI RESEARCH AUTHORIZATION LETTER

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **428366**

Date of Issue: **24/July/2022**

RESEARCH LICENSE

This is to Certify that Mr.. Nicholas Ochieng Oyottoh of Strathmore University, has been licensed to conduct research in Kiambu, Machakos, Nairobi on the topic: THE INFLUENCE OF LEAN SIX SIGMA ON ORGANIZATIONAL PERFORMANCE OF JUICE MANUFACTURING FIRMS IN NAIROBI METROPOLITAN AREA for the period ending : 24/July/2023.

License No: **NACOSTI/P/22/19102**

428366

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.