# PROCESS IMPROVEMENT TOOLS, TECHNIQUES AND OPERATIONAL PERFORMANCE OF MANUFACTURING FIRMS IN KENYA

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## DECLARATION

This research project is my original work and has not been presented for a degree at any other University.

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To my wife Serah Mbithe, my sons Mark Muuo and Maxwell Mwendwa and my daughter Marvel Ndanu, you have strengthened and inspired me throughout this research project and the entire course.

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# LIST OF ABBREVIATIONS AND ACRONYMS

**AGOA-** African Growth and Opportunity Act

**BPR** - Business Process Re-Engineering

**ERIP-** European Regions for Innovative Productivity

**FMEA-** Failure mode and effect analysis

**IPC** - Innovative Productivity Centre

**ISO** - International Organization for Standardization

**KAM**- Kenya Association of Manufacturers

**KBV**- Knowledge Based View

**KEBS**- Kenya Bureau of Standards

**NASA**- National Aeronautics and Space Administration

**NEPA**- Northeast Productivity Alliance

**PDCA-** Plan, Do, Check, Act

**PDSA-** Plan, Do, Study, Act

**PITT** - Process Improvement Tools and Techniques

**QC** - Quality Control

**QFD** - Quality Function Deployment

**QMS** - Quality Management System

**ROI** – Return on Investment

**RPN** – Risk Priority Number

**SME** - Small and Medium Enterprises

**SPC-** Statistical Process Control

**TPM** - Total Productive Maintenance

**TQM** - Total Quality Management

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## ABSTRACT

Process improvement is a necessity for many organizations both locally and globally as they commit to be effective and efficient for survival in the competitive markets. Company strategy, Process Improvement Tools and Techniques (PITT) and other operational aspects should be integrated to attain a sustainable competitive advantage. Process improvement tool is an instrument with a clear task, mostly restricted in purpose and used independently while a technique has broader utilization, requiring more energy, knowledge, skill, understanding and training to be implemented successfully. The general objective of the study was determining how adoption of PITT affected the operational performance of manufacturing and exporting firms in Kenya with specific objectives of identifying the adoption levels of the techniques and tools, the moderating factors between the techniques, tools and operational performance as well as their relationships. Adoption of process improvement tools and techniques was anchored in the knowledge based view theory and Michael Porters theory of competitive advantage. The scope of the study was 965 companies which were registered in the Kenya Association of Manufacturers and Exporters directory for the year 2017/2018. Divided into 14 categories, primary data was collected through the use of Google form questionnaires from a sample size of 60 respondents in the production departments. Submitted questionnaires were then exported to SPSS version 23 for descriptive analysis and SmartPLS Version 3.2.4 for factor analysis. Results indicated that most companies were locally registered and sold in the local market and a few exported their products. More youths were in the production divisions matched by their less than ten years work experience. All the process improvement tools were statistically significant while process improvement techniques like benchmarking, business process re-engineering, kaizen, brainstorming and total productive maintenance were statistically insignificant with t-test values of 1.465, 0.334, 0.498, and 0.48 and 0.676 respectively. Training on process improvement tools and techniques was a key moderating factor to achieve operational performance with t-statistic value of 4.867 and a correlation coefficient of 0.783. Measures of operational performance that were directly affected by adoption and implementation of PITTs included quality, cost and speed of delivery leaving only the aspect of flexibility. The study recommended that companies should be aware of the process improvement tools and techniques and adopt the ones that fit them most if they are to achieve operational performance, especially quality in their operations. A suggestion for further study was determining if startup companies are aware of process improvement tools and techniques and to what extent they utilize them as well as study the topic on the service industry.

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background of the study

Process improvement is a necessity for many organizations both locally and globally as they commit to be effective and efficient for survival in the competitive markets. Company strategy, Process Improvement Tools and Techniques (PITT) and other operational aspects should be integrated to attain a sustainable competitive advantage (Benner & Tushman, 2002). The aim of improving any process is to lower costs, decrease wastes and rework as well as eliminate bottlenecks. Process improvement can therefore be defined as an orderly approach to closing gaps in performance of a system by identifying and getting rid of causes of low quality products and services, process disparity, streamlining and reduction of cycle time, and non-value-adding activities (Oakland, 1993). Traditionally and over the years, quality, time, cost and flexibility, have been used as measurements for assessing operational performance of all firm's activities (Hayes, Wheelwright & Clark, 1988).

Adoption of process improvement is anchored in the knowledge based view theory and Michael Porters theory of competitive advantage. Michael Porter argues that the competitiveness of a country is a function of four major determinants namely: factor conditions; demand conditions; related and supporting industries; and, firm strategy, structure, and rivalry (Porter, 1990). The KBV explains how firms can use knowledge to differentiate themselves from competitors and gain sustainable competitive advantage (Grant, 1996). A firms' lack of knowledge, or failure to utilize both tacit and explicit knowledge may hinder improvement of processes. Therefore, knowledge of process improvement tools and how to utilize them is key in successful implementation. Manufacturing firms in Kenya have realized that effectiveness and efficiency can be achieved or increased by adopting PITT which in turn leads to competitive advantage and meeting customer needs (Kenya Association of Manufacturers (KAM), 2017). However, globalization and technological changes have raised the levels of rivalry in manufacturing industry where local firms must compete multinationals who present similar, and sometimes better quality products (Were, 2016). Thus adoption of PITT that enhance operational performance is a must for manufacturing firms at all levels for their survival.

### 1.1.1 Process Improvement Tools and Techniques

Process improvement is the reorganization of flow of work, vital tasks and activities so as to optimize operations, create efficiency and improve the quality of products (Sirma, 2005). The improvement process comprises various stages which include identifying a given process which needs improvement, analyzing the existing process and lastly defining and designing ways of streamlining it for optimization (Hammer & Champy, 1993). McQuater et al. (1995) define a tool as an instrument with a clear task, mostly restricted in purpose and used independently. They include flowcharts, cause and effect diagrams, relationship diagrams, pareto analysis, histograms and control charts. The authors also define a technique as having broader utilization, and require more energy, knowledge, skill, understanding and training to be implemented successfully. One technique can be a combination of tools, for instance SPC technique can be said to comprise graphs, charts and histograms. Other examples of techniques according to this author include Failure Mode and Effect Analysis (FMEA), benchmarking and QFD. According to Spring, McQuater, Swift, Dale, and Booker, (1998), choosing the right tool or technique and correct method of implementation is a key issue. Dale (2003) indicates that there is no superior technique to another, all are useful and appropriate for diverse applications. Every technique has distinct features and can be used to analyze the same data in a separate and unique manner.

### 1.1.2 Operational Performance

Operational performance involves measures where management of operations plays key roles (Boyer & Lewis, 2002). Improvements in performance can be revealed in different ways like reduction of inventory, lead time or improvement of quality (Miguel & Brito, 2011). These types of improvements can be grouped in larger categories of competitive priorities as cost, quality, delivery and flexibility to ease comparability, completeness and theoretical underpinning (Miguel & Brito, 2011). Traditionally, operational performance has therefore been assessed and measured using the four factors: cost, quality, speed and flexibility (Ferdows & De Meyer, 1990; Skinner, 1969).

### 1.1.3 Manufacturing Firms in Kenya

KAM, (2017) report says that manufacturing firms in Kenya have grown gradually since the 1990s and become more complex in the recent past with a wide range of offerings. The major manufacturing activity is the transformation of agricultural raw materials, including coffee and tea. Other industrial activities include electronics production, publishing, vehicle assembly, and soda ash processing. Computer components assembly began in 1987 (SoftKenya, 2014). The number of manufacturing companies registered with KAM totals 965 broken down as follows: food and beverages sector carrying 22%; service and consultancy at 10%;  Chemical and allied, metal & allied, paper and board, plastics and rubber each 9%; textiles and apparels 7%; motor vehicle and accessories 6%; energy, electrical and electronics 5%; building, mining and construction 3% pharmaceutical and medical 3%; timber, wood and furniture 2%; fresh produce 1% and leather and footwear 1% (KAM, 2017).

Were (2016) alludes that the cost of production in Kenya is very high and cheap imports from India and China always threaten locally manufactured equivalents. One of the reasons is wasteful processes. Additionally, to access the African Growth and Opportunity Act (AGOA) markets, manufacturers must meet certain product qualification standards. Most Kenyan firms have fallen short of obtaining AGOA visas to sell their products in the African market due to inferior product offerings (Ministry of Industry, Trade and Cooperatives, 2016). The complexity in product qualification here points out to sub optimal quality issues, due to inefficient and ineffective processes. The Kenya Vision 2030 states that the manufacturing sector has a role to increase the share of products in the regional market from 7% to 15%. (Ministry of Industry, Trade and Cooperatives, 2016). In most occasions, the companies are largely undersized, an indicator that country's manufacturing sector depends on imported raw materials and finished goods (World Manufacturing Production, 2014). Again, the 7% market share vis-à-vis the import dependency points out to inefficiencies in production. Most Kenyan manufacturing companies are owned or controlled as family businesses, with a huge focus on being reliable to only advance their returns (KAM, 2017). Thus they produce conservative products that only increase assurance of return customers (Bolo and

Wainaina, 2011). This could therefore be an indicator that they do not embrace improvements. Most countries that produce and export more sophisticated products have fast growing economies (Hausmann et al., 2006). The complex products also fetch higher market prices and hence bigger incomes (Imbs and Wacziarg, 2003). Kenya's complexity in production regressed in the last decade, compared to Uganda and Tanzania which marked a strong growth (Were, Velde, and Wainaina, 2017), an indicator that firms became more conservative and no complex production processes were introduced or no improvements were made to existing processes.

## 1.2 Research Problem

The manufacturing industry is faced with complexities and challenges in the market including organizational, logistical, political, technological, competition, globalization, changing customer preferences and tastes thus organizations have to adopt PITT to ensure optimized and streamlined processes (Coskun, Basligil & Baracli, 2008). Gill (2009) argues that benefits of process improvement programs are futuristic, and may not be felt instantly by the customer. Some proactive companies factor in process improvement programs at strategy level while other conservatives adopt PITT along the way for survival. Studies have been conducted both locally and globally on PITT. Globally, Sujová & Marcineková (2015), in their study on improvement of processes on wood processing companies in Slovakia found that some SMEs have utilized improvement tools like benchmarking, Statistical Process Control (SPC), International Organization for Standardization (ISO) standards and 5s methods and have considerably benefited whereas large companies and multinationals only adopted SPC and ISO standards. The population and the context of study cannot be used to make conclusions on the Kenyan case and the whole manufacturing sector.

Irungu and Were (2016) studied the subject in the context of financial performance, concluding that adoption of PITT enhanced profitability. The study did not reveal any connection of PITT to operational improvements. Gitu (2012) studied the factors influencing improvements at Nairobi City Water and Sewerage Company and deduced that the culture of an organization, the corporate strategy and human resource are critical factors that influence adoption and implementation of PITT. Of particular concern is the revelation that the workforce must receive training and instruction to ensure a sustainable continuous improvement of quality. Sirma (2005), in his paper on popular process improvement approaches among Small and Medium Enterprises (SMEs) in Nairobi noted that most have adopted a fragmented approach to implementation, preferring the easily implementable parts while ignoring the more complex ones resulting in a mix of abortive improvement plans. Again, the population in this study is biased to SMEs in all sectors, ignoring other manufacturing firms. Nyamwange et al. (2015) in their study revealed that the manufacturing firms adopted specific improvement approaches that are aligned in the value chain and have significantly contributed to operational performance. However, the study did not focus on tools and techniques. They recommend that further study should be done in this area, including training and quality induction programs. Sika (2015) in his paper on plant maintenance strategies used by large manufacturing firms in Kenya notes that both corrective and preventive methods were utilized and the conservative work order system was used to generate maintenance jobs with no improvement in the processes over the years.

From the reviewed studies none has focused on the adoption of PITT versus operational performance. Studies have been carried out in the sugar industry, hospitals, water and sewerage and SMEs, leaving out manufacturing firms. There is also no studies addressing the ineffective and piecemeal implementation of the tools and techniques and the aspect of training. Therefore this study sought to fill these gaps.

## 1.3 Research Objective

The objective of this research study was to determine how adoption of PITT affected the operational performance of manufacturing and exporting firms in Kenya.

### 1.3.1 Specific Objectives

i. To identify the extent of adoption of process improvement techniques by Kenyan manufacturing firms.
ii. To identify the extent of adoption of process improvement tools by Kenyan manufacturing firms.

iii. To assess the moderating factors on process improvement with a keen interest in training

iv. To establish the relationship between PITT, intervening factors and operational performance.

## 1.4 Value of the Study

Scholars and Academicians will find the study useful as it will contribute to literature and theory, and research gaps emanating thereof would necessitate further studies. It will also seek to address the contradictions exemplified in existing literature concerning the levels of adoption, utilization, implementation, training and benefits of PITT and clarify obscure issues.

The government and stakeholders in the manufacturing sector will find this study beneficial when creating policies, formulating strategies and generating regulatory structures particularly where process improvement tools and techniques are involved, for instance in offering incentives to efficient companies. Also, institutions like KAM will find this study useful as a guide when planning PITT training programs for manufacturers.

One outcome of the study was be the PITT adopted by the manufacturing firms in Kenya and factors affecting the choices. The decision makers of manufacturing firms has been made aware of suitable PITT applicable to their firms, the training needs and necessary recommendations for improvements. They will also be able to better understand fluctuations and variations in production, and why their products do not qualify to the AGOA and global markets and take a step towards quality improvement. Manufacturing firms in Kenya will also be challenged to establish both short term and long term operational strategies involving PITT to ensure sustainable competitive advantage, other than being forced into adopting PITT for survival. Actually, companies will know what to do to improve their processes, the correct mix of PITT, the right time of implementation and training required.

**CHAPTER TWO**

**LITERATURE REVIEW**

## 2.1 Introduction

Companies that have undertaken a successful process improvement plan with the correct PITT and training have witnessed tremendous improvements in their operations including reduction in inventory, reduction of costs of production, removal of redundant processes, timely delivery and generally improved efficiencies (Bateman, 2005). This chapter presents both theoretical and empirical review covering PITT and benefits of adoption and successful implementation to operational aspects of manufacturing firms in Kenya. The aspect of training is also discussed. A conceptual framework is also presented which will form the basis of the research.

## 2.2 Theoretical Literature Review

Theoretical anchoring is essential in the value of PITT to the operational performance of manufacturing firms in Kenya. Adoption of process improvement is anchored in the theory of competitive advantage and the knowledge based view theory.

### 2.2.1 Theory of Competitive Advantage

Firms compete in sophisticated international markets and therefore need to utilize certain principles to create and sustain competitive advantage. Michael Porter's theory provides core principles of competitive advantage applicable to industries, building up to a whole economy. The competitiveness of a country is a function of four major determinants namely: factor conditions; demand conditions; related and supporting industries; and, firm strategy, structure, and rivalry (Porter, 1990). Factor conditions are inputs which affect competition in any industry. Continuous upgrading and developing advanced and specialized factors of production creates a significant and sustainable advantage in any given field (Porter, 1990). Firm strategy and structure determine company goals and individual goals. Individual goals and shareholder motivation have significant role in creating and upgrading competitive advantage as it is the basis of attracting qualified human resources and sustained commitment of capital in the industry in turn enhancing productivity and effectiveness.

Domestic rivalry not only creates pressures to innovate but to innovate in ways that upgrade the competitive advantages of a nation's firms. The presence of rivals lowers the significance of advantages created through little effort and investment (Porter, 1990). In a market economy, the direction of production is determined by the needs of customers. Competitiveness in an industry is impossible to be achieved unless demand conditions allow for successful realization of firms' products. The dynamic influence of home demand shapes the rate and character of improvement and innovation by a nation's firms. Competitive related and supporting industries cause access to cost-effective inputs. Globalization makes inputs available on global markets, with emphasis shifting to their effective utilization. The process of innovation and upgrading involves mutual influence between firms and their suppliers where suppliers help firms to perceive new methods and opportunities to apply new technology and firms influencing suppliers' technical efforts in a direction of testing new developments and ideas. Other factors include exchange of R&D, joint problem solving or transmitting of information through suppliers to different firms accelerating innovation and improvement (Porter, 1990)..

### 2.2.2 Knowledge Based View Theory

According to the knowledge-based view of the firm, a firm should be understood as a social community specializing in speed and efficiency in the creation and transfer of knowledge since knowledge has become the key source for business performance (Kogut & Zander, 1996). The knowledge-based view (KBV) explains how firms can use knowledge to differentiate themselves from competitors and gain sustainable competitive advantage (Grant, 1996). The KBV of the firm addresses the issues of the existence, the boundaries, and the internal organization of the multi-person firm (Foss, 1996). The starting point is that knowledge is the key explanatory factor, and the nature of knowledge (tacit, socially constructed etc.) is an important determinant enhancing understanding of firm organization and behaviour (Foss, 2005).

The essential elements of the KBV include knowledge being the most important resource and factor of production, performance differences between firms exist because of differences in firms' stock of knowledge and capabilities in using and developing knowledge, organizations exist to create, transfer, and transform knowledge into competitive advantage, there is need for integration and coordination of knowledge in a firm, knowledge is demonstrated in many forms and located on many levels, some knowledge can be externalized into explicit form, while some knowledge will always remain tacit and knowledge is dynamic, it is continuously re-interpreted and modified, and related to learning and change (Foss, 2005). A firms' lack of knowledge, or failure to utilize both tacit and explicit knowledge may hinder improvement of processes. Precisely, knowledge of PITT and how to utilize them is key in successful implementation.

## 2.3 Process Improvement Tools and Techniques

McQuater et al. (1995) defines PITT as practical competencies, procedures, channels, methods or ways that can be employed to particular tasks to promote constructive change and improvements. In the recent past, SMEs have been applying process improvement techniques like process mapping, six sigma, lean thinking and benchmarking to optimize their processes and improve operational performance (Malik and Blumenfeld, 2012). Organizations whose focus is improving internal and external processes have implemented various approaches including continuous improvement, total quality management and Business Process Re-engineering (BPR) (Trkman, 2013). McIvor, (2010) suggests that organizations apply process improvement tools such as input output analysis, benchmarking, pareto diagrams, cause and effect diagrams, six sigma and process mapping to improve their internal processes. Clearly, different authors do not agree on the difference between tools and techniques. Although they differ in the descriptions, they end up referring to the same items in their discussions.

Ahmed and Hassan, (2003) summarizes the uses and benefits of tools and techniques of process improvement as defining problems, analyzing problems, evaluating performance and continuous improvement correlating to Deming's (1982) Plan Do Check Act (PDCA) cycle. Ishikawa (1985) classifies the functions and tasks of a manufacturing firm into four categories and relates them to corresponding applicable tools and techniques as follows: new product introduction (QFD, brainstorming and cause and effect diagram); production stage (pareto chart, control chart and process flow diagram); product or process assessment (pie chart, histogram, bar chart, scatter diagram); all stages of data collection (check sheet, measles chart, check list, tally charts and capability indices). The authors agree that PITT are applicable at all stages of problem solving and improvement processes. Ishikawa (1985) proposes that the success of any organization is influenced by treating quality improvement as a continuous process. It is therefore not enough to implement the PITT and relax, there is always room for improvement.

### 2.3.1 Process Improvement Tools

McQuater et al. (1995) defines a tool as an instrument with a clear task, mostly restricted in purpose and used independently. For the purpose of this discussion, we refer process improvement tools as proposed by Ishikawa (1985) popularly known as the seven quality control (7QC) tools namely check sheet, pareto chart, flow chart, control chart, histogram, Ishikawa diagram and scatter diagram.

Vilfredo Pareto (1848-1923), came up with the principle of unequal distribution, popularly referred to as 80/20 rule or the principle of the “vital few” and the “trivial many” whose outcome is a pareto chart (Gupta & Kumar, 2014). According to Li, Ye, Sun, Dong & Wang (2014), pareto charts assist organizations to prioritize their resources to the “big problem areas of the business." Data collected is usually sorted in descending or ascending order and presented in a chart. As more changes occur, proactive measures can be taken. With time, the nature of the “vital few” problems adjust and processes are optimized and streamlined. The advantage of utilizing this tool is that more improvements can be achieved with less resources (Gupta & Kumar, 2014).

Oakland (1993) defines a flow chart as a systematic plan of a process involving recording the series of events and activities, stages and decision in an accurate, clear and concise manner, easy to understand and communicate. He argues that if improvements are to be made, the facts relating to the existing process must be recorded first. Flowcharts are drawn using standard symbols and the act of flowcharting improves knowledge of the process therefore the team can identify and eliminate bottlenecks, waste and other quality problems.

Ishikawa (fishbone or cause and effect) diagram is a practical tool for analyzing or examining problems or events versus the activities that generate or advance the problems (Watson, 2004). According to Dey, (2004), there are four steps involved when using fishbone diagram namely: problem identification, determination of major factors or elements involved, pinpointing likely causes and examining the fishbone diagram, then rectifying various problems. Solutions are generated to rectify the causes of problems consequently improving processes. The diagrams are reviewed as problems are solved and improvements are made (Basic tools for process improvement, 2009). The fishbone diagram has broad use in research, marketing, logistics, healthcare, manufacturing and office operations and has been utilized successfully in healthcare management especially obstetrics, gynecology and emergency departments (White et al., 2004).

According to Oakland, (1993) a scatter diagram represents the relationship between two variables in a graphical manner. The different variables are plotted in the vertical and horizontal axes at right angles. The spread of the points is used as a measurement of the relationship between the variables and correlation can be observed. Forecasts and predictions on the behaviour of values lying outside the range of measurement can also be made accurately. Scatter diagrams are an important tool for process improvement as they show the existing state of events and how the variables can be manipulated to achieve the desired improvement.

Oakland (1993) describes check sheets as useful for recording direct observations and gathering facts about the process in a simple way. Data is gathered and arranged by adding tally or check marks against preset classes or groups of items or measurements. They include tally charts and measles charts. Check sheets give raw data which can be manipulated and analyzed for use in a process improvement program.

A Histogram is a graphical presentation of variation and distribution of variables, where data is placed in clusters and the frequency of occurrence of events within the clusters represented in bars. It is very effective to use histograms where huge quantities of data is collected and the range is broad. The users are able to view the disparities and variations in a physical graph and pinpoint areas or regions that exhibit abnormal or unexpected occurrences. The advantage of histograms is that they display the outcomes of actions of process attendants and can be used to predict the future and the information can be used to rectify and improve processes (Oakland, 1993).

Control charts are used to monitor and assess processes under control using statistical means and ranges. A control chart presents data and values in chronological manner displaying the variations over time. The control chart is presented with lines showing the mean (desired values), upper and lower warning lines (a signal warning that the process is unstable) and upper and lower action lines (a signal that the process is out of control and action or decision must be taken to rectify or improve the process). At any given time, process attendants are able to know the state of control of the process. The charts provide a record of processes historically and help to detect or predict changes and variations so that action can be taken to improve or streamline processes (Oakland, 1993).

### 2.3.2 Process Improvement Techniques

McQuater et al. (1995) define a technique as having broader utilization, requiring more energy, knowledge, skill, understanding and training to be implemented successfully. One technique can be a combination of several tools. For Instance, Mauléon and Bergman, (2009) argues that many organizations utilize versions of Shewhart's theories for statistical problem solving, mostly with the title six sigma. They also claim that the PDSA cycle is emphasized in most improvement work but with different headings including kaizen, six sigma and lean thinking. The exploratory nature of process improvement is also described in a recent Harvard Business Review article on Toyota, by Takeuchi, Osono and Shimizu, (2008). The authors emphasize that the PDSA cycle has evolved over time to bear different headings as knowledge development increased, but the concept has remained the same in process improvement. For the purposes of this research, we discuss ten process improvement techniques mentioned by different authors including six sigma, benchmarking, kaizen, BPR, SPC, brainstorming, FMEA, QFD, process Mapping, Lean Thinking and Total Productive Maintenance (TPM).

Antony and Banuelas (2002) define six sigma as a process improvement methodology which applies both statistical, numerical and non-statistical tools and techniques to eradicate process disparities and variations resulting in improved process capacity and operational performance. Schroeder, (2003) and Linderman et al., (2002)) emphasize the need to use well organized methods and procedures in selection of processes for six sigma improvement, employment of well trained experts and a careful scrutiny of the anticipated operational and financial returns of the implementation (cost benefit analysis).

Boxwell, (1994).defines benchmarking as a technique involving measurement and comparison of processes of an inefficient firm and other industry leaders in a view of obtaining and utilizing relevant information to identify and administer improvements. In 1979, Xerox introduced benchmarking as a process improvement tool. According to Camp, (1995) benchmarking has since been applied widely in the healthcare sector, government organizations and manufacturing firms worldwide. Voss *et al.,* (1994) reckons that benchmarking has progressed over the years to focus on management practices and activities that improve performance. Meybodi, (2006) notes that benchmarking has been utilized widely by organizations seeking ISO 9000 certification.

Kaizen is a notion originating from Japan which means continuous improvement and involves employees at all levels of an organization (Halgren, 2007). The ultimate aim of kaizen is to remove waste in every system and structure of the firm by improving and standardizing all processes and tasks. Small improvements are achieved progressively through employee combined effort and consolidated energy (Imai, 1986). Kaizen is applicable in many areas of business including information systems, training, logistics, product innovation and development, internal processes, inventory control, improvement of procedures, reporting and documentation (Imai, 1986)

BPR, according to Hammer and Champy (1993) was invented to help firms re-design and restructure their processes in such a way to cause enormous change and improvement in performance of the firm, especially in quality of products and services. Peppard (1999) emphasizes the integration of BPR to the corporate strategy of the business and measurement of results of the re-engineering process. Implementation of BPR is unique to the type of firm, whether manufacturing or service and careful consideration must be made so as to reap the benefits (Shin & Jemella, 2002).

It is less costly to get high quality product the first time than to rework, reprocess or to dump products as waste (Awaj, Singh & Amedie, 2013). Firms utilize SPC to monitor, identify and remove any defective materials and inefficient operations in the process so as to attain uniform products. Various steps in the process are monitored using SPC methods and abnormal trends are identified and problems are solved before getting out of control (Lim, Antony & Albliwi, 2014). Implementation of SPC techniques can reduce immensely production costs through avoiding the recycling of chemicals, blending after production, extra processes of separation and abstaining from dumping the product as waste. Quality must be built into the product, not added as a SPC afterthought.

Osborn, (1953) defines brainstorming as a divergent reasoning process by an individual, team or group whose aim is to generate as many ideas as possible, analyze them and use them to develop practical solutions to problems. The author defines four guidelines to successful brainstorming as follows: idea generation, open expression of ideas however crazy they are, deferral of judgment and consolidation and improvement of ideas.. Rossiter and Lilien, (1994) argue that brainstorming is preferred by managers because it generates well refined and innovative results. Brainstorming is used widely to establish problems, determine areas of improvement, design solutions to problems and develop action plans (Paulus, Kohn, & Arditti, 2011). Seaker and Waller, (1996) conclude that brainstorming is relatively inexpensive and smaller firms can utilize this method to improve their processes.

Dong, (2007) defines FMEA is a technique used to establish possible failures of products and complex systems and analyze their effects. It is a well-organized approach that begins with known areas of potential failure at one level and analyzes the effect on the next level sub system, and eventually the entire system. The analysis of failure modes and effects also helps users to commence actions that remove or lower the chances of recurring possible failures. Askari et al, (2017) affirms that FMEA is a proactive tool for risk assessment and identification of possible hazards and is an effective technique for continuous improvement in healthcare institutions to identify both human and systemic errors and offer realistic advice to solve them.

Cohen, (1995) defines QFD as an organized way for translating customer requirements into design specifications through continuous communication between the design team and the customer. The outcome of QFD is improved design, shorter product development cycle, higher quality product and reduced cost of production (Crowe and Cheng, 1996). Cristiano et al., (2001) allude that the heart of QFD is in the correlation matrices between the customer requirement and the engineering metric. Chao & Ishii, (2004) conclude that in QFD, the business strategy and the customer voice are integrated in the value chain process but decisions made must be practical. Oakland, (1993) defines seven new tools for quality function deployment as Process Decision programme Chart, tree diagram, affinity diagram, quality table, interrelationship diagraph, matrix data analysis, and arrow diagram.

A process map is a physical drawing showing how inputs, outputs and functions are interconnected in a process. According to Aguiar and Weston (1993), process mapping helps in identifying and eliminating redundant tasks and components of a process therefore reducing its complexity. Anjard, (1998) discusses that many businesses develop process maps prior to initiating process improvements. Soliman, (1998) argues that it is necessary to consider an optimal level of mapping so as to save mapping costs, minimize reworks and reduce operational costs.

Womack et al., (1990) define lean thinking is a philosophy that involves a structured approach to remove waste through continuous improvement. It is comprised of concepts at corporate strategy level and implementation of tools and techniques at tactical levels (Hines et al., 2004; Shah & Ward, 2003). Shah & Ward, (2007) argue that for successful lean implementation, employee attitude and culture are critical and ought to change. Bessant, (2003) alludes that behaviour and attitude help to develop capacity that sustains continuous improvement. Papadopoulos, (2011) suggests that successful implementation of lean is also dependent on cooperation between stakeholders.

Total Productive Maintenance (TPM) involves maintaining and improving integrity of production and quality systems through the machines, equipment, employees and supporting processes. TPM targets improving core business processes. The phrase TPM was first used in 1961 by the Japanese company Denso. TPM is about productivity improvement and optimization of machine availability through which machines operate at their optimal level. The aim is to have an Overall Equipment Effectiveness **(**OEE**)** score of 100% and this represents perfect production. In that case, machines always work at full speed and deliver products of perfect quality (McKone, Schroeder, & Cua, 2001). Seven pillars of TPM include: Kobetsu Kaizen (Focused Improvement), Planned

Maintenance, Quality maintenance, Training and Education, Office TPM, Safety Health Environment (SHE).

## 2.4 Training as an intervening variable in process Improvement

McIvor, (2016) argues that firms engaging in process improvement must have internal competency and capacity in PITT for successful implementation. In fact some companies have recruited suitably skilled, well trained and knowledgeable persons to implement process mapping, six sigma, benchmarking and lean systems as some require use of technology and complex software. Dale and McQuater (1998) argue that use of PITT to improve processes is not very extensive and successful as envisioned, and cite inadequate training as the main drawback. Spring et al. (1998) have established that outcomes of implementation of a specific technique or tool are dependent on the level of training, experience and skills of the executing workforce.

Some basic tools and techniques like control charts, pareto analysis, check sheets and fishbone diagrams defined by Ishikawa (1976) are viewed as superficial and inappropriate and may not even require training (Lamb and Dale, 1994). Bamford and Greatbanks, (2005) note that even the elementary PITT have not been completely exploited. Yasin, Zimmerer, Miller and Zimmerer (2002) reveal that a piecemeal application of PITT ordinarily achieves below average to no results whatsoever. Ahmed and Hassan (2003) also emphasize that to achieve best results, the method used in application of tools and technique must be well analyzed. Kumar and Anthony (2008) and Ahmed and Hassan (2003) conclude that the major barriers to successful improvement programs are inadequate funding, limited time, insufficient human capital, lack of knowledge and training and internal resistance. Tennant et al. (2002) alludes that training of staff may be a motivating factor towards continuous improvement.

Various British training schemes targeting industries and regions to boost improvement of processes have been initiated in the past. According to Bateman and David, (2002), the Industry Forum was established in 1994 by Society of Motor Manufacturers and Traders to enhance capacity of automobile supply chain and therefore improve performance in operations. Honda, Nissan and Toyota endorsed their experienced engineers to train participating engineers on techniques of process improvement using master classes

(Pullin, 1998). The engineers would return to their firms and train fellow employees in a similar approach.

The NorthEast Productivity Alliance (NEPA) was started in 2002 in Northern England to initiate improvements in efficiency and productivity of local companies. The European Regions for Innovative Productivity (ERIP) project (2008) established Innovative Productivity Centers (IPCs) which were training grounds for process improvement subject. 23 companies benefited from the initiatives in six European countries and achieved greater performance (Secchi and Camuffo, 2016). In Kenya, such collective efforts have not been established, though it is suspected that some individual companies take their employees through formal training on PITT in government and private institutions as National Industrial Training Authority (NITA), Société Générale de Surveillance (SGS) and KAM.

## 2.5 Empirical Review

The research covers local and international studies conducted in the recent past. Some of the studies attempt to explain adoption of PITT and operational performance though in different contexts, while others test different concepts in relation to operational performance. Some companies have adopted the tools and techniques to enhance improvements in performance.

Brunet & New, (2003) focused on how Vietnamese companies have adopted different Kaizen practices and noted that most of the firms' management valued quality improvements. They note that lack of training is an impediment to effective implementation. Sirma (2011) conducted a case study on process improvement approaches used by 60 randomly selected Kenya Bureau of Standards (KEBS) registered manufacturing SMEs in Kariobangi, Nairobi. The study found that benchmarking was the only improvement technique which was moderately popular, other approaches being totally strange and noted the need for training. Sika (2015) did a research project on plant maintenance strategies used by large manufacturing firms in Kenya. The outcome of the study revealed that most companies employed corrective maintenance strategy implying that process improvement tools and techniques were clearly never implemented to detect and avoid failures whereas a good number utilized a mix of corrective and preventive maintenance approaches.

Ngware (2006) conducted a research on effects of TQM using Kaizen on implementation of business performance in service institutions, case of Kenya Wildlife Services. The results of the study revealed that for successful implementation of a quality management system, top management must allocate sufficient resources, ensure an effective organizational culture and structure and come up with key quality targets, practices and values to guide all employees of the organization. A study by Muthengi & Soni (2005) on effectiveness of kaizen system in enhancing financial performances in Kenyan firms, revealed that though it is based on simple principles, successful kaizen implementation requires training, dedication, persistence and leadership by experienced users. They note that the results achieved are proportional to the level of dedication to the project.

## 2.6 Conceptual Framework

The conceptual framework shows the connection between the independent variables comprising of Process improvement tools namely Pareto chart, Cause and effect diagram, flow chart, Scatter diagram, Check sheet, Histogram and Control chart; Process improvement techniques mentioned above including six sigma, benchmarking, kaizen, Business Process Re-engineering (BPR), Statistical process control (SPC), brainstorming, failure mode and effect Analysis (FMEA), quality function deployment (QFD), process Mapping and Lean Thinking; Training as an intervening variable which may be On the Job, Off the Job, general or specialized training and the dependent variables (operational performance) measured by using four attributes namely quality, cost, speed and flexibility as shown in the diagram below:

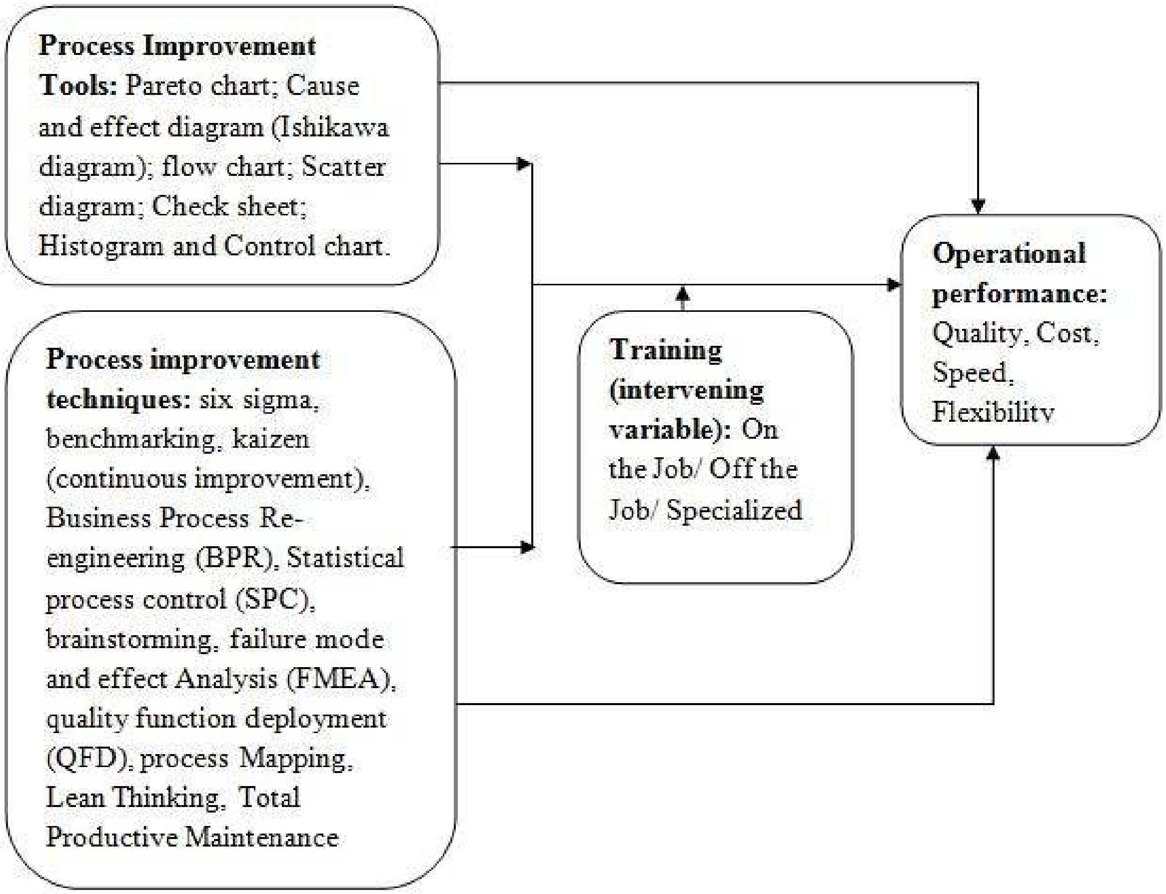


**Figure 1: conceptual model**

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter explains the strategy for acquiring and collecting data. It is structured as follows: research design, population and sampling, data collection methods and data Analysis.

## 3.2 Research Design

The research study employed descriptive research design. The choice of descriptive design was due to the nature of study which allows the researcher to narrate the area under study and discuss the data in a view to establishing relationships within a defined time span. Descriptive research was therefore suitable for this study so as to gather detailed information by describing events that are associated with various variables and hypothesis. The suitability of this research design was due to the main focus of investigating the relationships between the various variables and subsequently analyzing how adoption of PITT affected the operational performance of manufacturing firms in Kenya.

## 3.3 Population and Sampling

Due to the convenience in terms of accessibility, time schedule and financial resources available, priority was be given to firms within Nairobi as it also hosts majority of these firms. The target population represents the 965 manufacturing companies in different sectors as registered by KAM, (2017) which were exploited so as to generalize the results to the entire population. A representative sample was drawn from the target population to be utilized for measurement in the study. The accessible population was 200 firms. The sample for this research comprised of 60 manufacturing firms in Kenya comprising the different sectors as registered by KAM.

The study employed stratified random sampling design in collecting data for the research study incorporating all sectors as registered by KAM, (2017)as follows: food and beverages sector carrying 22%; service and consultancy at 10%; Chemical and allied, metal & allied, paper and board, plastics and rubber each 9%; textiles and apparels 7%; motor vehicle and accessories 6%; energy, electrical and electronics 5%; building, mining and construction 3% pharmaceutical and medical 3%; timber, wood and furniture 2%; fresh produce 1% and leather and footwear 1% (KAM, 2017).

Proportionate sampling across all strata was done as per the table 3.1 below. Borg and Gall (2003), state that at least 30% of the accessible population is enough for the sample size. Therefore, a sample size of 60 manufacturing firms was termed sufficient in this research study. The proportionate stratified random sample was obtained using the formula: (sample size/ accessible population size) x stratum size.

**Table 1: Sampling and sample size**

| Sector | % Share | Actual | Sample |
|---|---|---|---|
| Food and beverages | 22 | 44 | 13 |
| Service and consultancy | 10 | 24 | 7 |
| Chemical & allied | 9 | 18 | 5 |
| Plastics and rubber | 9 | 18 | 5 |
| Textiles and apparels | 8 | 16 | 5 |
| Energy, electrical and electronics | 6 | 12 | 4 |
| Building, mining and construction | 3 | 6 | 2 |
| Pharmaceutical and medical | 3 | 6 | 2 |
| Metal & allied | 9 | 18 | 5 |
| Paper and board | 8 | 16 | 5 |
| Motor vehicle and accessories | 6 | 12 | 4 |
| Timber, wood and furniture | 2 | 4 | 1 |
| Fresh produce | 1 | 2 | 1 |
| Leather and footwear | 1 | 2 | 1 |
| Others | 5 | 10 | |
| Total | 100% | 200 | 60 |

## 3.4 Data Collection

The source of data for this study was primary data. Primary data was acquired using structured questionnaires, which were written Google forms send to the emails of the respondents who were willing to participate after which they submitted the forms for the analysis. Part one of the questionnaire comprised of socio demographic information, part two dwelt on level of adoption of process improvement techniques, part three talked about the process improvement tools, part four handled questions on the performance attributable to PITTs while part five handled the effect of moderating factors on the operational performance of the companies. The respondents in this study were staff in operations including operations managers, production managers, plant managers, quality assurance managers or any other staff in the operations divisions as they were well versed with issues of process improvements. The respondents were presented with descriptive statements about the adoption of PITT, effect of training and operational performance in a Likert scale.

## 3.5 Data Analysis

The collected data was cleaned for completeness and consistency in preparation for analysis. Once cleaned, the data exported into the Statistical Package for Social Sciences (SPSS version 23) for analysis of the descriptive and SmartPLS version 3.2.4 for the factor analysis. The nature of data collected was largely quantitative thus descriptive statistical tools for analysis (Mean scores, frequencies, Standard Deviation and Percentages) were used to analyze the data. The percentages show the proportion of respondents who scored in different variables. Findings were presented in a tabular form for ease of interpretation and reporting. Tables enabled the reader to compare the trend of distribution more vividly than simply looking at the numbers. Factor analysis was used to compile the different attributes described in the questionnaire to match the particular tool or technique under study using the structural equation modelling analyzed by the SmartPLS software. Inferential statistics on the other hand were used to draw conclusions.

These included the multiple regression and correlation that were used to document the association and the levels for the three variables; independent variables, moderating variables and the dependent variables. Since the method of regression analysis was carried out through the use of the structural modelling, it was deemed not important to write down the equation.

# CHAPTER FOUR

# DATA ANALYSIS, RESULTS AND DISCUSSION

## 4.1 Introduction

This chapter brings out the results of answers from the sampled respondents. It gives the response rate, socio-demographic characteristics, the PITTs used by the various companies, factors influencing the choice of adoption and training as an intervening variable of the PITTs. The researcher identified companies of interest in the study and requested for their participation in the study. The respondents were then sent the questionnaires in form of Google forms for ease of answering and remittance.

## 4.2 Response Rate

Out of the 60 sampled respondents in the study, 52 respondents were willing and available to participate in the study. This number translated to 87% response rate. A similar research by Milanoi (2016) which achieved the objectives of her study had a response rate of 88.57% in which our study is close to. Several researchers deem a response rate of above 80% as excellent, 70-79% as good, 60-69% as fair and below 59% as questionable and unacceptable (Mugenda & Mugenda, 2003; Orodho, 2003; Kothari, 2003).

## 4.3 Socio-Demographic Characteristics

Socio-demographic is simply the characteristics of a population. In this study, the traits of interest were; age of the respondent, work experience and position,

**Position**

The study sought to find out the position that the respondents held. The positions of interest were the ones that dealt with the process improvement, tools and techniques in the manufacturing and service industry. They included; plant manager, quality assurance manager, operations manager and production manager.

**Table 2:Positions held by the respondents**

| Respondent | Percentage Share |
|---|---|
| Operation manager | 40.4 |
| Plant manager | 17.3 |
| Production manager | 23.1 |
| QA manager | 19.2 |

Results showed that the operation managers were the majority at 40.4% followed by the production managers at 23.1% then quality assurance managers at 19.2% and lastly the plant manager who were 17.3%. These positions were believed to be held by such people who understood all the PITTs in their respective companies.

**Age**

Age is important in surveys since it helps give a knowledge on the maturity levels of the respondents. The respondents were asked to state their age brackets and their responses were analyzed as in the table 3 below.

**Table 3: Age bracket of the respondents**

| Age Bracket | Percentage Share |
|---|---|
| 25-35 | 42.3 |
| 36-45 | 21.2 |
| 46-55 | 23.1 |
| Above 50 | 13.5 |

Most of the respondents were youthful implying that companies have realized the potential in youths and giving them positions to exploit their energies. There was no respondent below 25 years of age. However, those aged between 25-35 years were leading at 42.3%. The 46-55 years of age followed at 23.1% who were then followed closely by those aged 36-45 years at 21.2%. There were few respondents of 'near to retire' bracket since those aged above 50 years were the least at 13.5%.

**Experience**

After knowing the age of the respondents, it was important to determine their experiences both in their titles they held and in the companies they were.

**Table 4: Experience in the position and experience in this company**

| Number of years | Experience in position (%) | Experience in company (%) |
|---|---|---|
| Below 5 | 32.7 | 44.2 |
| 5-10 | 40.4 | 36.5 |
| 11-15 | 17.3 | 13.5 |
| 16-20 | 7.7 | 3.8 |
| Above 20 | 1.9 | 1.9 |

Table above shows that majority of the respondents had held their current titles/ positions for 5-10 years with a frequency rate of 40.4% followed by those who had held them for ‘below 5 years’ at 32.7%. Third were those who had held their positions for 11-15 years at 17.3% followed by 16-20 years at 7.7% and lastly the ‘above 20’ years bracket at 1.9%. This data correlates with their age brackets.

Majority of the respondents (44.2%) had worked in their current companies for below 5 years as seen in table 4 above. Close to them were those who had worked for 5-10 years at 36.5%. With relatively smaller percentages were those who were still working for their companies for 11-15 years, 16-20 years and above 20 years at 13.5%, 3.8% and 1.9% respectively.

**Type of the company**

The respondents were also asked to state the type of their companies as it appeared in the company registry and their response was as in the Table 4.4 below.

**Table 5: Type of Establishment**

| Company Type | Percentage Share |
|---|---|
| Private & government | 5.8 |
| Government Parastatal | 3.8 |
| Multinational | 21.2 |
| Private local | 69.2 |

Majority (69.2%) said that their companies were locally established followed by the multi-national companies at 21.2% then those both government owned with some shares from private investors at 5.8% and lastly the purely government Parastatals at 3.8%.

**Market**

It was good to find out the market scope of these companies. It was a way of knowing their target market and probably how competitive they could be. This was achieved through knowing the percentage of goods sold locally and those exported to other countries.

**Table 6: Percentage of Goods sold in Kenya**

| Goods sold in Kenya (%) | % No. of Companies |
|---|---|
| 0-30 | 19.2 |
| 31-50 | 15.3 |
| 51-70 | 15.3 |
| 71-100 | 61.5 |

It was clear that most of the goods most of these companies sold their products locally as indicated by 61.5% for those who said that the percentage of the goods sold in Kenya was between 71-100%. At an equal measure, the 31-50% and 51-70% category were 15.3% and lastly the ones with 0-30% market share were 19.2%.

## 4.4 Process Improvement Techniques

The study sought to find out to what levels the companies under study utilized the process improvement techniques as discussed and analyzed below. The indicator variables for all the 11 process improvement techniques were rated using a 5 point Likert scale where 1= strongly agree, 2= agree, 3= neutral, 4= disagree and 5= strongly disagree. The tables 7 and 8 below indicate the results of the means and standard deviations as analyzed using SPSS Version 23.

**Table 7: Descriptive analysis of 5 PI Techniques from indicator variables**

| **Indicator variables** | **Mean** | **SD** |
|---|---|---|
| Benchmarking | 2.05 | .99 |
| Compares its business process against business process of leading firms | 2.17 | 1.324 |
| Uses knowledge and experience of other firms for their advantage | 2.06 | 1.290 |
| Company adopts best practices from industry leaders | 1.92 | 1.311 |
| Company assesses its performance against other firms | 2.15 | 1.274 |
| Kaizen | 1.98 | .84 |
| Organization coaches staff for continuous improvement | 1.77 | 1.215 |
| Employees in all levels are involved in improvement process | 2.27 | 1.430 |
| Company focus on improving standardized activities and processes | 1.90 | 1.287 |
| Business Process Re-engineering | 3.97 | 1.14 |
| Company redesigned its processes | 3.58 | 1.433 |
| Company integrated the business process redesign and corporate strategy | 4.17 | 1.150 |
| Statistical Process Control | 2.35 | .92 |
| Monitor, detect & eliminate substandard materials & counterproductive operations in the process. | 2.73 | .910 |
| Abnormal trends identified & problems solved before they get out of hand | 1.71 | .915 |
| Process is regulated to maintain the standard and consistent product output | 2.62 | 1.402 |
| Brainstorming | 2.11 | .94 |
| Allows individual or group divergent thinking, open expression of ideas | 2.27 | 1.359 |
| Company encourages generation of many raw ideas, evaluates and develops into more viable solutions to problems | 1.96 | 1.171 |

From the results, majority of the companies studied were utilizing benchmarking as a process improvement tool. The value of the mean statistic implied that most of the respondents either agreed or strongly agreed with the statements describing benchmarking (*M*=2.05, *SD*=0.99). The value of the standard deviation implies a unit gap of respondents who were not sure if they were utilizing the particular tool, or were implementing the technique partially. These findings were in agreement with Sirma (2011) who conducted a case study on process improvement approaches used by 60 randomly selected Kenya Bureau of Standards (KEBS) registered manufacturing SMEs in Kariobangi with findings that benchmarking was the only improvement technique which was moderately popular amongst the SMEs.

Most of these companies under study used the statistical process control technique for process improvement. This is justified by the statistic values (*M*=2.35, *SD*=0.92), an indicator that most of the respondents either agreed or strongly agreed to the statements describing SPC. The near unit value of the standard deviation implies that some companies were possibly applying piece meal implementation of this technique, or were not sure if they were implementing it. The findings for SPC and benchmarking techniques were also consistent with Sujová & Marcineková (2015), who in their study on improvement of processes on wood processing companies in Slovakia found that most SMEs utilized process improvement techniques like benchmarking and Statistical Process Control.

Kaizen technique was found to be very popular among the manufacturing companies. This is explained by the mean value which was below 2 (*M*=1.98, *SD*=0.84), an implication that a huge number of respondents either agreed or strongly agreed to the statements describing Kaizen as applicable to their organizations. The standard deviation is less than a unit indicating there could be part of the population which neither agrees nor disagrees, or are partially implementing continuous improvement in their operations. The results were in consistency with Muthengi & Soni (2005) who studied effectiveness of kaizen system in enhancing performances in Kenyan firms, revealing that majority of the companies had adopted its simple principles and implemented successfully.

Results showed most of these companies under study did not utilize business process re-engineering. The values (*M*=3.97, *SD*=1.14) with the mean closer to 4 indicates from the scale that respondents disagreed with all the statements describing BPR. The results were in contrast to Nadeem (2016) who studied the subject in the context of the banking sector found that most banks had adopted BPR as a result of the changing technologies. This can imply that other factors not emanating from the business set-up mostly cause the business to re-engineer or the manufacturing sector rarely takes such drastic measures due to the nature of the sector. Brainstorming was a popular technique utilized by most of the companies as indicated by (*M*=2.1154, *SD*=0.94) implying that majority of the respondents had both strongly agreed and agreed to the statements describing brainstorming as applicable in their companies.

**Table 8: Descriptive analysis of 6 PI Techniques from indicator variables**

| Indicator variables | Mean | SD |
|---|---|---|
| Failure Mode and Effect Analysis | 2.19 | 1.18 |
| Identifies potential failures of products & systems & evaluate the effects | 2.12 | 1.308 |
| Initiates actions that eliminate or reduce recurring potential failures. | 2.27 | 1.388 |
| | | |
| Quality Function Deployment | 2.49 | 1.12 |
| Structured approach to translate customer requirements to design specs. | 2.44 | 1.392 |
| Proper communication between the client and design team | 2.40 | 1.418 |
| Prioritizes manufacturing processes & specs for key process parameters | 2.62 | 1.360 |
| | | |
| Process Mapping | 2.94 | 1.11 |
| Visual representation of work processes linking inputs, outputs & tasks. | 3.38 | 1.388 |
| Identifies bottlenecks, wasted activities, delays and duplication of efforts. | 3.06 | 1.335 |
| Eliminates non-value adding activities, reduces process complexities & develops future state maps | 2.38 | 1.223 |
| | | |
| Lean Thinking | 2.67 | 1.08 |
| Focus on demand and supply in order to keep minimum inventory levels | 2.42 | 1.348 |
| Ensures continuous flow of the raw materials and product | 2.21 | 1.391 |
| Systematic approach to identify and eliminate waste in all operations | 3.37 | 1.358 |
| | | |
| Total Productive Maintenance | 1.71 | .88 |
| Attention to autonomous and preventive maintenance | 1.79 | 1.054 |
| Training maintenance employees & standardized maintenance processes | 1.63 | 1.010 |
| | | |
| Six Sigma | 4.06 | .92 |
| Zero to negligible defects in products | 4.06 | .916 |

The results found that Lean thinking was partially implemented in the manufacturing companies. The statistical values (*M*=2.67, *SD*=1.08) indicate a tendency towards a mode of 3, which shows that respondents agreed and disagreed with the statements in equal measure. It could also mean that some of the respondents had adopted a piecemeal approach to implementation of lean systems. Six Sigma results showed that the organizations under study had not adopted and implemented six sigma technique. The findings could also imply that some companies had adopted the technique, but had implemented it unsuccessfully. Most of the respondents disagreed with the statements describing six sigma (*M*=4.06, *SD*=0.92). The findings on six sigma were contrary to the findings by Nyamwange et al. (2015) who established that manufacturing firms practiced six sigma as an improvement technique. However, the findings were true for lean thinking and benchmarking which established that they were very popular techniques among manufacturing companies in Kenya.

Failure mode and effect analysis was found to have been adopted and implemented among manufacturing firms in Kenya. The statistic values (*M*=2.19, *SD*=1.18) show that most of the respondents agreed to the statements describing FMEA. Thus, we conclude that companies were utilizing FMEA as a process improvement technique. The results for quality function deployment indicated that the technique was fairly popular among the manufacturing firms in Kenya. It was found that QFD had (*M*=2.49, *SD*=1.12) which depicted that most of the respondents agreed to the statements that described QFD. Process mapping was found to be adopted by some companies but partially implemented. It could also be an indicator that some companies had adopted and implemented this technique while others had neither adopted nor implemented it in equal measure. The statistic values (*M*=2.94, *SD*=1.11) indicate a mode close to 3, which implies that most of the respondents agreed and disagreed in equal measure. We conclude that process mapping was not among the PI techniques used by companies in the manufacturing sector.

The measures of TPM in this study were based on whether the companies gave attention to autonomous and preventive maintenance as well as conducting employee trainings on the maintenance processes. From the results, TPM was found to be a very popular technique among the manufacturing firms since it had (*M*=1.71, *SD*=0.87). The statistic values indicate that most of the respondents had either agreed or strongly agreed to the statements describing TPM. The findings were not in agreement with Sika (2015) who did a research project on plant maintenance strategies used by large manufacturing firms in Kenya revealing that most companies employed corrective maintenance strategy therefore implying that TPM was clearly never implemented to detect and avoid failures whereas a good number utilized a mix of corrective and preventive maintenance approaches.

## 4.5 Process Improvement Tools

The study sought to find out to what levels the companies under study utilized the process improvement tools as discussed and analyzed below. The indicator variables for all the 7 process improvement tools were rated using a 5 point Likert scale where 1= strongly agree, 2= agree, 3= neutral, 4= disagree and 5= strongly disagree. The tables 9 and 10 below indicate the results of the means and standard deviations as analyzed using SPSS Version 23

**Table 9: Descriptive analysis of 4 PI tools from indicator variables**

| Indicator variables | Mean | SD |
|---|---|---|
| Ishikawa/ Cause and Effect Diagrams | 3.39 | .99 |
| Engages employees to identify root causes of problems & their effects | 4.42 | 1.334 |
| Cause & Effect diagrams are revised as solutions are found | 3.37 | 1.121 |
| | | |
| Scatter Diagram | 1.93 | .93 |
| Company plots variables in a graph to determine how they are related | 1.96 | 1.220 |
| Company uses the relationships to control either variable | 1.88 | .963 |
| Company uses the graphs to make predictions | 1.94 | 1.145 |
| | | |
| Check sheets | 1.93 | .89 |
| Uses direct observation to gather facts about a process using tally marks | 1.98 | 1.306 |
| Uses the tally charts to analyze and improve processes | 1.88 | 1.114 |
| | | |
| Control Charts | 4.34 | .72 |
| Monitors processes in control using means and ranges | 3.98 | .776 |
| Makes decisions based on upper and lower action and warning lines | 4.75 | 1.211 |
| Uses data to detect, predict change & improve processes | 4.12 | .992 |

Ishikawa diagrams were partially adopted and utilized by manufacturing firms in Kenya. The results showed (*M*=3.39, *SD*=0.99) which implied that most of the respondents agreed and disagreed in equal measure. However, some of the respondents might have strongly disagreed to the statements. The unit standard deviation shows that there was a probability that some of the respondents were in piecemeal application of this tool in their organizations. It could also be an indicator that this tool was utilized sparingly, or it was mandated to some employees in the companies. It was evident from the findings of the study that most of the manufacturing companies used scatter diagrams. The statistic values (*M*=1.93, *SD*=0.93) shows that most of the respondents agreed to the statements describing scatter diagrams with a few strongly agreeing.

Similarly, check sheets were found to have been adopted and implemented in the firms with statistic values similar to scatter diagrams (*M*=1.93, *SD*=0.89). This shows that most of the respondents agreed to the statements describing check sheets with a few strongly agreeing. The standard deviation shows a close to a unit spread from the mean. The results show that most of the organizations had not adopted or utilized control charts as a process improvement tool. The statistic values (*M*=4.34, *SD*=0.72) show that most of the respondents in this study had disagreed to the statements describing control charts, with a few strongly disagreeing. The results were consistent with literature.

**Table 10: Descriptive analysis of 3 PI tools (pareto charts, Flow charts and Histograms)**

| Tool | Strongly agree | Agree | Neutral | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| Pareto Charts | 23.1 | 30.8 | 30.8 | 13.5 | 1.9 |
| Flow Chart | 17.3 | 34.6 | 7.7 | 38.5 | 1.9 |
| Histogram | 13.5 | 32.7 | 17.3 | 30.8 | 5.8 |

Manufacturing companies were found to have adopted and utilized pareto charts. When asked if their companies collect data, focused attention and applied resources to big problems areas, frequencies for those agreeing were (30.8%) and neutral (30.8%), those who were strongly agreeing (23.1%), those who disagreed (13.5%) and those who strongly disagreed (1.9%). The high frequency for the median (3) shows that some respondents agreed and disagreed in equal measure. However, since those who agreed and strongly agreed had a high percentage, we conclude that pareto charts were utilized as a PI tool in the manufacturing companies. The use of flowcharts was partially utilized by some of the companies as represented by those who strongly agreed (17.3%) and agreed (34.6%) However, those who disagreed were (38.5%), strongly disagreed (1.9%) and neutral (7.7%), With majority agreeing and strongly agreeing to using flow charts, we conclude that they were a popular tool among the manufacturing companies.

The findings showed that histograms were utilized as a PI tool. The respondents were asked if their companies collect data and plots histograms and CF curves, taking corrective action where necessary. The companies that agreed to utilizing histograms were (32.7%), strongly agreed (13.5%). Those who strongly disagreed were (5.8%), disagreed were (30.8%) and (17.3%) were not sure.

Greatbanks, (2005) noted that even the elementary 7QC tools have not been completely exploited. The findings of this study was in agreement with this literature as most of the 7QC tools were utilized by most of the manufacturing companies, with a few not completely exploited.

## 4.6 Operational Performance

All the descriptive variables explaining operational performance for this study were 18, describing four measures of operational performance namely quality, cost, speed and flexibility. The following table shows the results of the various performance indicator variables which were measured using a 5-point Likert scale where 1= strongly agree, 2= agree, 3= neutral, 4= disagree and 5= strongly disagree

**Table 11: operational performance indicators**

| Code | Operational performance Indicators | Mean | SD |
|---|---|---|---|
| | Quality | 3.02 | 1.361 |
| P1 | Product and service quality improvement | 3.10 | 1.600 |
| P2 | Very low/ negligible repairs/ reworks | 4.19 | 1.442 |
| P3 | Reduced customer complaints (customer satisfaction) | 2.02 | 1.462 |
| P4 | Increased sales | 2.92 | 1.186 |
| P5 | Quality control and quality certifications | 3.04 | 1.267 |
| P6 | Increased customer loyalty | 2.90 | 1.209 |
| | Cost | 3.448 | 1.503 |
| P7 | Inventory reduction | 3.81 | 1.727 |
| P8 | Waste reduction | 3.67 | 1.689 |
| P9 | Reduced scrap and rework costs | 2.35 | 1.153 |
| P10 | Labour productivity | 2.88 | 1.166 |
| P11 | Work in process reduction | 4.10 | 1.741 |
| P12 | Competitive pricing due to reduced cost of production | 3.88 | 1.542 |
| | Speed | 3.445 | 1.51 |
| P13 | Improved material flow and throughput | 3.88 | 1.789 |
| P14 | Improvement in productivity | 2.98 | 1.276 |
| P15 | Set up time reduction | 3.73 | 1.705 |
| P16 | Customer lead time reduction | 3.19 | 1.269 |
| | Flexibility | 3.69 | 1.37 |
| P17 | Manufacturing cycle reduction | 3.38 | 1.345 |
| P18 | Zero machine errors, zero losses from machines. | 4.00 | 1.386 |
| | Operational Performance | 3.3355 | .83865 |

The statistic values close to 3 indicate that the respondents agreed and disagreed to the descriptive statements in equal measure. These results indicate that the manufacturing companies had partially achieved certain aspects of operational performance. Some of the indicator variables that yielded a mean close to 3 included product and service quality improvement (*M*=3.1, *SD*=1.6), quality control and quality certifications (*M*=3.04, *SD*=1.267), customer lead time reduction (*M*=3.19, *SD*=1.269), manufacturing cycle reduction (*M*=3.38, *SD*=1.345).

Those near 4 and above indicate that most of the respondents disagreed with the statements and consequently deducing that such statements describing operational performance were not achieved as a result of implementation of PITTs. They included very low or negligible repairs (*M*=4.19, *SD*=1.442), inventory reduction (*M*=3.81, *SD*=1.727), waste reduction (*M*=3.67, *SD*=1.689), competitive pricing (*M*=3.88, *SD*=1.542), improved material flow and throughput (*M*=3.88, *SD*=1.789), work in process reduction (*M*=4.1, *SD*= 1.741), setup time reduction (*M*=3.73, *SD*=1.705), zero machine errors and losses (*M*=4.0, *SD*=1.386).

The quality measure of operational performance was partially achieved as a result of adoption and implementation of PITTs. The statistic values (*M*=3.0, *SD*=1.36) indicated that most of the respondents agreed and disagreed to the statements defining quality in equal measure. Similarly, cost and speed of delivery were partial achieved as a result of adoption and implementation of PITTS. The statistic values of (*M*=3.45, *SD*=1.50) and (*M*=3.45, *SD*=1.51) implies that most of the respondents agreed and disagreed in equal measure, with a few strongly disagreeing with the statements describing cost speed of delivery of products and services. Flexibility as a measure of performance was not achieved at all. This explained by the statistic (*M*=3.69, *SD*=1.37) with the mean statistic close to 4, an indicator that most of the respondents disagreed with the statements describing flexibility as a measure of operational performance.

Overall, operational performance was partially achieved by the manufacturing companies as explained by the static values (*M*=3.34, *SD*=0.84). This could also imply that there were other factors leading to operational performance of the companies rather than the adoption and implementation of the PITTs. These findings indicate that the adoption and implementation of PITTs directly affected the quality of product and service, cost and speed of delivery but did not necessarily affect the flexibility of operations. The findings were in agreement with literature especially the study by Nyamwange et al. (2015) who established that adoption of various PITTs had impacted positively on the organization performance and consequently on building its operational efficiency.

## 4.7 Moderating Factors

It was because of the reasons outlined above in the operational performance sub topic that moderating factors are important to help companies use and implement the process improvement tools and techniques successfully. This study targeted exploiting seven moderating factors with keen interest in training. The other six factors were management initiative, technology changes, increased competition, company expansion/ downsizing, customer feedback and regulatory compliances. The role of these moderating factors in performance was achieved through the analysis of the structural equation modelling discussed below.

## 4.8 Structural Equation Modelling (SEM)

For ease of analysis, all the item variables were coded as in table 12. The results findings in excel were then exported to SmartPLS for further analysis. The table 12 below shows the latent variables and their indicator variables. Since the sample size was below 100, the method of modeling used was the structural equation modeling (Hwang et al., 2010; Wong, 2010; Wong, 2013) which was done through a software known as Smart PLS version 3.2.4.

Structural Equation Modeling (SEM) is a second-generation multivariate data analysis method that is used for researches that need to test theoretically supported linear and additive causal models (Chin, 1996; Haenlein & Kaplan, 2004; Statsoft, 2013; Wong, 2013). It combines characteristics of factor analysis and multiple regressions to simultaneously examine both direct and indirect effects of independent and dependent variables (Faizan, 2017). With SEM one can visually examine the relationships that exist among variables of interest. The fact that unobservable, hard -to-measure intervening variables in this study makes it ideal for to use SEM.

According to Faizan (2017), there are two approaches to estimate the relationships in a structural equation model (SEM): Covariance-based SEM (CB-SEM) and Variance-Based VB-SEM/ PLS-SEM. Like with any statistical tool, PLS-SEM requires that researchers have considerable knowledge on the method applied, as PLS-SEM comes with several details that, if not treated correctly, can lead to incorrect conclusion, which can obviously cause severe problems for the future development of the theory (Nitzl, 2014). One of the basic requirements for running SEM analysis is the reliability and validity of the constructs. They were tested before running and the tests were good.

The justifications for using the PLS-SEM are outlined below as given by Faizan (2017).

- Primary objective of study is prediction and explanation of target constructs.
- Small sample sizes of 100 and below
- Ideal for Complicated models especially with moderating effects
- Assumptions about the underlying data are not taken into consideration
- Support reflective and formative measurement models as well as single item construct.

**Table 12: Constructs and indicator variables**

| Constructs | Constructs | Indicator Variables |
|---|---|---|
| Process Improvement Techniques | Benchmarking (BM) | B1, B2, B3 |
| | Kaizen (K) | K1, K2, K3 |
| | Business process Re-engineering (BPR) | BP1, BP2 |
| | Statistical Process Control (SPC) | SPC1, SPC2, SPC3 |
| | Failure Mode & effect analysis (FME) | FM1, FM2 |
| | Quality Function Deployment (QFD) | QFD1, QFD2, QFD3 |
| | Process Mapping (PM) | PM1, PM2, PM3 |
| | Lean Thinking (LT) | LT1, LT2, LT3 |
| | Six Sigma (SS) | SS1 |
| | Total Productive Maintenance (TPM) | TPM1, TPM2 |
| Process Improvement Tools | Pareto Charts (PC) | PC |
| | Ishikawa (ISHA) | ISH1, ISHA2 |
| | Flowchart (FC) | FC |
| | Scatter Diagram (SD) | SD1, SD2, SD3 |
| | Check sheets (CS) | CS1, CS2 |
| | Histograms (Hist) | Hist |
| | Control Charts (CC) | CC1, CC2, CC3 |
| Training | Training | T1, T2, T3 |
| Operational Performance | Performance (P) | P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P16, P17 |

**Training as an Intervening Variable in implementation of PITTs**

The respondents were asked how they viewed training on the process improvement tools and techniques as the intervening factor for the operational performance. Three types of training were of interest to the researcher including specialized training (T1), On the Job training (T2) and Off the job training (T3). Essentially, this was to know precisely the type of training on PITTs that yielded the best results in terms of operational performance. They also gave out the areas of training their employers had subjected them to in relation to their positions whether before, during or after adopting the PITT in their companies. These topics were trained to some of the participants in the study;

- Process improvement
- Quality control measure
- Client Need identification
- Process improvements
- Chemical and environmental health
- Compliance and international requirements for the fresh produce
- Quality inspection and customer relations
- Regulatory requirements for KRA for improved standards
- Quality inspection and customer relations
- Changing Dynamics

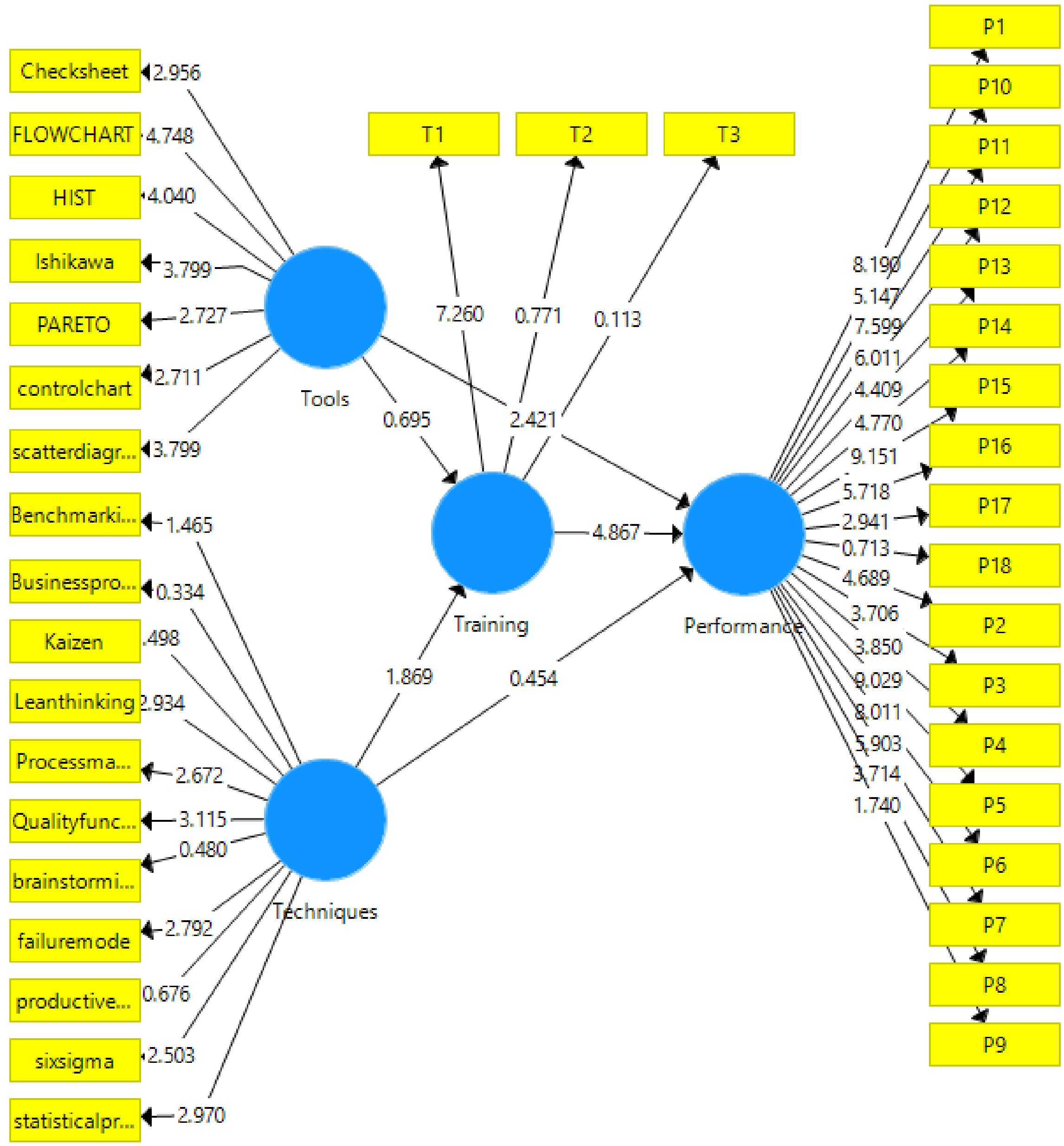


**Figure 2: Training as an intervening Variable**

The effect of training was analyzed using bootstrapping to produce the t statistic. The rule of thumb is that values above 1.96 are statistically significant while the values less than 1.96 are statistically insignificant. Figure 2 above showed that training was statistically significant with $t(52)=4.87$. This indicates that training is necessary for PITTs so as to achieve the required operational performance. Again, T1 (specialized training) was most likely to yield success in implementation of PITTs with $t(52)=7.26$, while on the job training and off the job training were found to be statistically insignificant with

$t(52)=0.77$ and $t(52)=0.11$ respectively. This was in agreement with Gitu (2012) who studied the factors influencing improvements at Nairobi City Water and Sewerage Company and deduced that workforce must receive specialized training and instruction from qualified professionals to ensure a sustainable continuous improvement of quality. Nyamwange et al. (2015) in their study revealed that manufacturing firms acquired specialized training and conducted quality induction programs that significantly contributed to operational performance. Muthengi & Soni (2005) in their study revealed that though kaizen was based on simple principles, its successful implementation required training, dedication, persistence and leadership by experienced users. These researchers support the findings of this study.

Other moderating factors are discussed in the structural equation modelling below

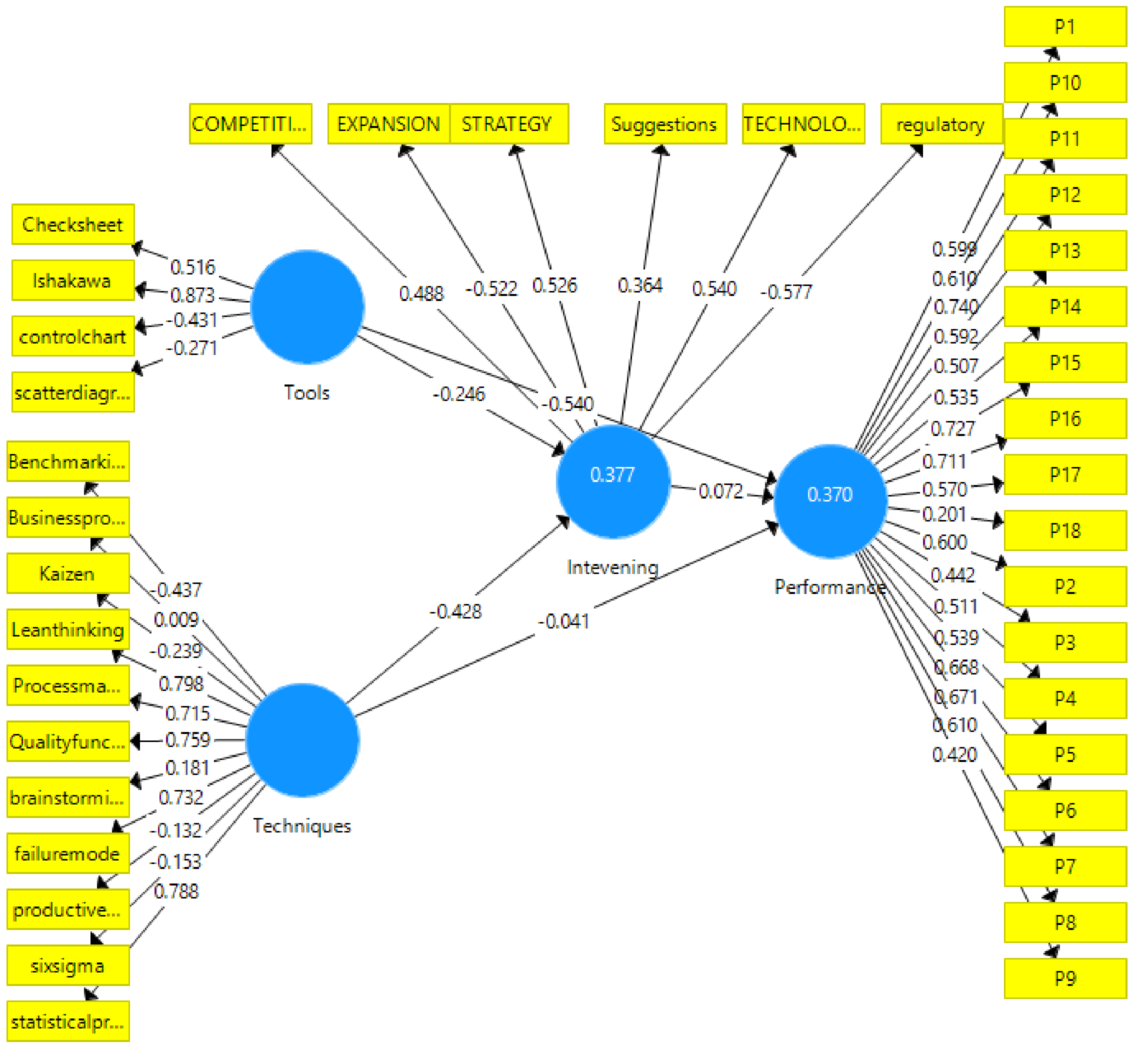


**Figure 3: PITTs and other intervening factors**

The figure 3 above was used to show the regression paths on how the specific variables loaded on their construct variables. The interpretation for these results is that for every unit increase in the item variable, the construct variable would change by the same magnitude of the given regression coefficients. Indicator variables with negative values are believed to cause negative change to their constructs while indicator variables with values less than 0.3 are believed to be of statistically insignificant relationship with their constructs (Ondiek, 2016). For the model to be of good fit, these statistically insignificant variables ought to be removed.

The figure 3 above showed that moderating factors associated with performance by a Pearson coefficient factor of 0.377. However, regulatory compliance and expansion/ downsizing caused the companies to negatively perform by a coefficient of -0.577 and -0.522 respectively. The other intervening factors were positively impacting performance and the implementation of PITTs with unit changes of 0.54, 0.364, 0.526 and 0.488 for technology, customer suggestions, strategic initiative and increased competition respectively.

## 4.9 Relationship between PITTs, moderating factors and operational performance

**Table 13: Mean, STDEV, T-Values, P-Values**

| | Sample Mean (M) | Standard Deviation (STDEV) | T Values | P Values |
|---|---|---|---|---|
| **Techniques -> Performance** | 0.026 | 0.189 | 0.454 | 0.650 |
| **Techniques -> Training** | -0.683 | 0.354 | 1.869 | 0.052 |
| **Tools -> Performance** | -0.417 | 0.187 | 2.421 | 0.016 |
| **Tools -> Training** | 0.171 | 0.283 | 0.695 | 0.488 |
| **Training -> Performance** | 0.627 | 0.138 | 4.867 | 0.000 |

Process Improvement tools seemed to have a direct impact on the operational performance ($M$=0.417, $SD$=0.187), $t$(52)=2.421, $p$=0.016 as compared with the techniques ($M$=0.026, $SD$=0.189), $t$(52)=0.454, $p$=0.65. Training had a statistically significant influence on performance with ($M$=0.627, $SD$=0.138), $t$(52)=4.867, $p$=0.000. However, there was an influence of techniques with training ($M$=0.0.683, $SD$=0.354), $t$(52)=..869, $p$=0.052). The rule of thumb that any value below 1.96 are insignificant which should be confirmed using the p-value statistics significance threshold of 0.05 and below.

## 4.10 Correlations

Correlation reflects the strength of relationship and direction between two constructs. The correlations of the latent constructs were carried in the Smart PLS analysis and produced the following results. According to Rumsey (2016), correlation coefficient (r) range from +1 to -1 whereby, a negative value implies a negative relationship and positive value implies a positive relationship. In addition, an r value of exactly 1 implies perfect linear relationship, 0.7 is a strong linear relationship, 0.5 is a moderate relationship, 0.3 is a weak relationship and 0.0 implies that there is no linear relationship.

**Table 14: Variable correlations**

| | Intervening | Performance | Techniques | Tools |
|---|---|---|---|---|
| **Intervening** | 1.000 | 0.376 | 0.584 | 0.518 |
| **Performance** | 0.376 | 1.000 | 0.727 | 0.603 |
| **Techniques** | 0.584 | 0.727 | 1.000 | 0.636 |
| **Tools** | 0.518 | 0.603 | 0.636 | 1.000 |

The table 14 above showed that the association between the intervening variables and the performance were positively but weakly correlated r(52)=0.376. Further the association between techniques, tools and performance recorded a moderate positive correlation r(52)=0.584, 0.518 respectively.

## CHAPTER FIVE

## SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

### 5.1 Introduction

This chapter will summarize the results of the findings, give conclusions and recommendations. The summary, conclusions and recommendations will be based on the general and specific objectives of the study which were guided by the various literatures of other scholars as well as theories such as competitive advantage theory and knowledge-based view theory.

### 5.2 Summary of findings

The general objective for the study was to determine how adoption of PITT affected the operational performance of manufacturing firms in Kenya with specific objectives of identifying the levels of adoption of the process improvement techniques, tools by Kenyan manufacturing firms, assessment of the moderating factors on the operational performance of the companies and establishing the relationship among PITT, moderating factors and operational performance and assessing the moderating effect on process improvement.

All the 14 categories of the manufacturing and exporters firms identified by the study were represented. Operations managers were the majority in the participation of the study followed by the production managers, quality assurance and plant managers the least. More of the youths took up these positions with a significantly small number for those aged above 50 years. Majority had experience of 10 years and below in the positions they held. Most of the companies were locally constituted with their market being largely in Kenya and very few practiced pure exports for their products.

Process improvement techniques under study were eleven namely; bench marking, six sigma, kaizen, BPR, statistical process control, brainstorming, failure and effect analysis, quality function deployment, process mapping, lean thinking and total productive maintenance. Out of these eleven techniques, only five were found not to be fully utilized by these companies namely BPR, benchmarking, kaizen, brain storming and total productive maintenance since their t-test statistics and p-values failed the test.

Seven process improvement tools were studied; check sheet, pareto chart, flow chart, control chart, histogram, Ishikawa diagram and scatter diagram to find out which ones the companies under study used. Results showed that the process improvement tools were all statistically significant using the t-test statistic and the p-values.

Eighteen performance indicators were sought on which ones were attributable to the adoption of PITTs. The findings showed that only two factors could not be attributed to the levels of adoption of the process improvement tools and techniques, which included reduction scrap and rework costs and having zero machine errors, zero losses from machines and zero work-related accidents. The eighteen operational performance indicators were also representing four operational performance measures namely quality, cost, flexibility and speed of delivery. It was found that quality, cost and speed measures were directly attributable to adoption and implementation of PITTs.

The effect of moderating factors was analyzed using structural equation modelling. It was found out that regulatory compliance and expansions/ downsizing of companies affected the operational performance of the companies negatively. The correlation coefficients of the other moderating factors (competition, management initiatives, suggestions from customers, technology changes and regulatory compliance) on the dependent variables were weak. However, training had a strong correlation on the operational performance implying that on the onset of the adoption of the PITTS, there was need to carry out specialized training on the staff for an effective operational performance. On the job and off the job training did not yield strong results.

## 5.3 Conclusions of the study

Based on the findings of this study, several conclusions were reached. There was more uptake of the youths in the managerial positions of production divisions with few respondents working up to their late ages. This could imply that most of the respondents were well versed with most of the PITTs under study as some of these PITTs were recently discovered. Operational performance, especially quality in companies could not be realized without the uptake of the process improvement techniques and the tools. For operational performance to be realized, the process improvement tools and techniques have to be moderated by other external factors mainly specialized training in conjunction with other factors like the competition, management initiatives, suggestions from customers and technology. Training had a strong correlation on the operational performance implying that on the onset of the adoption of the PITTS, there is need to carry out specialized trainings on the staff for an effective operational performance.

## 5.4 Recommendations of the study

The adoption of a single technique or tool does not guarantee operational performance of the company. It is a recommendation that the two must be simultaneously used to achieve satisfying results of the companies. We recommend the companies to be informed of all the techniques and tools and adopt the ones that fit them most.

It is recommended to the government to put up regulatory measures that affect the companies in a positive way rather than negative. Also, to the companies, strategies ought to be put in place to accommodate changes in the company (expansion or downsizing) so that the operational performance is affirmed.

## 5.5 Limitations of the study

The research was limited to firms that were listed in the KAM (2017) manufacturers and exporters directory. The study targeted the accessible population and specifically firms which were willing to participate in the research thus far flung manufacturing firms were not reached. Firms in the service industry were also not well represented, as the KAM (2017) manufacturers and Exporters directory lists them as one category.

## 5.6 Suggestions for further Research

The companies under study were those registered in the 2017/2018 Kenya manufacturers and exporters directory. It is important to study the upcoming companies (startups) with an aim of enlightening them on the PITTs. A study on the topic in the service industry is also recommended.

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**APPENDICES**

## Appendix 1: Letter of Introduction

UNIVERSITY OF NAIROBI
SCHOOL OF BUSINESS

DATE 24TH OCTOBER 2018

**TO WHOM IT MAY CONCERN**

The bearer of this letter JOSEPH NDATA NZIOKI

Registration No. D61/82582/2015

is a bona fide continuing student in the Master of Business Administration (MBA) degree program in this University.

He/she is required to submit as part of his/her coursework assessment a research project report on a management problem. We would like the students to do their projects on real problems affecting firms in Kenya. We would, therefore, appreciate your assistance to enable him/her collect data in your organization.

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

Thank you.

UNIVERSITY OF NAIROBI
SCHOOL OF BUSINESS
24 OCT 2018

PROF. JAMES M. NJIHIA
DEAN, SCHOOL OF BUSINESS

# Appendix 2: Questionnaire

**Part I- General information about the organization and respondent.**

1. Company Name (optional) ……………………………………………………………

2. In what sector of manufacturing does your company belong? (Tick in the appropriate box).

| | | |
|---|---|---|
| 1. | food and beverages | |
| 2. | service and consultancy | |
| 3. | Chemical & allied | |
| 4. | plastics and rubber | |
| 5. | textiles and apparels | |
| 6. | energy, electrical and electronics | |
| 7. | building, mining and construction | |
| 8. | pharmaceutical and medical | |
| 9. | timber, wood and furniture | |
| 10. | pharmaceutical and medical | |
| 11. | Metal & allied | |
| 12. | paper and board | |
| 13. | fresh produce | |
| 14. | leather and footwear | |
| 15. | Others | |

3. Position of respondent (Tick as appropriate)

a) Production manager ( )
b) Operations manager ( )
c) Process manager ( )
d) Plant manager ( )
e) Quality Assurance manager ( )
f) Other (specify)

4. What is your age bracket?

a. 25-35 years ( )
b. 36-45 years ( )
c. 46-55 years ( )
d. Above 55 years ( )

5. How many years have you worked in this position

a. Below 5 years ( )
b. 5-10 years ( )
c. 11-15 years ( )
d. 16-20 years ( )
e. Above 20 years ( )

6. How many years have you worked for this company in this position?

a. Below 5 years ( )
b. 5-10 years ( )
c. 11-15 years ( )
d. 16-20 years ( )
e. Above 20 years ( )

7. How can you describe the ownership of your company? (Tick as appropriate)

a. Local ( )
b. Foreign ( )
c. Government Parastatal ( )
d. Other (Specify) ( )

8. Please indicate the percentage of products or services sold in these markets:

a. Local market…………………………
b. Foreign market………………………

**Part II- Extend of Adoption of PITT**

1. Please rank by ticking in the appropriate box the nature and extent to which the attributes below are significant to your company using the following rating: 1 = strongly agree, 2= agree, 3= neutral, 4= disagree and 5= strongly disagree.

| ATTRIBUTES | RATING | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Company compares and measures its business process against business process of other leading firms | | | | | |
| Company uses knowledge and experience of other firms for their advantage | | | | | |
| Company adopts best practices from industry leaders | | | | | |
| The organization assesses its performance against other firms | | | | | |
| The organization coaches staff for continuous improvement | | | | | |
| Employees in all levels of an organization are involved in improvement process | | | | | |
| Waste elimination in all systems through improving standardized activities and processes | | | | | |
| Company redesigned its processes | | | | | |
| Company integrated the business process redesign and the corporate strategy | | | | | |
| Company monitor, detect and eliminate the substandard materials and counterproductive operations in the process. | | | | | |
| Abnormal trends identified and problems solved before they get out of hand | | | | | |
| Process is regulated to maintain the standard and | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| consistent product output | | | | | |
| Company allows individual or group divergent thinking programs, open expression of all ideas regardless how outrageous or wild | | | | | |
| Company encourages generation of many raw ideas, evaluates and develops into more viable solutions to problems | | | | | |
| company identifies the potential failures of products and complex systems and evaluate their effects | | | | | |
| Company initiates actions that eliminate or reduce or prevent the chance of recurring potential failures. | | | | | |
| Company has structured approach for translating customer requirements into design specifications. | | | | | |
| proper communication between the client and design team | | | | | |
| Company prioritizes manufacturing processes and specifications for key process parameters | | | | | |
| Company transforms data into visual representation of work processes which shows how inputs, outputs and tasks are linked. | | | | | |
| Company identifies bottlenecks, wasted activities, delays and duplication of efforts. | | | | | |
| Company eliminates non-value adding activities and reduces process complexities and develops future state maps | | | | | |
| The organization focuses on demand and supply in order to keep minimum inventory levels | | | | | |
| Company ensures Continuous flow of the raw materials and product | | | | | |
| Company has adopted a systematic approach to identify and eliminate waste in all its operations | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| company removes process variations | | | | | |
| Company achieves zero to negligible defects in products | | | | | |
| Company collects process data, focuses attention/ apply resources to big problem areas | | | | | |
| Company engages employees to detect/ identify root causes of quality problems & their effects | | | | | |
| Cause & Effect diagrams are revised as solutions are found | | | | | |
| Company plots facts relating to existing processes in a flow chart | | | | | |
| Company uses flow chart to identify bottlenecks & wasteful processes & eliminate them | | | | | |
| Company plots variables in a graph to determine how they are related | | | | | |
| Company uses the relationships to control either variable | | | | | |
| Company uses the graphs to make predictions | | | | | |
| Company uses direct observation to gather facts about a process using tally/ check marks | | | | | |
| Company uses the tally charts/ measles charts to analyze and improve processes | | | | | |
| Company collects data and plots histograms and CF curves, takes corrective action where necessary | | | | | |
| Company monitors processes in control using means and ranges | | | | | |
| Company makes decisions based on upper and lower action and warning lines | | | | | |
| Company uses data to detect and predict change and also improve processes | | | | | |
| Company gives attention to autonomous and preventive | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| maintenance | | | | | |
| Company conducts training of maintenance employees and standardizes maintenance processes | | | | | |

**Part III - Operational performance indicators and the factors influencing the choice of PITT.**

1. Please rank by a tick in the appropriate box the nature and extent to which the implementation of process improvement tools and techniques has impacted your company's operational performance using the following ratings: 1= strongly agree, 2= agree, 3= neutral, 4= disagree and 5= strongly disagree

| **Operational performance Indicators** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| Product and service quality improvement | | | | | |
| Very low/ negligible repairs/ reworks | | | | | |
| Reduced customer complaints (customer satisfaction) | | | | | |
| Increased sales | | | | | |
| Quality control and quality certifications | | | | | |
| Increased customer loyalty | | | | | |
| Inventory reduction | | | | | |
| Waste reduction | | | | | |
| Reduced scrap and rework costs | | | | | |
| Labor productivity | | | | | |
| Work in process reduction | | | | | |
| Competitive pricing due to reduced cost of production | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Improved material flow and throughput | | | | | |
| Improvement in productivity | | | | | |
| Set up time reduction | | | | | |
| Customer lead time reduction | | | | | |
| Manufacturing cycle reduction | | | | | |
| Zero machine errors, zero losses from machines and zero work-related accidents. | | | | | |
| **Others (specify)** | | | | | |

2. What factors have led to adoption of PITT in your company? 1= strongly agree, 2= agree, 3= neutral, 4= disagree and 5= strongly disagree.

| **Factors influencing adoption of PITT** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| Management Initiative (part of Strategy) | | | | | |
| Technology changes | | | | | |
| Increased competition (survival tactic) | | | | | |
| Company expansion/ down sizing | | | | | |
| Customer feedback (suggestions) | | | | | |
| Regulatory compliance | | | | | |
| Others (specify) | | | | | |

**Part IV - Extent of training on PITT**

1. Did your company employees undergo any training (Specialised/ On the Job/ Off the Job) in any of the PITT prior, during or after adoption? Specify

2. Please tick appropriately the extent to which the following training on the PITT has led/ can lead to increased operational performance in your company using the following rating: 1= strongly agree, 2= agree, 3= neutral, 4= disagree and 5= strongly disagree.

| **Mode of Training** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| Specialized (T1) | | | | | |
| On the job (T2) | | | | | |
| Off the job (T3) | | | | | |

## Appendix 3: List of Companies Interviewed

| | Name of Company |
|---|---|
| 1 | Simba Apparel (EPZ) Limited |
| 2 | Kenya Trading (EPZ) |
| 3 | Insight Kenya |
| 4 | Unilever East Africa |
| 5 | Kenya Power Limited |
| 6 | East african cables |
| 7 | Metsec Cables Limited |
| 8 | Dilpack Kenya Limited |
| 9 | Fontana Limited |
| 10 | From Eden |
| 11 | Sunland Roses |
| 12 | Alpine Coolers Limited |
| 13 | Aquamist Limited |
| 14 | Baker Corner |
| 15 | Brookside Dairy |
| 16 | Alpharama |
| 17 | C&P Industries |
| 18 | Athiriver Tanneries Limited |
| 19 | Athi River Steel Plant |
| 20 | Agro-Irrigation Pump |
| 21 | Doshi & Company Hardware |
| 22 | Davis & Shirtliff |
| 23 | General Motors |
| 24 | Simba Corporation |
| 25 | Allpack Industries |
| 26 | Chandaria Industries |
| 27 | Paperhouse of Kenya |
| 28 | Rai Plywoods (k) |
| 29 | Kentainers Limited |
| 30 | Techno Plast Limited |
| 31 | Safepak Limited |
| 32 | Kenpoly Manufacturers |
| 33 | Beta Healthcare International |
| 34 | Biopharm Limited |
| 35 | Njimia (K) Limited |
| 36 | Zain Pharmaceuticals |
| 37 | Mckay & Company Advocates |
| 38 | NIC Bank |

| | |
|---|---|
| 39 | Premier Training Services |
| 40 | Darfords Enterprises Limited |
| 41 | Kapa Oil Refineries |
| 42 | Mombasa Cement |
| 43 | East African Portland Cement |
| 44 | Highlands Mineral Water |
| 45 | Mastermind Tobacco |
| 46 | Mini Bakeries (K) Limited |
| 47 | Banbros Limited |
| 48 | Timsales Limited |
| 49 | Kenya Ports Authority |
| 50 | Crystal Africa Limited |
| 51 | Crown Paints |
| 52 | Saj Ceramics |