AN ASSESSMENT OF COMPUTER AIDED DESIGN ADOPTION IN APPAREL PRODUCTION AMONG SMALL AND MEDIUM SCALE APPAREL MANUFACTURERS IN KISUMU CITY, KENYA

BY

GRACE A. TITI

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SCHOOL OF ARTS AND SOCIAL SCIENCES

MASENO UNIVERSITY

DECLARATION

I declare that this thesis is my original work and has not been submitted to any other university for the award of any degree

Signature..... **Date.....**

GRACE A. TITI

PG/MA/052/09

This thesis has been submitted to Maseno University Board of Postgraduate Studies for the fulfillment of Master of Arts degree in Design with the approval of:

PROF. SUSAN ABONG'O

DEPARTMENT OF ART AND DESIGN

SCHOOL OF ARTS AND SOCIAL SCIENCES

MASENO UNIVERSITY P.O. BOX 333 MASENO, KENYA

Signature..... **Date.....**

DR. OKOTH SYLVESTER Mc OYOWO

DEPARTMENT OF COMPUTER SCIENCE

SCHOOL OF COMPUTING AND INFORMATICS

MASENO UNIVERSITY P.O. BOX 333 MASENO, KENYA

Signature..... **Date.....**

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DEDICATION

To the almighty God be the glory and honor, Amen.

ABSTRACT

The large scale apparel industry can acquire the latest equipment as well as computer software such as Computer-Aided Design (CAD) to maintain a competitive edge in production. The integration of CAD technology in the apparel production and marketing chain has been explored and emphasized in the large scale industries. The adoption of CAD in production processes in apparel firms was, therefore, crucial if the apparel industry within Kisumu City was to remain competitive in the global market. However, the small and medium scale (SMEs) apparel manufacturers in Kisumu City still employed manual methods of production instead of automation, with no emphasis on upgrading their production methods. The purpose of the study was to assess the proportion of CAD adoption in apparel production among small and medium scale apparel manufacturers in Kisumu city. The specific objectives of the study were to establish the proportion of CAD adoption in apparel production, determine the patterns of CAD use and explore factors influencing the adoption of CAD in apparel production among SME apparel manufacturers in Kisumu city. The study has significantly contributed to the development of knowledge on CAD use and curriculum development on apparel skills training for SMEs within Kisumu city. The study used concepts of Systems theory Betalanffy (1968), which explains that the skills and techniques employed in a production process have an impact on the quantity and quality of apparel products. It was limited to SME apparel manufacturers. On secondary data, a systematic approach was taken to identify published and unpublished literature on the adoption of CAD use. The research used a descriptive survey research design. The study was within Kisumu City. The study population was SME apparel manufacturers. The target population was 293 manufacturers. Purposive sampling was used to select a sample size of 117 respondents which represented 40% of the target population. Data were collected using structured questionnaires, key informant interviews, and observations. Descriptive statistics were used to analyze quantitative data and presented in frequencies, means, and percentages. Qualitative data were transcribed, organized into themes, and finally reported. The characteristics of the respondents indicated 59% of employees were female, form 4 leavers or below were 85%. A total of 59.1% acquired skills training on the job, and did not hold any certificate on skills training. They employed the use of basic machines for production and lacked specialty among the products. The study established that 80% did not involve the use of CAD. The average level of output for those who used CAD was 93%. On patterns of CAD use, CAD in design was the most popular (35%). The findings further revealed that the level of education and skills acquisition processes influenced production methods and the quality of products. The study concluded that the majority of the respondents had limited capital investment, a low level of education, and obtained their skills on the job. The SMEs were capable of coping with the new trends of technology. The findings also suggested that skills and skills formation were an indispensable part of production. The study provided information which could be of use to strengthen manufacturing in the SME apparel sub-sector and among similar enterprises in Kenya. The study recommends the sensitization of CAD use, CAD training and enforcement of policies within the apparel sector. The research suggests a comparative study to establish if skills influence levels of production.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

CAD	-	Computer-Aided Design
CBD	-	Central Business District
COMESA	-	Common Market in Eastern and Central Africa
DDP	-	District Development Plan
EPZA	-	Export Processing Zone Authority
EU	-	European Union
GDP	-	Gross Development Product
GoK	-	Government of Kenya
KIPPRA	-	Kenya Institute for Public Policy Research and Analysis
KNBS	-	Kenya National Bureau of Statistics
KPMG LLP	-	Klynveld Peat Marwick and Goerdeler Limited Liability Partnership
Kshs	-	Kenya Shilling
KSM	-	Kisumu
MUERC	-	Maseno University ethics review committee
NACOSTI	-	National Commission for Sciences, Technology, and Innovation
NDP	-	National Development Plan
RATES	-	Regional Agricultural Trade Expansion Support
SDG	-	Sustainable Development Goals
SMEs	-	Small and Medium-scale Enterprises
T&C	-	Textile and Clothing
TVET	-	Technical, Vocational, Education, and Training.
UNDP	-	United Nations Development Programme

OPERATIONAL DEFINITION OF TERMS

Adoption- The stage of selecting technology for use by an individual or an organization.

Apparel- Clothing, especially outer garments, attires

Apparel Industry- Makers and sellers of fashionable goods

Apparel production The process by which computers are employed to enhance the development and manufacturing of products

CAD- A wide range of computer-based tools and software‘s that assist design professionals in creation, modification, analysis or optimization of design

CAD software-A program that provides the user with input tools to streamline design processes, drafting, documentation, and manufacturing

CAD users- Manufacturers who use computer-aided design programs and software‘s during apparel development

CBD- The hub of commercial and retail business activities

Diffusion- The stage in which the technology spreads to general use and application

Industry - The aggregate of manufacturing or technically productive enterprises in a particular field, often named after its principal product e.g., the automobile industry; the steel Industry, Apparel Industry

Pattern: a hard paper which is made by following each component for a style of garment or apparel. It could also be referred to as a template from which the parts of a garment are traced onto fabric before being cut out and assembled

Patterns of use - describes the behavioral patterns of CAD use and their related services by the user.

Production the processes used to transform semi-finished goods/sub-assemblies into goods or services.

Small scale industry- Firms with fewer than 10 employees

Medium scale enterprises - Firms with employees between 10-50

Manufacturer – A person/entity that makes a product through a process involving raw materials, components, or assemblies employing different operation methods

LIST OF PLATES/ PHOTOS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The apparel industry is one of the most critical sectors of the economy concerning investment, trade, revenue, and employment generation all over the world (European Commission [EU], 2010). According to Theo (2003), the apparel industry has unique characteristics of being labor-intensive, and plays an essential role in the industrialization of today's developed countries. He further suggests that developing countries wishing to industrialize should begin with the apparel manufacturer. The sector includes made-to-measure and ready-to-wear garments which are considered as one of the primary sources of increased foreign exchange earnings. The ready-to-wear garment industry, which ranks among the largest consumer goods industry in the world, is also regarded as the most dynamic segment in the apparel industry (Yaqoob, 1991).

The large scale apparel industries around the world have adopted the use of CAD as the latest technology to remain competitive in the global market. One key strategy in the industry competitiveness appears to be the ability to develop a means of product differentiation and delivering the right quality products that meet customer expectations (Anderson, Sara, Cavanagh, and Thea, 1999). The use of the latest technology has raised the need by the SMEs in apparel manufacturing firms to focus on new competitive strategies due to challenges brought about by CAD. Collier (1990) report indicated that the adoption of CAD technology in apparel production, and marketing chain, has been explored and emphasized in the large scale industries. It proved to be necessary since the development of apparel products and their success in marketing depends on the production method used, which influences the effectiveness, quality, and quantity of apparel product.

The strategies employed in a production process determine the internal strengths and the opportunities of the manufacturing firm. The need to develop production methods to compete in the global market effectively is the logical step in the evolution of technological skills. The study, therefore, underscores the importance of establishing the proportion of CAD adoption in production processes among small and medium scale apparel firms within Kisumu City if the industry was to remain competitive in the global market.

The rapid growth of technological advancement in many industries, including the apparel industry, has forced businesses to demand a computer- literate workforce (Smith & Necessary, 1996). Computer technology can reduce the time required to complete a task, increase the accuracy of many of these processes and serve the interests of large scale apparel manufacturers (Glunk and Kunz, 1990). Even though CAD increases accuracy in the production of apparel products, Chajed (1998) emphasized that the CAD system is merely a tool and it cannot replace the primary skill of the designer, but helps to elaborate the imagination, and increase the work efficiency.

Apparel manufacturers are now seeking for faster and more efficient methods of product development. This is because the nature and speed of technological innovations and accompanying organizational changes in developed countries are finding it more difficult to keep up with the gap between developed and developing countries. These trends affect not only the direction, composition, and volume of international trade in textiles and garments but also the industrialization process and labor markets at a country and regional level (Jezkova, 1993). In Asia, countries like China, Malaysia, and Japan have increased their patterns of CAD use to produce at a cost advantage over other countries.

The majority of their production systems use computers, which leads to greater efficiency and effectiveness in production (E.U., 2017). This competition has put much pressure on SMEs who find it difficult to market or sell their products.

In Africa and other developing countries, the apparel manufacturing industry is still considered a labor-intensive enterprise providing employment opportunities to a large number of men and women. In Kenya, the textile and apparel sector was once the fifth-largest foreign exchange earner but dropped to a minimum contribution of the Gross Domestic Product (GDP) from the mid and late 90s. However, data available for the last five years indicated that the sector is on its way to recovery mainly due to AGOA and increased government support (EPZA, 2005). It shows that there is a market for locally manufactured goods which necessitates exploration. According to EPZA (2012) report, the sector accounts for about 44.4% of Kenya's Gross Domestic Product (GDP), and contributes more than 53% of the country's export earnings, and employs about 79.7% of the population. The industry also generates a high turnover rate with relatively little capital investment. It is partly because the large part of it falls under the category of SME apparel industry which requires low capital investment.

In Kenya, the textile and apparel sector has the potential to play a critical role in anchoring the country's more profound movement into the middle-income status and in serving as a source of gainful employment for its fast-growing, young population (the Republic of Kenya, 2018). The SME apparel industry contributes significantly to the socio-economic development of the country, which is facilitated by an enabling environment for sustainable growth and promotion of commerce, trade, tourism, and regional integration. These processes are promoted to improve the welfare of all Kenyans (Government of Kenya, 2002). The large scale apparel manufacturers in Kenya are increasingly using computer-technology in apparel production.

The manufacturers who have adopted the use of CAD programs and software during apparel development have different ways of application. Their patterns of CAD use ranged from designing, pattern making, pattern grading, marker making, pattern layout, fabric cutting to development of prints among other production processes. The application of CAD in large scale apparel manufacturing firms has been the cutting edge in terms of agile product development, consistent quality, and faster dispatch of goods (Medcrave, 2019). The patterns of CAD use among the SMEs have not been established.

The development of apparel products and their success in marketing depends on the production method used, which influences the effectiveness, quality, and quantity of apparel production. The Kenya Vision 2030 (GoK, 2007) emphasizes on the country becoming the provider of choice for basic manufactured goods in central and eastern Africa. The parliamentary service commission (2019) further expounds on the manufacturing sector as crucial for the achievement of vision 2030 and is arguably the most important for job creation because of its strong forward and backward linkages with other areas in the economy.

The industry mainly produces agro-processing products, textiles, leather, construction materials, and machinery. The micro and small scale enterprises (MSE) dominated the industry and with characteristics of low skilled jobs. Mason and Kachienga (2012) further noted that in 2004, the manufacturing sector in Kenya accounted for over 20 percent of Kenya's gross domestic product (GDP), provided employment to about 300,000 people in the formal sector and 3.7 million persons in the informal sector. The apparel industry also has direct linkages with the textile processing that are important for the exploitation of new market opportunities presented by AGOA, the European Union, and other markets where Kenya can export the apparel products.

The opportunities presented by AGOA provide Kenya with a ready market for external trade if well utilized. According to RATES (2003), such interventions also create employment for many people directly and indirectly. Most of the apparel industries are in cities and urban centers, dominated by tailors and dressmakers who make clothes to customer's orders, and have not adopted the use of CAD (Coughlin, 1991).

Even though Kenya has enjoyed business opportunities, the country has been unable to keep pace with the global industry's dynamics and technological changes. Despite being active throughout the entire value chain, meaningful integration has remained elusive. The SME apparel subsectors have remained uncompetitive and limited investment downstream has led to capacity imbalances and relatively weak productivity and quality in the finished products. It is particularly telling that 93% of the garment segment's textile inputs are of import (Kisumu Polytechnic, 2015).

Kisumu city, the third-largest city in Kenya after Nairobi and Mombasa has developed to become the leading commercial, trading, industrial, communication, and administration center in the lake basin region (GoK, 2009). The city's administration is currently engaged in planning for the SME apparel industry in terms of site and funds. The achievement is through collaboration with other institutions, the private sector—moreover, donor-funded programs. Kamwela (2016) further affirms that the government of Kenya and development organizations has put a focus on promoting and supporting the SMEs as a way of enhancing and encouraging broader participation in the manufacturing industry.

The county government of Kisumu has also planned to repossess and revive all factories that had stalled. The blame on the cotton mill's collapse in the region was on the lifting of price controls,

which led to the liberalization of the cotton sub-sector. After that, investment of minimal effort and resources had been put in the value-added chain in the SME apparel sector in Kisumu County (Njenga, 2014). Currently, the county is implementing a garment making cluster that will bring together the SME apparel manufacturers in addressing their production needs. The group is the first one of its kind in Eastern and Central Africa, sponsored by the European Union, through COMESA (Common Market of Eastern and Central Africa). The county's strategic plan also gives a clear signal that there is a future in the apparel sector. It was therefore deemed essential to strategize on ways of developing the SME apparel sector since they were the leading employers in the informal sector within the city.

The city has industries that include: apparel industries, soft drink manufacturers, ironsmith, fish industries, and farm machinery industries (GoK, 2009). The SME apparel industry creates employment for the residents of Kisumu city. According to the census of 2009, the city had a population of 473,649 persons which has been increasing at a rate of 4.7% annually (GoK, 2012); the promotion of the apparel industry provides a window of opportunity for improving individual income for local entrepreneurs. A random survey conducted by the researcher in Kisumu town revealed that most of the SMEs apparel enterprises were individually owned and employed between one to fifty employees. Another study conducted on 16 micro and small scale garment producers outside Nairobi (16 districts), revealed that most of these firms were producing suits, men's, ladies and children's wear, embroidery products and uniforms with minimal use of CAD in their production processes (RATES, 2003).

In Kisumu city, the SME apparel manufacturers provide apparel products and services to individuals and institutions; hence, an essential source of both formal and informal employment.

It showed that the role of the SME apparel industry needed to be looked into to determine its crucial role in the county's economy. SME's manufacturing sector is the most significant manufacturing contributor to the Kenyan economy. They represent the most substantial proportion of the manufacturing industry in Kenya (Kagechu, 2013). The manufacturers within Kisumu city do not focus on the mass production of fashion apparel. The ready-to-wear clothes available to the consumers are either imported or are second-hand goods, even though there was an increase in the growth of the SME apparel industry in Kenya (Wafula, 2007). This growth is an attribution to new changes in technology such as the use of CAD, but SMEs manufacturers within Kisumu had clung to the manual methods of production. The techniques used were almost static, and yet technology is dynamic.

The efficiency with which technologies are implemented and adopted determines the success of any industrial operation. No technology remains static, and any technology in place has to be continuously upgraded to reduce the cost of production and introduce new products as well as Product differentiation (GoK, 1996). Trends in the global market make it clear that Kisumu would be unable to compete sustainably, unless the SMEs within the county improved on their production patterns, efficiency, workforce development and the formation of favorable policies, to remain truly competitive (GOK 2015). It would influence the quality of apparel products, which may affect the economic growth of Kisumu city. As noted by GoK (2015), inflexibility in TVET programs also poses a mismatch between the skills learned and the skills demanded by industries, non-inclusion of CAD in training programs, as well as lack of sufficient modern equipment, played a crucial role in selection of production method.

The focus of the study was to assess the proportion of CAD adoption in production by SMEs apparel manufacturers as a change in technology, and to determine the new methods of

production and establishing its influence on the quality, quantity, and efficiency of production. Previous studies have shown that the patterns of CAD use in apparel manufacturing can enhance productivity to a great extent hence contributing to the economic growth of a country (Medcrave, 2019). The benefits of CAD in the apparel industry were observable in the large scale apparel industry which had contributed to global, national, and local economies. With CAD software, a designer could not only see his or her creations as a digital image but also create a scale on pieces and denote dimensions of garment parts. It saves time by limiting the need for tailoring and other later adjustments. A designer can see her design on a virtual model and then plays with color and fabric choices to perfect their designs (Giselle, 2010).

SMEs apparel manufacturing firms have faced stiff competition from overseas companies. They have continually been looking for new ways to reduce labor and material costs, to respond to consumers' needs, and improve on the quality of garments it manufactured even though fashion changes more quickly. New computer technologies such as CAD were, therefore, essential to establish if its inclusion would help the SME apparel industry meet their production needs and compete with the rest of the world. In Kisumu, there were no apparent records of studies concerning the use of CAD in the apparel industry. Relevant studies have shown CAD to be very important as a new technology in production and had shown a significant impact in large scale industry in terms of quantity, quality, and labor reduction.

1.2 Statement of the Problem

The integration of CAD technology in the apparel production and marketing chain has been explored and emphasized in the large scale industries. The assessment of CAD adoption in apparel production processes among firms is crucial if the SMEs are to remain competitive in the global market. However, to the researcher‘s understanding, an assessment of the adoption of CAD and change in production processes among SMEs apparel manufacturers in Kisumu city had not been established. It is in this light that the study seeks to fill the existing gap by determining the proportion of CAD adoption in apparel production by the SMEs during manufacturing. The SME apparel manufacturers have stuck to manual methods of production instead of automation, with no emphasis on upgrading their production methods to new technology. These manual methods of production take a prolonged period, less active or poor quality in some cases, and expensive processes. These methods involve much human labor and are rather tiresome, hence slow down the production process. The slow process in production reduces its competitiveness against imported ready-to-wear and second-hand clothing, which have been constructed by CAD-related equipment. It also poses challenges for the SME apparel industry in urban centers to compete with products from other countries which have adopted CAD use. The patterns of CAD use and factors influencing its adoption by SME apparel manufacturers have not been assessed. Since the impact of CAD has been experienced in large scale apparel manufacture, the study, therefore, intended to establish the proportion of CAD adoption in apparel production, the patterns of CAD use by the SMEs apparel industry as well a identifying any possible influence in the production processes among the SMEs apparel manufacturers in Kisumu city.

1.3 Purpose of the Study

The purpose of the study was to assess the proportion of CAD adoption in apparel production among SMEs apparel manufacturers in Kisumu city.

1.4 Objectives of the Study

The main objective of the study was to determine the proportion of CAD adoption in apparel production among SMEs apparel manufacturers in Kisumu city.

The specific objectives of the study were to:

i. Establish the proportion of CAD adoption in apparel production among small and medium scale apparel manufacturers in Kisumu city

ii. Determine the patterns of CAD use in apparel production among small and medium scale apparel manufacturers in Kisumu city

iii. Explore factors influencing the adoption of CAD in apparel production among small and medium scale apparel manufacturers in Kisumu city.

1.5 Research Questions

The research questions that the study attempted to answer were:

i. What is the proportion of CAD adoption among small and medium scale apparel manufacturers in Kisumu city?

ii. What are the patterns of CAD use in apparel production among small and medium scale apparel manufacturers in Kisumu city?

iii. What are the factors influencing the adoption of CAD in apparel production among small and medium scale apparel manufacturers in Kisumu city?

1.6 Significance of the Study

Small and medium scale apparel manufacturers have stuck to manual methods of production that are very slow, less effective, of poor quality in some cases and render the processes expensive. They tend to use more manual methods of production, which involve much human labor and are rather tiresome, hence slow down the production process. In a study carried out by Mason, Bowling, and Niemi (2000) they indicated that the vision for the industry of the future is to be second to none in the global economy. By operating as a highly competitive, flexible, just-in-time, manufacture-on-demand system, that facilitates free competition and specialization among manufacturers and suppliers. They argue that the reality is, many existing small firms are ill-equipped to participate in this vision. Moreover, there is a concern that the learning cycle for SMEs to implement Computer-Aided Design (CAD) is too long and costly for them to make the transition effectively.

The study, therefore, becomes necessary to emphasize techniques that small and medium scale apparel manufacturers could adopt to remain competitive to the increasing change in technology. By utilizing improved technology, there would be an impact on the production method, hence improvement on the quality of the end product. The study provided information for strengthening production strategies among the SME apparel manufacturing sub-sector within Kisumu City and among similar enterprises in Kenya. This strategy is in line with the economic pillar of vision 2030 of the Kenyan government, which emphasizes the application of information communication technology and computerization.

The Kenya Vision 2030 (GoK, 2007) emphasizes on the country becoming the provider of choice for essential manufactured goods in central and eastern Africa.

The overall intention of Kenya‘s vision 2030 is to be a globally competitive and prosperous nation with a high quality of life. The vision is further strengthened by the budget watch of the Parliamentary Commission (2018), which focuses on manufacturing as one of the four key pillars. The manufacturing agenda intends to emphasize expanding the sector‘s contribution to economic growth by focusing on the acquisition of appropriate and relevant skills that sustain and increase the competitiveness of locally manufactured goods against cheap imports.

The study is also in line with SDG no 8, which promotes sustained economic growth, higher levels of productivity, and technological innovations. The goal encourages entrepreneurship and job creation as an effective measure to eradicate forced labor, slavery, and human trafficking. With these targets in mind, the goal is to achieve full and productive employment, and decent work, for all men and women by 2030 (UNDP, 2016).

These, therefore, presented the need to improve the productivity and competitiveness of the economic sector in SME apparel since there is an emphasis on large scale apparel industries. The SME apparel manufacturer if emphasized could produce garments for both local and international markets. The adoption of computer-aided design at all levels of production could help bridge the gap between SMEs and large scale apparel industries in terms of technology and quality. This study has contributed to the development of knowledge on CAD use, penetration, and curriculum development concerning apparel skills training for SMEs within Kisumu city.

1.7 Scope of the Study

The study was limited to SMEs apparel manufacturers that had less than fifty employees, within Kisumu city, in Kisumu Central (Sub-County). The study was also to determine the proportion of

CAD adoption in production among small and medium scale apparel manufacturers in Kisumu city. This was within a target population of 293 SMEs.

1.8 Theoretical Framework

The theoretical framework adopted for the study was derived from the concepts of systems theory that were put forward by Betalanffy (1968). Systems theory is a system that focuses on many interdependent parts functioning as a whole for some purpose. The policy explains that the skills and technology applied in a production process have an impact on the quantity and quality of the apparel product; hence the adoption of CAD skills and technology in the production process would influence product quality and quantity.

The theoretical framework premised on variables anchored on the selected theories for this research. In general systems theory, the input in the production cycle is a process into output and feedback sent to be part of the next contribution. The production process begins with the design of the product as an input, whose results rely on the acquired skills. The skills gained differ from one producer to another, depending on where training skills had been acquired. The attitude, creativity, awareness, or experience further influences one's skills in the business. The entry-level to the apparel industry production cycle is determined by the level of education, the type of skills training, and available capital. Mbwambo (2005) explains that there is a direct relationship between formal education and the success of entrepreneurs. Culture further explains superior performance among financially constrained individuals.

The education level contributes positively and significantly to the performance of SMEs. However, according to Rogerson (2009), the most successful entrepreneurs in SMEs apparel manufacturers are trained on the job. The concept of transformation:- in the production process,

an experienced apparel SMEs will produce a highly styled product based on CAD skills while a less skilled manufacturer may have difficulty in production since some of the skills are based on manual methods of production. The products will generally be subjected to competition and will have a competitive advantage depending on the quality. Highly styled products would sell faster and at a higher price as compared to poorly designed products. The whole process leads to production output.

The products manufactured by the SMEs employ different techniques such as CAD for production, which leads to different styles and qualities of products. It is an assumption that product differentiation leads to business growth as well as increased individual income, which also boosts the national economy. The feedback obtained from the consumer is communicated to be the next input. It guides the producer in evaluating the progress of the business and allows the making of rational decisions. F.g.1.1 illustrates the system's production process with interdependent parts functioning as a whole.

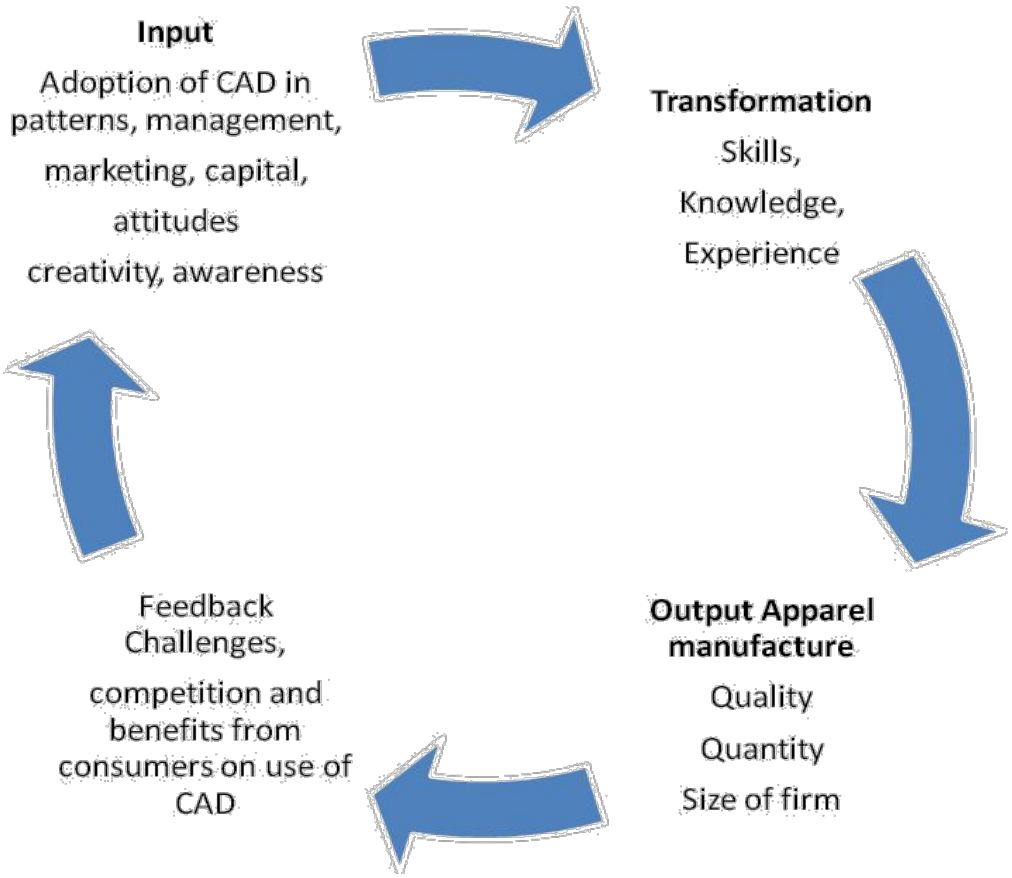

Figure 1. 1: An Illustration of Apparel Production Cycle (general systems theory) derived from Betalanffy, (1968)

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section provides a review of the works previously done and is related to the subject under study. Contributions of these past researches were meant to bridge the gaps concerning the present study. The study intended to assess the proportion of CAD adoption in apparel production among the SME apparel manufacturers in Kisumu city.

The literature review was in sections. It focused on CAD adoption in the apparel industry, the patterns of CAD use in apparel production and factors influencing the adoption of CAD. Also, it's Influence on the growth of SMEs apparel industry.

2.2 Adoption of CAD in the Apparel Industry

Apparel industry has played and continues to play a significant role in the economy of developed as well as developing countries. In today‘s world, the large scale apparel industry makes a substantial contribution to national economies, especially in the developing world. The apparel industry contributes to the socio-economic development of the country through the facilitation of an enabling environment for sustainable growth and promotion of trade, commerce, tourism, and regional integration (GoK, 2002). In this regard, an increasing number of countries, including India and Kenya, are investing in this industry for reasons of economic growth (Mason & Kachienga, 2012). They do not argue that investing in enterprises should be preferred to other business ventures, but rather be considered as an alternative for industrial growth.

Since production methods required for industrial growth are varied, SMEs must decide which alternative method would benefit the firm most. The apparel industry is also recognized as being

the stepping stone for industrial development. The study noted that these first steps are facing challenges from competitors such as China and Asia which have adopted the use of CAD for mass production and export of ready-made clothes to the Kenyan market (Kaplinsky & Morris, 1999). According to Sendler & Wawer (2008), they explained that CAD technology had enabled experts to produce three-dimensional (3D) models, compared to the traditional methods where the SMEs had to use paper and pen to create designs. The conventional techniques took more time and were more troublesome to maneuver.

The decline of Kenya‘s textile industry also contributed to the production challenges faced by SMEs. It was as a result of market liberalization policies of the early 1980s, which were spearheaded by the World Bank and opened up the local economy to second-hand clothes. The second-hand clothes have influenced consumer preferences since the construction of these clothes is a result of CAD and other specialized machines. Kenya, Uganda, and Tanzania import second-hand clothes that hurt the SME apparel industry. Kenya alone imports around 100,000 tonnes of second-hand clothes, shoes, and accessories a year (Kubania, 2015). Mark (2012) further argues that the influx of cheap clothes has heaped pressure on the SMEs apparel industry that is already struggling to adopt CAD as a change in technology amid patchy infrastructure. A lot of emphases were, therefore, necessary for the sustainability of the SME apparel industry.

The apparel industry is one of the country‘s strategies for economic recovery as outlined in several policies such as economic recovery for wealth, employment creation and investment programme for the economic recovery strategy among others (GoK, 2007). The development of any country largely depends on the industrial input that has been put in place. An industrial input that focuses on quality improvement through integration of CAD use is one, but one-way for SMEs to improve their competitiveness and respond effectively to technological changes.

Even in the absence of competition, improvement in quality could facilitate a firm‘s competitiveness in the global region. To improve on quality, the importance of formulation and implementation of growth-oriented policies that focuses on the adoption of CAD as a production method was necessary. The use of CAD has been noted to improve quality and quantity of production in the large scale apparel industry.

The adoption of CAD is the decision of acceptance, rejection, and the subsequent implementation, by an individual or an organization. Adoption is an individual or organizational process that leads to diffusion as a systematic process. Taherdoost (2018), describes the technology acceptance model as one which explains the motivation of users by three factors; perceived usefulness, perceived ease of use, and attitude toward use. Therefore, adoption is guided by two chief beliefs like perceived usefulness and ease of use, which have a considerable impact on the perspective of the user. Sometimes, other factors known as external variables (user skills, production methods, user participation in design, and the implementation process nature) are a consideration in the model of CAD adoption.

Empirical evidence suggests a growing number of large scale apparel sectors attempting to develop global products for industrialization by adopting use of CAD skills. In Kenya, the goal of manufacturing has long been a strategy for economic development. The sector accounts for about 24% of Kenya‘s GDP, which contributes more than 50% of the country‘s export earnings and employs approximately 75% of the population (EPZA, 2005). Currently, the SME apparel industry has received emphasis as the primary strategy for addressing the principle challenges of development in Kenya, which contributes to employment creation and poverty eradication (Ronge & Nyangito, 2000).

The sector accounts for 24% of Kenya‘s GDP, and if emphasis could be put to improve on production processes by adopting the use of CAD, It could also be possible that the percentage of GDP could increase. It is further confirmed by Collier, J.R., & Collier, B., (1990), who stated that CAD/CAM technology is becoming increasingly apparent in the textile and apparel industries and their integration throughout the production and marketing chain is emphasized and explored.

According to RATES (2003), the apparel sector employs a large number of people directly and indirectly. The beneficiaries of direct employment are a large number of the population. It explains the importance of emphasizing on the SME apparel production sector so that more avenues could be created for employment. Without skilled SMEs, production could not be valid. The SMEs employed are also trained to enhance their CAD skills and to make production achievable. The apparel industry is a sector where CAD technology could be adopted even in emerging countries at relatively low investment costs. The technological features such as CAD have made it suitable as the significant steps on the industrialization ladder in large scale apparel industries in Bangladesh, Sri Lanka, Viet Nam, and Mauritius (Nordas, 2004). Indeed, the rapid advancement in technological features and CAD skills would greatly facilitate the development of apparel products among SMEs.

The CAD technology has also revolutionized the large and SMEs apparel industry in India and, has become a cornerstone of many new manufacturing strategies (Kaur and Kaushal, 2015). The use of CAD in the large scale apparel industry has been practiced for many years in developed countries all over the world and has brought a revolution in the industry which has evolved to cover many different aspects of the garment design and development process (European Commission, 2010).

These studies confirm that the use of CAD in large scale apparel industry has been the practice for long and the industry has realized its impact on the production process. It has not been the case for the SME apparel industry, of which production methods do not take into account the technological changes. The importance of relating technological changes becomes necessary with the situation in Kisumu, particularly with the reality of SMEs. It was evident that if the SMEs could adopt the use of CAD in their production process; there could be some influence considering the impact experienced in the large scale industries.

Small and medium scale enterprises adopt strategies due to technological changes and competitive forces in different ways. Some improve current products, while others employ techniques that ensure operational effectiveness. The production process involves the designing, of which designers initially sketch designs by hand. A growing number in large scale apparel industries translate these sketches to the computer through CAD software. CAD software allows designers to view maps of clothing on virtual models and in various colors and shapes, saving time by requiring fewer adjustments of samples and prototypes (Corea, 2007).

The CAD software has become one of the essential tools for pattern making and related jobs in the clothing industry. It has so many advantages in apparel manufacturing and has brought a revolutionary change in today‘s readymade apparel export business (Mayedul, 2017). Computer software is further used to convert the initial idea of a product into detailed engineering design. Computer Aided Design replaces the sketches and engineering drawings traditionally used to visualize products and communicate design information (Mc GrawHill, 2003).

On the side of management, large scale apparel industries used CAD software to enhance the ability to analyze situations, make cost-effective decisions, and communicate with others.

However, the small and medium scale apparel industries have continued to practice traditional methods of production as well as management. Computer communications are the leading trends of the day in the textile and apparel industry, impacting the way all companies do business (Brown & Rice, 1998). In large scale industries, the internet is further used to enable easy access and retrieval of documents containing text, and graphics from websites anywhere in the world. The internet has made a computer communication network to be more useful for apparel designers. Large scale apparel manufacturers have adopted the use of CAD software in Kenya. The adoption of CAD use among the SME apparel manufacturers as concerns communication has not been established.

As production processes change, SMEs find themselves in an unfamiliar environment and have to respond by integrating change and internalizing the ability to adapt to the new environment for survival and growth. Technological innovations must be adopted within a production line, and the role of the user must be considered in the acceptance process since different user groups tend to have different levels of perception of the technology, and evaluate adoption and implementation from that perspective (Park et al. 2009). ILO (2000), further confirms the diversity of technology in use in Kenya‘s apparel industry, but little documentation has been given and therefore, challenging to identify the level of technology integration in the apparel industry.

It was, therefore, necessary that the adoption of CAD as a new technology in the market needs to be enhanced by SMEs at all levels of the apparel production process. The adoption process of CAD software established was to establish the proportion of its use among the SME apparel manufacturers in Kisumu, and if there if influence on the production process.

2.3 Patterns of CAD use in Apparel Production

SMEs play an essential role in the Kenyan economy. According to the Economic Survey (2006), the sector contributed to over 50 percent of new jobs created in the year 2005. The SMEs manufacturing enterprises frequently cluster together in open air or sheds and exposed to the sun that could be used to build collective efficiency (Navdi, 1999). The aggregate efficiency determines the patterns of CAD use employed for production by these enterprises. The profiles of CAD use in large scale apparel industries have been to design, draw, create woven textures, and drape models to create patterns, adjust sizes, and determine fabric colors and trying various combinations in diagrams (Palak, 2012). Medium and small scale apparel manufacturers use traditional production methods, yet new technology focuses on the use of CAD and computer-aided means of production in the market.

Computer Aided Design is the driving force to industrialization in the apparel and textile sectors. The usefulness of CAD has driven the market to produce specific software for different aspects of textile and apparel manufacturing (Textile Exchange, 2008). The CAD software has already been in use in large scale apparel industries as well as other production sectors. The position of small and medium scale apparel industries has not been determined. The study helped to define the patterns of CAD use in the SME apparel industry as well as identifying the possible influence in the production process.

There are several CAD software's available in the market for apparel production. These are designed for specific use and desired end product. Raaz (2017) indicates that in the fashion industry, CAD software is used to assist in the design process to allow it to be more detailed. It makes it easier to ensure that designs are flowing together in one collection.

The adoption of CAD makes textile designs more attractive and competitive to meet the rapidly changing mood of the consumer for fashionable designs, both nationally and internationally. The available patterns of CAD use established in the market included: CAD in design, CAD in pattern drafting, CAD in cutting, and CAD in the making. Examples included: 3D Body scanner: 3D Body scanning system for an apparel industry scans the human body. The software is a combination of body scanner and measurement extraction. The emerging applications of these technologies are unlimited and include; custom fitting apparel**,** apparel sales, sizing survey, apparel sizing standards development**,** 3D product development, automotive seating, body shape analysis, adequate evaluation and other applications like virtual reality and ergonomics (Gerald, 2007). 3Dimension body scanner shown in Plate 2.1 scans the whole body in seconds and rapidly produces a true-to-scale 3D body model. The available CAD software enables large scale firms to develop competitive advantage on their products in a way that is difficult for competitors to imitate.

Plate 2. 1: 3D Body Scanners (DALC University, 2010)

The global competition has recognized the role of product and process improvement in business strategy. The involvement of CAD software has improved business development in large scale apparel industry. Software such as Adobe Photoshop, Adobe Illustrator: has enabled designers to re-color scanned fabrics or images without having to reduce the number of colors, and most importantly, without losing their original textures and shadings.

Illustrator can be used both technically and creatively. Illustrator is quick and easy to produce both detailed technical drawings for the factory and perfect colored drawings for designs. Illustrator can easily be adapted to make drawing fashions fast and efficient (Gulnazahmad, 2010). The illustration strategy has emphasized on the improvement of product and process designs in the apparel industry. Style draper pro: which enables designers to apply virtually any kind of fabric to a line model, so they can display new designs with their existing models, therefore creating an infinite range of samples, while Gemini CAD: provides fast and accurate support for the entire preparation of a new garment from simple design to production optimization.

It is important to note that the advancements of technology and the ever-changing demands of the market needs have been the real forces behind the changes in apparel production. The made to measure computer software which generates a pattern based on customer‘s measurements by applying alterations to pattern pieces without manually making pattern modifications were employed, for example, Acumark CAD software simplifies and accelerates pattern design, grading, and marker generation. Plate 2.2 shows an example of patterns generated by the use of Acumark software.

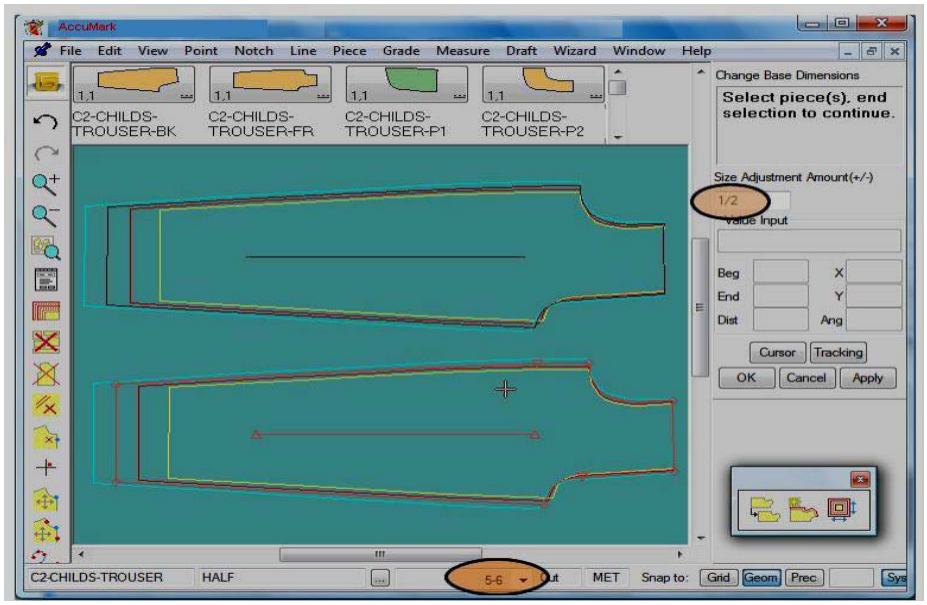

Plate 2. 2: Patterns generated by the use of Acumark (African Apparels, 2010)

Other uses of Acumark CAD software include a comprehensive set of pattern development tools, grading of patterns for the full range of sizes, computerized marker making for best fabric use, import and export of data to a wide variety of CAD systems, design and prototyping capabilities. Gerber plotter presented in plate 2.3 works along with the computer; it enables the developed markers printed in full-scale patterns. The available software in the market, therefore, provides opportunities for apparel manufacturers with new technology to explore in the current market.

The future of the apparel industry is also determined by technology if such systems interfaced part programming routines that obtain explicit machine control information. The positive responses to technological changes require firms to change their strategy which does not match to its environment and also to redesign their internal capability to match this strategy. If the approach of the firm is not matching with its environment, then a strategy gap arises.

Porter (1990) affirms that it is essential for firms to shift their production strategies with changes in the background and match their capabilities to the selected procedure to survive, and remain relevant.

Plate 2. 3: **Gerber plotter for printing (African Apparels, 2010)**

Changes in production processes shape a firm‘s opportunities and challenges. A new production process necessitates the formulation of a new strategy best suited to cope with change. The use of Computer-Aided grading software, as shown in plate 2.4, enables the pattern developer to grade a range of sizes at the click of a button. The graded patterns are then separated and printed independently. The application of CAD asserts its usefulness, as an essential tool for production in large scale apparel industry. Most manufacturing companies implemented CAD as the designing and manipulation tool to produce blueprint patterns (Sackett & Gubanc, 2004).

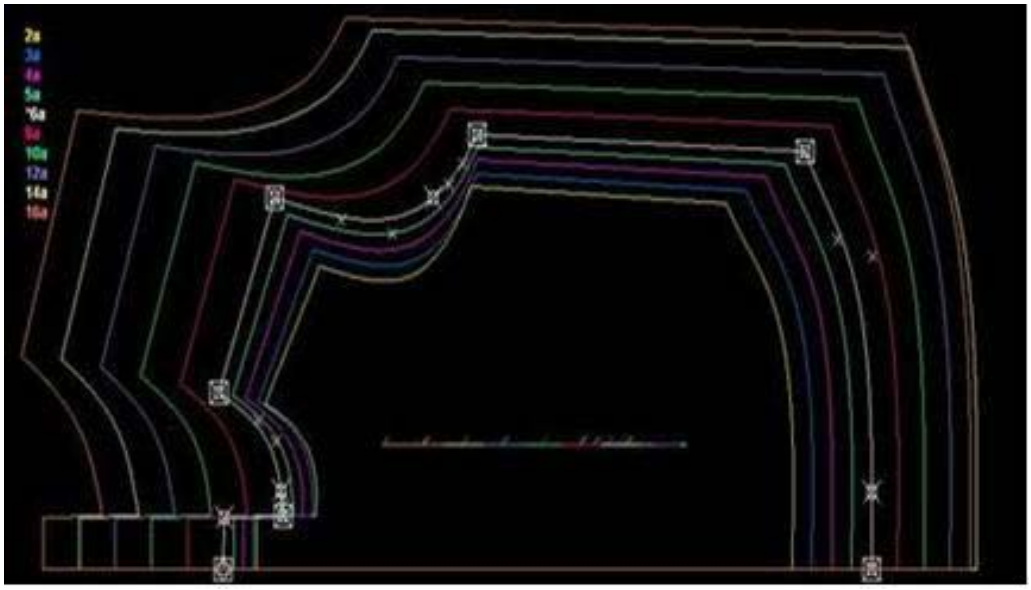

Plate 2. 4: **A pattern developed by Computer-aided grading software (Textile School, 2010)**

Quality improvement is but one-way for small and medium apparel manufacturing firms to improve their competitiveness and respond effectively in regards to industrialization. Computerized cutting machines have improved the effectiveness of cutting processes in the apparel industry.

An automatic cutter shown in plate 2.5 is an automated machine in which the patterns laid onto the cutting table. The set machine automatically cuts the patterns. Rorah (2016) affirms that textile cutting is a standard pre-production stage in the apparel manufacturing process that has developed from a manual to a fully automated procedure in recent decades. The Lacer cutting technology has improved the efficiency and sustainability of cutting pattern markers on a large cutting scale, as well as the ability to cut intricate internal patterns and shapes on a smaller cutting scale.

Plate 2. 5: **Automatic cutter (EPZA, 2005)**

Computerized Embroidery machine in plate 2.6 is an automated machine in which the designs are scanned and digitized into the computer program. The set machine automatically embroiders the designs. The embroidery CAD technology has improved the production processes in the aspects of interface, speed, and reliability. Its impact has created a source of competitive advantage for manufacturing industries which is widely accepted by practitioners, governments, and academics. To attain competitive advantages, it is therefore vital for companies to emphasize on CAD technology and how they use it in the organization (Phaal R. Farrukh, C., & Probert, D. 2001).

Plate 2. 6: **Computerized Embroidery machine (Signature brandings, 2011)**

Computer Aided Design is an essential tool in the large scale apparel industry. The adoption of CAD use is evident at different levels of apparel production processes.

Among the standards adopted include computerized buttonholer (plate 2.7) which is software that enables the garment maker to set the machine in such a way that it automatically cuts and works on the buttonhole. Buttonholer CAD technology has enabled apparel manufacturers to make buttonholes within a limited time as compared to the traditional method, which, took more time and was more troublesome (Kang et al.,2014).

Plate 2. 7: **Computerized Button Holler (Rongo University, 2017)**

CAD is an essential tool in the large scale apparel industry. The adoption of CAD use is evident at different levels of production processes. Among the standards adopted include computerized buttonholer (plate 2.7) which has software that enables the garment maker to set the machine in such a way that it automatically cuts and works on the buttonhole. Buttonholer CAD technology has enabled apparel manufacturers to make buttonholes within a limited time as compared to the traditional method, which, took more time and was more troublesome (Kang, 2014).

The implementation of CAD within the apparel firms has been a complete change in the production process. CAD could be seen as an innovation process because the impact of the changes could be radical. The aspect of pressing has been made easier by computer-controlled pressing, which allows **t**he garments dressed onto the dummy pressing machine (plate 2.8), and at the click of a button, the machine presses the set clothing. It is seen that the contributions of CAD nowadays in the apparel manufacturing sector are supporting what the previous researchers

have mentioned before like Löwstedt (1989) looked upon the implementation of CAD and how it changed the organization, he found out that new technology created changes in the organization but it does not decide the changes trajectories.

Plate 2. 8: Computer-controlled pressing machine (Press machine, 2011)

Computer-controlled sewing (Plate 2.9) is a conventional electric sewing machine. It has the necessary components of a sewing machine, and besides, it can sew different sorts of stitches. The device has in-built processers, as well as small monitor display for more effortless operation. In these models, the computer directly controls several different motors, which precisely move the needle bar, the tensioning discs, the feed dog, and other elements in the machine. This excellent control makes it possible to produce hundreds of different stitches. The integration of CAD with other applications can shorten the product development process and increase the efficiency of the workforce.

According to Haoxue, M. (2004), the rapid development of computer technologies has significantly impacted the product development process.

Computer-Aided Design (CAD) has been used to fulfill the various design and sewing tasks, and realize product concepts in the early phase of the product development process, without physical parts manufactured.

Plate 2. 9: **Computer-controlled sewing machine (Computers in Biology and Medicine, 2007)**

Computerized quilting machine (Plate 2.10) is widely in use for producing mattresses and quilted duvet. It does the feeding of material, spreading, quilting, and cutting automatically. It adjusts presser foot depending on material, huge memory in computer system to enable it to quilt intricate patterns, and keep the continuing quilting of the trend even in case of intermission switch-on, low noise, precision, stable and excellent performance. Professional punching system is primarily for designing, producing and stimulating of computerized quilting patterns.

Plate 2. 10: **Computerized single-needle quilting and duvet making machine, (Global sources 2017)**

Computer-aided design (CAD) is increasingly in use within the fashion design industry. CAD allows designers to view maps of clothing on virtual models and in various colors and shapes, thus saving time by requiring fewer adjustments of prototypes and samples later (Kaur, 2014).

The CAD sublimation system for large inkjet plotters shown in plate 2.11 are designed for applications of wide printable widths. The professional and commercial users can produce the sublimation- transferred printings in a timely and cost-effective manner; T-shirts, decorated apparel, promotional products such as banners, tradeshow graphics, carpet graphics, sporting goods, interior signage, and tile murals.

Technology and innovation, therefore, become an essential inclusion in the textiles and apparel industry; the challenge remains the rate at which technologies keep on changing almost daily. It is, therefore, difficult for apparel manufacturers who are trying to adopt patterns of CAD use to compete in the competitive market (Nguku, 2012).

The apparel sector has also experienced challenges in acquiring skilled personnel in CAD as well as a lack of effective coordination of training policies as concerns the new technology. Kamau (2012) argues that the application of apparel CAD technology in the training of the future labor force is a significant step in coping with dynamic changes apparent in production processes in the textile and apparel industry. CAD is, therefore, crucial if the industry is to remain competitive in the global market.

Plate 2. 11: **Large format inkjet plotter (http://www.chempland.co.kr/img/inkjet, 2012)**

The implementation and usage of CAD technology in the apparel industry has come a long way since its inception. CAD technology has transformed the way SMEs operate in the global industry, and apparel manufacturing ceased to be a small-scale industry. Banerjee (1995) emphasized that a more flexible, dynamic, and versatile technique like CAD has developed to keep pace with the diversity of modern generation demand. Manufacturing activities create not only opportunities for technology transfer, but also environmental skills and knowledge development, which could be adopted in other industries to promote products that could lead to the inventive competitive edge (Mason & Kachienga, 2012).

Besides, CAD technology has faced changes that have posed a significant challenge to the SME apparel sector. Many SMEs appear to be unfamiliar with new technologies. Those who seem to be well-positioned are often unaware of this technology, and if they know, it is neither locally available nor affordable or not situated to local conditions (GOK, 2012).

Today the apparel industry attracts the best professionals globally and is highly regarded as a serious business. As a result of this growth and global cross border development, technology providers are dedicating customized services specifically for the apparel industry (Nordas, 2004). Since technology is changing at a fast rate, producers in developing countries such as Kenya are forced to look for ways to adapt to the current trends of production. CAD has become indispensable for textile designers and has led to endless possibilities.

The entire process of designing is revolutionized, where previously designers used to labor over graph paper and stencils. Now they have to play with a mouse or stylus pen to come out with innovative designs and the result is not only an increase in speed, but greater accuracy than the manual process. It is no wonder that even SMEs designers and manufacturing in developing countries are using CAD systems (Oates 2005). The change has forced the small and medium-scale manufacturers to look for strategies to differentiate themselves from other firms, typically through incremental innovations in manufacturing processes and market innovations (Mason & Kachienga, 2012).

In Kenya, technology levels in the small and medium scale apparel industry are still relatively low, and most firms still use standard industrial sewing machines and only the large establishments producing high-quality clothing have introduced CAD and other computer software for designing, special sewing operations, and inventory control.

Jezkova (1993) affirms that small and medium scale apparel manufacturers still used simple operator-guided electric machines, while some firms in export processing zones (EPZs) used computerized attachments. In Kisumu city, a pilot study by the researcher revealed that the majority of small and medium scale apparel manufacturers are in the Kibuye market. Most of these traders produce low-quality wear for low-income consumers. On the other hand, manufacturers in the city center produce high-quality, fashionable apparel.

Although adoption of CAD in the large scale apparel sector is on the increase, there is little documentation on the position of CAD adoption among SMEs within Kisumu County. It, therefore, becomes challenging to identify the level of technology adoption in the SME industry. The technology adoption process, therefore, should have an organized structure and pathway. According to Denise (2001), technologies are outlined by their application and the desired outcome. He emphasizes the need for the industry to be exposed to various techniques such as CAD to be competitive in the business world.

2.4 Factors Influencing the Adoption of CAD and its Influence on the Growth of Small Scale Apparel Industry

The apparel industry is a labor-intensive, low wage, dynamic, and innovative sector depending on which market segments are focused. In the high-quality fashion market, modern technology describes the characteristics of apparel industry as relatively well-paid workers and designers, and a high degree of flexibility (Nordas, 2004). In India, the textile and apparel industry contributes significantly to the Indian economy. It accounts for 14 percent of total industry output and nearly 5 percent of Gross Domestic Product (GDP). It provides direct employment to 38 million people and is the largest foreign exchange earner, contributing almost 20 percent to India's total exports (Kaur, 2014).

In Kenya, the switch from import substitution to liberalization influences the small and medium scale apparel industry's growth, which released workers and created a niche for the smaller enterprises hence resulted in retrenchment and closures of large scale firms (Shefali's & Carr, 2004). It led to high volumes of imported garments and other textile products which pushed local producers out of the market.

Kenya's economic underperformance in comparison to Asia is its failure to industrialize and establish sustainable export and domestic markets by developing the manufacturing capability for competing for both locally, regionally and in global markets (Mason & Kachienga, 2012). Nyori and Ogola (2015) further confirm that over the past few decades, the manufacturing sector has evolved from a more labor-intensive set of mechanical processes to a sophisticated set of information-based technology processes. They attribute to the existence of various advanced manufacturing technologies, which perform more and more functions by these machines instead of human labor.

Theo (2003), states that the apparel industry played an essential role in the industrialization of today's developed countries. The sector has unique characteristics of being labor-intensive and links with outer segments of the economy, such as agriculture. He further suggested that developing countries wishing to industrialize should begin with the clothing and apparel industry (Theo, 2003). It is also easy to enter this sector, as the capital required is little and training services widely available in schools and colleges. It characterized by relatively low operational costs as customers often supply the raw material to be made for them (Rates, 2005).

Technological advances, which include automation and computer-aided designing systems in all the areas of manufacturing, including the textile and apparel industry, have changed business practices that have affected the apparel industry. Automation, in general, can be explained as the use of automatic equipment in place of manual labor. The scenario is significant in the large scale apparel industries with increased emphasis on the use of CAD and quick response to customer demand. Rapid response capability links apparel manufacturers more closely to related firms in the textile and retail sectors of the economy. Fast response is aided by communications technology which is communicated to and received from firms in the industry. Other technological features that have influenced the apparel industry include computerized equipment and material transport systems.

Even though the technology and the sequence of operations have not changed much, CAD innovations have improved efficiency at each stage of production and not least, improved coordination between stages and provided a more seamless interface between them (Nordas, 2004). Computers and CAD software aid in many functions, such as design, marking, and cutting. Overhead conveyor systems used to transport material between sewing machine operators and other sewing processes.

Besides these changes, the SME apparel industry, especially its sewing function, has remained significantly less automated than many other apparel manufacturing industries.

In Kisumu city, the government has also played a vital role by actively promoting the establishment of small and medium scale industry, to encourage the manufacture of affordable and high-quality garments in the area (NDP, 1996). Further efforts are being made to provide the necessary infrastructure which include an extension of rural electrification program, credit providers such as non-governmental organizations, women enterprise development, credit organizations, banks, and, cooperatives. Such efforts encourage factors that could influence the growth of the small and medium scale apparel industry in Kisumu city. The efforts could affect the rate of production as well as an improved economy.

The apparel and textile industry has faced several challenges due to globalization such as cheaper imports from Asia (Nguku, 2012), as well as second-hand goods which have been constructed by modern equipment such as CAD. Kenya, Uganda, and Tanzania import used clothes that do much damage to the local apparel and textile industry. Kenya alone imports around 100,000 tonnes of second-hand clothes, shoes, and accessories a year (Kubania, 2015). The apparel industry has further faced significant challenges such as increased volumes of imported goods entering the domestic market, in the contemporary U.S. textile and apparel industry as an attempt to foster development in selected world regions and maintain the viability of the local industry (Nordas, 2004). It is further confirmed by Mason & Kachienga (2005), who found that the Kenyan apparel industry has played a significant role in the country's economic development; but the sector's competitiveness has decreased due to inadequate industrial strategy and the adoption of technological changes.

China and other Asian countries' can produce the right quality products efficiently at lower comparative costs since they have adopted the use of CAD. With the adoption of CAD, they have remained a threat to apparel manufacturers in most developing countries in Africa. There are several new challenges and industry dynamics that force the branded apparel industry to change and adapt or lose relevance. The inclusion of CAD as a change in technology has shown an impact on the production process in large scale apparel industries.

Several leading companies have already begun to reshape the blueprint for success by implementing leading-edge supply chain capabilities combined with a holistic business process that dramatically reduces cycle times, increases visibility across the entire value (Mason & Kachienga, 2005). Nayak (2016) advises that the apparel manufacturers around the globe should take advantage of CAD as the latest technology in their production processes to make their products more competitive.

In Kenya, the tertiary colleges and institutions of higher learning offer CAD in their training of fashion design courses. It is because the application of CAD technology is considered a significant step in coping with dynamic changes apparent in the textile and fashion industry. The use of CAD technology in the fashion industry further enhances speed and efficiency in garment production and designing through increased precision, productivity and organized information flow within the SME sector (Omondi, Imo, and Otina, 2016).

Small and medium scale apparel manufacturing industries are relatively low in operational costs, and initiating such a trade doesn't require much capital (RATES, 2003). Many economists attribute the relative size of many small and medium scale industries in less developed countries to the scarcity of money and administrative experience.

Often, the economic growth and the small traditional enterprise improves in one sector after another, leading to many people engaging in small and medium scale apparel production (Cooley, 1997).

The sewing machines range from simple foot driven, Chinese made butterfly brand, to particular purpose expensive ones such as buttonholing/fixing and chain stitch machine which provides little opportunity for the inclusion of CAD and other modern skills (Mbwambo, 2005). It's further noted that small and medium scale apparel firms produce a variety of products ranging from reduced quality wear for low-income consumers, to high-quality, fashionable apparel either on order or to sell wholesale to specialty shops while others specialize in African attire, tie and dye, decorative batik and fashionable quality attire with international taste (Mbwambo, 2005).

In the high-quality fashion market, the industry is characterized by modern technology, relatively well-paid workers and designers, and a high degree of flexibility. The competitive advantage of firms in this market segment is related to the ability to produce designs that capture tastes and preferences, and even better influence such tastes and preferences (Nordas, 2004). With such opportunities presented for SMEs, the inclusion of CAD use could make considerable progress to the end product.

Even though CAD is of use in the production processes of large scale apparel manufacture, it has remained a challenge in the small and medium scale apparel industries in Kenya. The technology increases the apparel manufacturing sector's productivity, which has remained labor-intensive. However, the variability of cloth, intricacy of cuts, and seams of the assembly processes has faced challenges of automation. Machine operators, therefore, continue to perform most sewing tasks, and automated sewing is limited to simple functions.

While in some cases, computerized sewing machines are used, hence the increased productivity of operators and reduction in required training time (Ronge & Nyangito, 2000).

Even though innovation of computers and further development of software for designing has eased the work of designers, apparel manufacturers have faced severe pressures from the change over the last few years, including mass merchants, retail private label brands and agile vertical retailers. Each one threatens to erode prices and margins further while demanding faster sell-through as well as increased speed and flexibility (Nordas, 2004). Giselle (2010) also argues that although many designers in large scale industries are using CAD in their design processes, the SME's main challenge is to change from paper to digital. The study, therefore, considered it essential to explore the problems influencing the adoption of CAD in apparel production among SMEs in Kisumu City.

2.5 Summary

In summary, the study noted that the large scale apparel industry had adopted the use of CAD in their production processes. The study further realized the use of CAD as a computer technology which has reduced the time for production, human labor as well as improving effectiveness in large scale apparel industries. The use of CAD has also influenced the whole production process in the large scale apparel industry, while the small and medium scale industry is slow in adopting the new CAD technology.

The patterns of CAD use among the small and medium scale apparel manufacturers were minimal. The SMEs have clung to the traditional methods of production, of which the consumers claim are of poor artistry and quality. The apparel industry has been influenced by competition

from other companies overseas as a result of the liberalized market, which led to the closure of several large scale industries and resulted in an increase of small and medium scale industries.

The small and medium scale industry acts as a stepping stone for industrial growth and development and is also a significant source of employment. The study emphasized ways that could be adopted to improve production methods. The study also considered the integration of computer use at all levels of production to enhance effectiveness. The review was to help bridge the gap between developing and developed countries in terms of technology. The factors influencing the adoption of CAD were low capital, competition arising from the liberalized market, and lack of specialization among their products which negatively impacted the adoption of CAD use.

CHAPTER THREE

RESEARCH METHODOLOGY

The present study was an assessment of CAD adoption in apparel production among small and medium scale apparel manufacturers in Kisumu City, Kenya. The study was conducted with a view to establish the proportion of CAD adoption, the patterns of CAD use, and factors influencing the adoption of CAD in apparel production among small and medium scale apparel manufacturers in Kisumu city. There was a review of relevant literature on the subject, and the following systematic procedure was adopted for achieving the formulated objective:

3.1 Research Design

This study was carried out using a descriptive survey design which is a form of mixed method. Orodho (2003) states that: Descriptive survey is a method of collecting information by interviewing or administering a questionnaire to a sample of individuals. The benefits of using this design are that it describes the phenomena at a point in time, establishes occurrences, outcomes, and conditions or type of behavior.

Kothari (2008) describes descriptive survey design as the conceptual structure of conducting the research, which constitutes the blueprint for the collection, measurement, and analysis of data. Therefore, on these perspectives, investigations on the SME's processes of manufacturer were done. The survey method was used to collect data to explain the variables identified in the study. The design involved a collection of information from a cross-section of respondents that were involved in small and medium scale apparel manufacture. This design employed the use of questionnaires, interviews, and observations. The research design was suitable for this study because it revealed the present position of CAD adoption by small and medium scale apparel manufacturers in Kisumu city.

3.2 Study Area

The study was carried out in Kisumu City, within Kisumu East District in Kenya. Kisumu city is the third-largest city in Kenya. Kisumu is on the eastern shores of Lake Victoria at the tip of Winam gulf. It is situated in a strategic position in the East African Community with accessibility to the regional countries of Burundi, Rwanda, Tanzania, and Uganda. The city has a population of 473,649 persons which has been increasing at a rate of 4.7% annually (GoK, 2012). The District covers 557.7Km2. It borders Nyando to the East, Nandi East District to the North East, Emuhaya to the North, Kisumu West to the North West and Rachuonyo to the South (GoK, 2012).

Kisumu is an industrial city, with many types of industries. The city has mixed and varied cultures of high fashion preferences that create a need for a fast and quality rate of apparel production to compete in the fast-growing fashion trend.

The apparel industry in Kisumu city has been in existence for a long time and acts as an essential source of employment. The city hosted the millennium city initiative program which capitalizes on new opportunities by designing social and economic development strategies and attracting the foreign direct investment necessary to create jobs and stimulate domestic enterprise (GoK, 2009).

3.3 Study Population

The study used a population of 293 small and medium scale apparel manufacturers that operate within the city and are recognized by the city council (Kisumu Polytechnic, 2015). The population included employers and employees. The small and medium scale apparel manufacturers included those who had less than 50 employees and used varied skills of production. In Kenya, SMEs are enterprises with less than 50 workers. The census indicated that SMEs comprise the lion share of enterprises in Kenya (Parker and Torres, 1994). The target population is the experimentally accessible population on which a researcher wants to generalize the results of the study (Mugenda & Mugenda, 2003). The target population for the study was all small and medium scale apparel manufacturers in Kisumu city.

3.4 Sampling Procedures and Sample Size

The study adopted a two-stage sampling procedure, where the population was categorized into 4 groups, depending on the location of the respondents. The respondents were in two groups: employers and employees. Purposive sampling was then used to select the employer respondents to be interviewed. This methodology was to ensure that all clusters of small and medium scale apparel manufacturers were in consideration.

Purposive sampling allows the researcher to use cases that have the required information concerning the objectives of the study (Mugenda & Mugenda, 2003). Kombo and Tromp (2009), describe purposive homogenous sampling as the picking up of a small sample with similar characteristics to describe some particular subgroup. The selections of samples are done based on knowing some aspects of the population, which in this case were SMEs apparel manufacturers. The convenience and snowball sampling were further used to help the researcher distinguish employers from employees who had the same characteristics from the population.

A baseline survey conducted under the Common Market of Eastern and Southern Africa (COMESA) support in Kisumu garment making cluster project indicated a population of 293 licensed small and medium scale apparel manufacturers, which consisted of employers and employees. The data available did not distinguish the employers from the employees; however, several employers were self-employed and did not have extra employees other than themselves.

The researcher, therefore, used a sample size of 117 employers and employees of small and medium scale apparel manufacturers (Table 3.1) which constituted approximately 40% of the total population. According to Mugenda & Mugenda (1999), 20% to 30 % of the population is adequate for research; however, the larger, the better. The researcher, therefore, sampled 117 respondents from a population of 293 licensed small and medium scale apparel manufacturers.

The distribution of questionnaires was at the ratio of 1:9 for employers and employees, respectively.

Table 3. 1: Sample Frame

Cluster Area	SMEs Target population	Accessible Population 117 (40%)
Milimani/Nyalenda/Dunga/Nyamasaria	59	24
Kibuye market	96	38
CBD/Kamas/Bus stage	85	34
Kondele/Migosi/Mamboleo/Nyawita/Manyatta	54	21
Total	293	117

Source: Kisumu polytechnic: Kisumu Garment making Clusters Baseline Survey (2015)

3.5 Data Collection Methods

Data were collected using questionnaires, interviews, and observations. The data collection was within three months.

3.5.1 Questionnaire for Employees

Questionnaires are research instruments that are used to collect data over a large sample (Kombo & Tromp, 2006). Kerlinger (1973) adds that a questionnaire is widely used in research because it is possible to give similar or standardized questions to the subject. The administering of the questionnaire was to 105 employees with closed-ended and open-ended items. Closed-ended items were used to avoid irrelevance, while the open-ended items were used to allow freedom of expression by the respondents.

The questionnaire consisted of four sections A, B, C, and D. Section A included demographic characteristics of the employees, section B established the proportion of adoption of CAD in apparel production among small and medium scale apparel manufacturers in Kisumu city, section C was to determine the use patterns of CAD in apparel production among small and medium scale apparel manufacturers in Kisumu city and section D explored factors influencing

the adoption of CAD in apparel production among small and medium scale apparel manufacturers in Kisumu city. The questionnaire for employees, attached as appendix 3.

3.5.2 Key Informant Interview for Employers

Interviewing is one of the methods or approaches used in survey research for collecting data (Kathuri & Pals, 1993). The interviews were used to gather more data from the respondents as a follow-up technique on issues that could not be gathered from the questionnaire.

The interview schedules were administered to 12 employers who represented approximately 10% of the sample population. The interviews were administered through drop and pick to the 12 respondents. This was important since employers were major decision-makers within the industry. The interview schedule included questions that enabled the researcher to obtain clear and detailed information on the factors influencing the adoption of CAD in production. Interviews allow the researcher to probe the person being interviewed. The interview schedule is attached as appendix 4.

3.5.3 Observation Checklist/Schedule

The researcher used an unstructured observation checklist in appendix 5 to obtain information and aspects of the study not addressed by the questionnaire. These would include patterns of CAD use, the stages in the actual apparel production process, and information on those using CAD. These stages included: designing, pattern drafting and development, garment cutting, and garment making. Observations are essential because some behavior involves habitual routines of which people are hardly aware of (Kombo & Tromp, 2006).

The observation was also used to gather more data from the respondents as a follow-up technique on production processes. The observation checklist attached as appendix 5

3.6 Validity and Reliability

The validity and reliability of the questionnaires were a consideration. Donald, Mc Brney, Theresa & White (2010), define validity as an indicator of accuracy in terms of the extent to which a researcher‘s conclusion corresponds to reality. According to Kathuri & Pals (1993), validity is the degree to which a test measures the variable it claims to measure. The findings obtained from the study were generalized to the population of the study. Besides, the arrangement of items in the questionnaires was from simple to complex ones.

Reliability implies the stability or dependability of an instrument or procedure to obtain information (Kasomo, 2007). A reliable instrument for a piece of research yields similar data from similar respondents over time (Louis C., Lawrence, M., & Keith, M, 2005). The study adopted the pre-test of tools to assess the consistency of the questionnaires. The administering was to a small percentage of the small and medium scale apparel manufacturers from the target population that did not participate in the actual study. Based on pre-tested results, there were appropriate modifications to the tools. The number of pre-test subjects was ten. Orodho (2005), states that the pre-test sample should be small, about 1% of the entire sample population. It was to ensure that the research instruments were valid.

The reliability of an item is very much outstanding when establishing the validity of the inferences one makes based on scores from summated scales used as predictor components for assessing attitude and perception of research. Since summated scales are an assembly of interrelated items, variables derived from such instruments were declared to be reliable only when they provide stable and reliable responses. It was essential to making sure that the instrument used to measure the particular object was indeed accurate in measuring the variable. If a measurement device or procedure consistently assigns the same score to individuals or

objects with equal values, the instrument is considered reliable. The study adopted Cronbach‘s alpha. Cronbach‘s alpha is typical when assessing the internal consistency of a questionnaire (or survey) that is made up of multiple Likert-type scales and items, and it is also used to test the reliability.

Reliability analysis was carried out on the perceived task values scale comprising 37 items. Cronbach‘s alpha showed the questionnaire to reach acceptable reliability, $\alpha = 0.335$. Most items appeared worthy of retention, resulting in a decrease in the alpha if deleted. There are some exceptions to this; examples are item 35, 31, 30, 20, and others as in table 3.2, which would decrease the alpha to $\alpha = 0.250$, 0.182, etc. As such, these items were removed.

Table 3. 2: Reliability statistics

Reliability Statistics

Cronbach's Alpha	Alpha Based on Standardized Items	N of Items
.335	.424	37

3.7 Data Analysis and Presentation

According to Brymann & Cramer (1999), data analysis seeks to fulfill the research objectives and provides answers to research questions. The researcher, therefore, used descriptive statistics for quantitative data analysis.

The data collected through questionnaires were considered in categories and subcategories. Descriptive statistics were used to analyze quantitative data, established the proportion of CAD

adoption, determined the patterns of CAD use, and explored factors influencing the adoption of CAD. The descriptive statistics such as frequency tables, pie charts, and graphs were used to present the data. Qualitative data were coded and grouped according to the category of the respondent. Each respondent numbered, and each questionnaire coded. Qualitative data were transcribed and then organized into themes as they emerged.

The data were then tallied to establish the frequencies and percentages. The numbers of respondents giving similar answers were converted to illustrate relative levels of opinion. It enabled the researcher to arrive at valid conclusions about all the research objectives. The photographs taken from observations were combined with these conclusions to reveal further findings.

Tables and figures used for organizing and summarizing the research findings. The uses of tables were for the analysis and presentation of data in the study. It was because tables enabled the presentation of figures which cannot be made possible in narrative form.

3.8 Ethical Consideration

This research work was in adherence to all ethical concerns. First, the researcher requested permission from the National Commission for Science, Technology, and Innovation (NACOSTI) to undertake the research. The researcher requested for informed consent of the participants where they signed whether they agreed to be part of the study or not. In the university, the researcher was granted permission from the School of Postgraduate Studies, through the Maseno University ethics review committee (MUERC) to be allowed to undertake the study. Among other things, the researcher strictly observed the confidentiality of information, genuineness, and anonymity in the study. The researcher ensured that there was no plagiarism, and all quoted materials indicated in the reference.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The purpose of the study was to assess the proportion of CAD adoption in apparel production among small and medium scale apparel manufacturers in Kisumu City, Kenya. The study targeted a population of 293 with a sample size of 117 (40%) respondents. Specific objectives were formulated to assist in data collection and analysis.

In this section, the results presented and discussed findings under the characteristics of the respondents and the 3 objectives of the study, which were:

i. Establish the proportion of CAD adoption in apparel production among small and medium scale apparel manufacturers in Kisumu city
ii. Determine the patterns of CAD use in apparel production among small and medium scale apparel manufacturers in Kisumu city
iii. Factors influencing the adoption of CAD in apparel production among small and medium scale apparel manufacturers in Kisumu city

The results from the questionnaires and interview schedules were analyzed quantitatively and qualitatively.

4.2 Characteristics of the Manufacturers

The characteristics of the respondents mainly referred to their background details: gender, level of education, professional/skills training attained, and experience in business, location of the firm, and size of the industry.

4.2.1 Gender of the Manufacturers

Table 4. 1: Gender of the employees

Gender	Frequency	Percent
Male	**43**	**41**
Female	**62**	**59**
Total	**105**	**100**

These details helped to provide background information for the study, which intended to establish the background information of employers and employees in the apparel industry within Kisumu. The findings of the study established that 59% of the respondents were female, while 41% were male (Table 4.1). This representation may be because most girls fall out of school at an early age, hence resort to informal employment which includes small and medium scale apparel industries. The findings of this study concur with the study by Korinek (2011), who reported that women make up the majority of the workforce in export-oriented textiles and clothing sectors in many developing countries.

The study noted that women were generally more presented than men in the apparel industry. It is in agreement with Korinek (2011), who argued that women‘s and men‘s differences in orientations, access to education, employment and resources meant that they are affected differently by trade liberalization and unequally take advantage of the opportunities that trade offers. Additionally, Dickerson (1995), noted that it is women in developing countries that are often poorer, less educated, have less access to information and technology and are more constrained in their employment choices than men.

Dickerson (1995) further found that even though the garment sector is a prototypically a female industry, some of the higher-skilled tasks within the sector, such as cutting, are often performed by men. He noted that in some countries, large numbers of men are also engaged in the stitching of children‘s and women‘s clothing. It could be an actual scenario in areas where technologies used in the industry are upscaled. It can be a justification that men are accustomed to responsibilities that are associated with high skilled tasks.

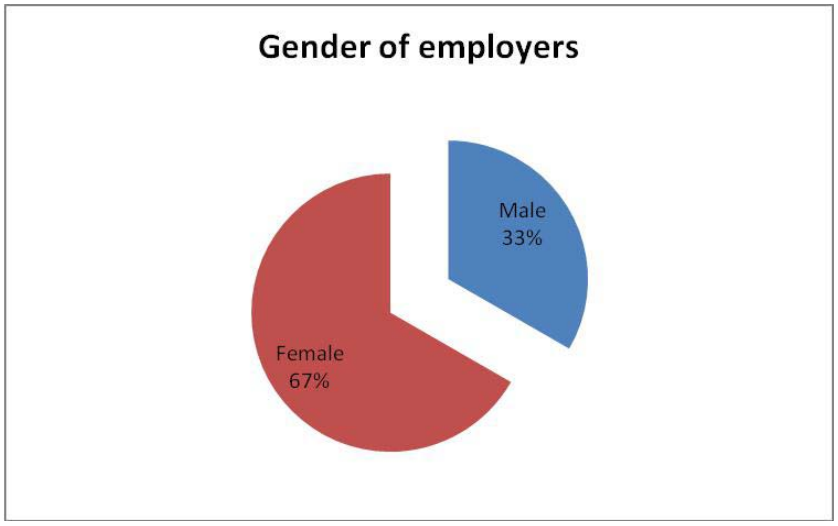

Figure 4. 1: Gender of the employers

The study further established the gender of employers. As shown in Figure 4.1, the study noted that 67% of the employers were female, while 33% were male. It demonstrates that females dominate the SME apparel industry both as employers and as employees. When asked, the female respondents explained that they choose to venture into this kind of business because the enterprise is easy to create. It, therefore, indicates that more women venture into this kind of enterprise because of its simplicity. This study complements one conducted in the Middle East, which confirmed that small and medium-sized enterprises (SMEs) with female ownership represented 30% to 37% of all SMEs (Barq, 2016). The study implies that women were highly represented in the apparel industry.

4.2.2 Employees Highest Level of Education

Table 4. 2: Employees Highest Level of Education

Highest level of Education	Frequency	Percent
University	3	2.9
College/Diploma	10	9.5
Certificates	3	2.9
Form four	54	51.4
Standard eight	32	30.4
Any other specify	3	2.9

On the education level of the respondents, the information presented in Table 4.2 shows that the employee's level of education ranges from primary school to university graduates. Form four school leavers and below represented a high proportion totaling to 85%. It was noticeable that the majority of the respondents had not gone beyond form four level of education.

As concerns, the education levels of SMEs, Mbwambo (2009) had established contrary findings. His findings indicated that formal education frequently showed a weak and significant relationship with success, but there is a direct relationship between formal education and the success of entrepreneurs. He argued that education explains superior entrepreneurial performance among constrained individuals, and the level of education also contributed positively and significantly to their performance. These findings concur with Salinger (2007) who connotes that primary education develops literate & numerate fundamental workforce, while technical and vocational education provides skills training for employability. Secondary education channels skilled graduates into the workforce or relevant industry, while post-secondary education delivers higher-level skills training for employability.

He further noted that there is virtually no pre-employment training for sewing operators; besides, he highlighted the fact that skilled factory training opportunities exist only in specific skill areas,

and skilled graduates did not consider the garment industry as a possible career path demand. The finding shows the importance of establishing the level of education of employees and the influence of skills on production.

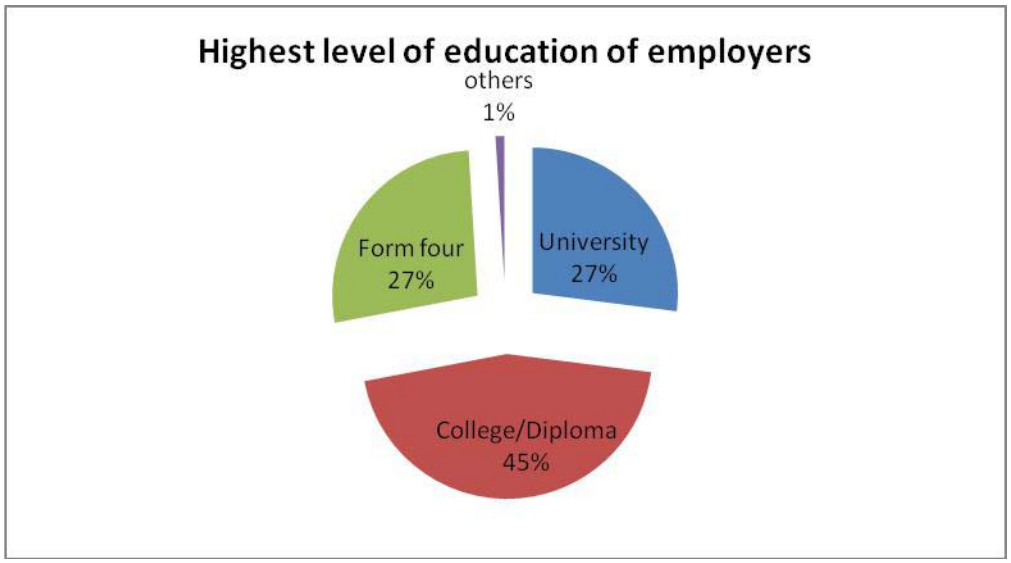

Figure 4. 2: Employers highest level of Education

On the employers 'academic qualifications, the respondents had varied skills ranging from skills acquired on the job, certificate, diploma, and university degree. Almost half (45%) of the respondents (Figure 4.2) had college/diploma certificates, A total of 27% of the respondents had obtained a university degree, and another 27% had acquired form four levels of education. The findings established indicate that the level of education influences the aspirations of an individual to start a business. This indication is confirmed by the fact that most of the respondents were form four level, and above.

It was evident in the study that the employers had acquired university degree of education, while the majority of the employees were trained on the job and did not have any educational qualifications. Training on the job forms the fundamental structure for competency.

From the study, training on the job improves with years of experience. The employees trained on the job were skilled in specific skills areas and were able to perform routine tasks correctly. The challenge is not able to adopt emerging skills like CAD based on the unwillingness to change.

4.2.3 Skills Training

Table 4. 3: Skill/professional training of the employees

Level of Skills training	Frequency	Percent
University degree	3	2.9
Diplomas	9	8.6
Craft/Technician certificate	5	4.8
Trade test	26	24.7
On the job	61	58.0
Others	1	1.0

The study further investigated on the skills of the employees and established that 58.1% of the respondents (Table 4.3) had no formal skills training. When asked, the respondents indicated that they were trained on the job and did not hold any educational or skills training certificate. Thus, people need to have the chance to be exposed to practical skills of training. This exposure would help them to ensure their existence and contribute to building their country‘s economy.

The findings concur with suggestions by Yu (2001), who found that small firms gain their industrial experience on the job, and they only make goods based on skills they learned from the previous employer.

It may explain that training on the job allows an employee to improve on the required skills hence work more productively; however; vocational discipline should accompany schooling. Salinger (2007) further found that most of the production workers in the apparel industry train on the job.

A possible explanation for this could be that training on the job may take a few weeks to several years to learn most skills. The indications confirm that the employees can give validated feedback on the type of skills that are needed to perform a task. A possibility could also be that there are no specific educational requirements, high school or vocational school graduates as an edge in getting the job and advancing to better positions.

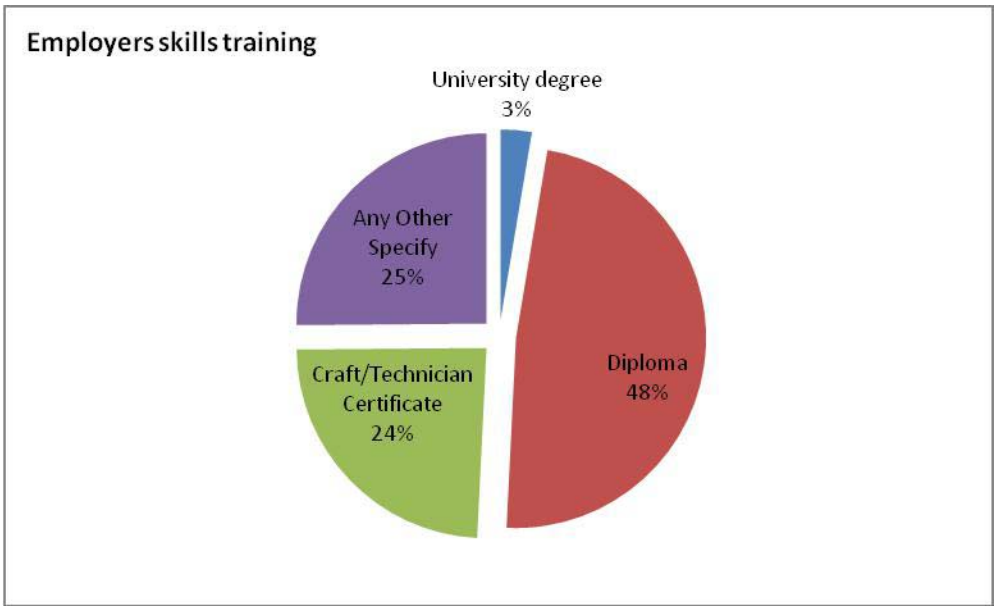

Figure 4. 3: Employers Skills Training

The study established that more than half of the employers had professional skills training. Almost half (48%) had a diploma as indicated in Figure 4.3, and a quarter (25%) of respondents had acquired their skills on the job. They indicated that their employers had trained them within the workplace.

Another 24% had Craft/technician certificates, while one percent had a university degree. It was clear that skills training are essential to employers who are aspiring to venture into an apparel

manufacturing business. It demonstrates that skills training had an influence or it could be a possible pre-condition for business start-up.

4.2.4 Experience in Business

On the experience of employees, Table 4.4 shows a summary of the findings of the study.

Table 4. 4: Employees experience in the industry

Experience	Frequency	Percent
Below 1 year	1	1.0
1-2 years	7	6.7
2-4 years	22	21.0
Above 4 years	75	71.4

Concerning the employer's work experience, the findings, as presented in Table 4.4, indicated that 71.4% of the employees who responded had served in the industry for durations of four years. The findings show that the respondents had been in service for an extended period, hence experienced in the business. This may also show that most employers had practical skills and experience. It should note that the work experience of employers is essential in their performance. The duration of employment could influence the quality of production. Given that the majority of the respondents acquired their skills on the job, and were performing, it could be an assumption that experience improves quality.

The study also observed that only 21% of the respondents had served in the industry for a period between two to four years, about seven percent had served for one to two years, and only one percent had served for less than one year.

From the findings of the study, it is evident that more than three-quarters of the respondents interviewed had served in the industry for more than 4 years and were therefore considered to have adequate experience in apparel manufacture within the SMEs apparel industry in Kenya. It could be the ability that enables them to train other personnel on the job.

Figure 4. 4: Employers experiences in business

As shown in Figure 4.4, the findings also established that more than half (64%) of the employers had been in business for 4 years, while 27.3% had operated for more than two years but less than four years. Nine percent had operated between one to two years. These findings revealed that some employers and employees had been in business for quite some time. Experience in business is a crucial indicator of improvement in skills as well as the quality of the products. It implies that experience in business could lead to increased output as well as the production of unique products and long terms of vision.

4.2.5 Location of the Firms

The result presented in Table 4.5 indicates that 66.7% of the firms were located within the CBD, while 33.3% were outside the CBD.

Table 4. 5: Location of the firms of employees

Location	Frequency	Percent
Within CBD	70	66.7
Outside CBD	35	33.3
Total	**105**	**100**

The study further revealed that most of these firms were small and medium scale manufacturing industries with minimal capital. Minimal capital was a significant constraint to the SMEs. World Bank (2016), indicated that textile and apparel manufacturers in Kenya faces challenges ranging from limited access to finance and a demanding business environment that is characterized by poor infrastructure. The results were outstanding as they gave insight into areas where these businesses are as well as their characteristics. The results also demonstrate that the entrepreneur‘s interests are within the CBD. It could be attribution to the fact that the majority of the clients operate within the CBD.

The determining factors on the location of firms depended on customers or establishment costs. European Foundation (2008), confirms that the global developments create new challenges as well as strategic options where firms move their activities to locations that offer the best possible combination of benefits and costs to the firm. Most textiles and clothing firms have moved the manufacturing activities to low-cost countries in Eastern Europe or Non- European countries such as India and China. This cluster kind of organization is in line with the Kenyan vision 2030 policy that intends to re-organize the SMEs into industrial parks.

The parks are self-contained geographical areas with high-quality infrastructure facilities, which houses businesses of an industrial nature. It is an area zoned and planned for industrial development (Ministry of Industrialization, 2017). This strong association may mean that the SMEs would have a cluster that encourages shared resources among themselves.

4.2.6 Size of the firms

Table 4. 6: Size of the industry with the employees

No. of employees		Frequency	Percent
Small Scale		93	88.5
Medium	11-20	3	2.9
	21-30	8	7.6
	Above 30	1	1.0
	Total	**105**	**100**

The study further sought to establish the size of the industry with the employee's numbers. The size of the industry was to determine the number of employees and their levels of output. In this study, the relation of employees/output was necessary to establish the number of those employed per firm. The study revealed that 88.6% (Table 4.6) had between 1-10 employees.

It shows that the majority of the industries were small scale hence low production levels. It concurs with Mc Cormick (2009) of which, she noted that numerous small and medium scale firms had self-employed tailors, resulting in local styles and local goods that dominated the market and are not for international trade.

A percentage of seven point six of the respondents had employees between 21-30 employees, while approximately three percent of the respondents had between 11-20 employees.

It has emerged that the findings in this study implied, many people are employed in small scale industries, as compared to a medium scale.

The number of manufacturers employed in the medium scale industries was not many as compared to the small scale. Plate 4.1 shows an example of a medium scale industry displaying the kind of machinery used. It explains that both genders are involved with the male using a straight stitch sewing machine while the lady uses a specialized sewing machine. The scenario indicates that both genders are capable of using any machine if given the opportunity.

Plate 4. 1: **Medium size industry (Kisumu National Polytechnic production unit, 2017)**

In some cases, the employers were self-employed and operated both as employers as well as employees. Joshi and Singh (2010), confirms that the number of employees can supplement technological investment. It demonstrates that technology investment is an indicator of the organizational size, which aids organizational efficiency and growth.

These indications confirm the need for CAD adoption as a technological investment within the apparel industry since it could supplement some of the tasks done by the operatives. It could also imply improved production with such kind of investment. It assumes that companies having few employees, but with modern technological innovations has increased production efficiency than companies with higher numbers of employees. It demonstrates that the adoption of CAD technology in the production process contributes positively in terms of capital incurred. It could be true since some of the laborious production processes could be performed within a single touch.

Table 4. 7: Output of garments per day (employers only)

Output without CAD	Frequency	Percent
1- 10	7	58
31- 40	2	17
41- 50	3	25
Total	**12**	**100**

On average, as shown in Table 4.7, the study revealed that more than half (58%) of the employers did not employ the use of CAD and produced less than 10 garments per day. Twenty-five percent (25%) produced between forty-one to fifty garments. Further observations indicated that most of these high numbers were mass-produced and were of low quality. Kamwela (2016), established that other researchers have shown that SMEs tend to have low productivity since they do not have the required tools to produce these products. They also tend to be weak in terms of competition with other SMEs as a result of not using advanced technology.

Table 4. 8: Total capital investment by Employers

Capital in Kshs.	Frequency	Percent
30,001-50,000	3	25
50,001-70,000	4	33.3
70,001 and Above	5	41.7
Total	**12**	**100**

On the assessment of capital investment, the information presented in Table 4.8 showed that almost half (41.7%) of the employers had invested Kshs.70, 000, and above. It was an impressive indicator which implied that the business was stable given the investment of more capital. This indication also confirms that there is positive growth within the apparel sector.

Another 33.3% of the employers were operating with an investment ranging from 50,001 to 70,000 Kenya shillings. As much as investments are essential in business, 25% were operating with investment capital that was below 50,000. It was clear that even if the majority of the manufacturers were operating with the necessary equipment, it was still expensive in terms of cost, given their levels of operation. Even though the manufacturers in this industry had low capital investments, they still made significant contributions to the Kenyan economy. Equity bank (2017) reported that the Textile and Clothing (T&C) sector, is a marginal player in the national economy and contributes zero point six percent to GDP which accounts for six percent of the manufacturing sector earning seven percent of total export. This study is in agreement with a policy brief carried out by the Institute of Economic Affairs (2006), which established that it was straightforward to venture into this sector because the capital required was relatively low, training services were readily available and affordable, and operational costs are low.

Table 4. 9: Types of Apparel Produced by Employees (multiple responses)

Types of products	Frequency	Percent
All	15	14.3
Men, children and ladies wear	16	15.2
Men, ladies, children and uniforms	39	37.1
Men, ladies, children and household	6	5.7
Children and ladies wear	9	8.6
Ladies	3	2.9
Uniforms	4	3.8
Households	7	6.7
Men, households and uniforms	3	2.9
Ladies, uniforms and households	3	2.9

As presented in Table 4.9, the information presented provides an analysis of products that were produced by various firms. It was meant to establish what the SMEs produced regardless of CAD adoption or not. Men, ladies, children, and uniforms were the main products produced. This information confirms that the manufacturers produced assorted products based on customers 'orders. A percentage of 37.1% majored in Men, Ladies, Children, and Uniforms. When asked, a respondent expressed the following concerns:

> *"…..There are no specific products that could be made and availed readily to consumers. Besides, the majority of the consumers require different products at different times, but we do not have modern technology which could enable us to specialize in products.*

This variety of products confirms that there was a lack of specialization among the producers. The respondents indicated that they had limited skills and specialized equipment such as CAD to specialize on given products.

Another 15.2% of the respondents were specialized in Men's, Ladies', and Children's wear, while eight point six percent of the respondents specialized in Children's and Ladies' wear. The figure confirms that each producer works on more than one type of product. It was a clear indication, majority of the respondents did not produce on any particular product, and this could attribute to the fact that they did not follow the right stages of production of which CAD is used, and their productions relied on the needs of the customers. They mainly replicated new and selected products that could use technologies within which were readily available to increase their competitiveness. A proportion of the respondents (14.3%) had no specialty in any given product.

One can confirm from the above findings that the availability of facilities CAD use, and specialized machines for production was not sufficient among the apparel SMEs. On the contrary, to bring about modern machines, equipment, material supply, and other production facilities should be considered.

Limitation on the type of equipment used could also be an attribute to the kind of products produced, leading to a lack of specialization. It was evident in several respondents since they produced all types of apparel. Lack of specialization influences the quality of products since different products require different skills and equipment to manufacture. Specialization justifies the importance of manufacturing a single type of product, which is easy to obtain by specialized equipment. In this way, it also argued that it is easier to manage both the number of specialized pieces of equipment, as well as CAD skills required by the respondents to produce a single product type. The assumption could be that manufacturing one or several related types of apparel products stand a better chance for CAD inclusion and of high-quality production.

The study indicates a lack of specialization among the firms, on products manufactured by the SMEs. Specialization improves the quality and accuracy of a given product. Thus, the quality of an apparel product depends upon the SME. The SME should see himself as a skilled manufacturer devoted to the search for excellence. Kuzilwa (2009) further expressed that small scale producers tend to produce products of varying qualities in terms of product mix. The products are hence differentiated with labels to make them appear distinct. Production on a large scale on varying products therefore becomes a bit technical since different products require different equipment to perform specific skills. It, therefore, requires several manipulations to achieve specific specialized skills.

Household products that constituted six point seven percent of the total production included various products that needed specialization. Production of household products when done along with other items such as dresses, quality is compromised. The use of CAD is involved at different levels of production and for different products. This is confirmed by Salinger (2007), who noted that the apparel industry makes clothing and related products that include men's, women's, and children's outerwear, underwear, sleepwear, bathing suits, hats, hosiery, furs and many other items such as bed and table linens, curtains, tents, and other goods made from cloth. In line with this view, from the observation checklist lack of specialization exists among the SMEs.

The product mix was prominent among their production processes. It indicates that specialization is a fundamental challenge that hinders the manufacturers from adopting CAD in their production processes.

4.3 Proportion of Adoption of CAD in Apparel Production among Small and Medium Scale Apparel Manufacturers

4.3.1 Equipment for Apparel Production Process

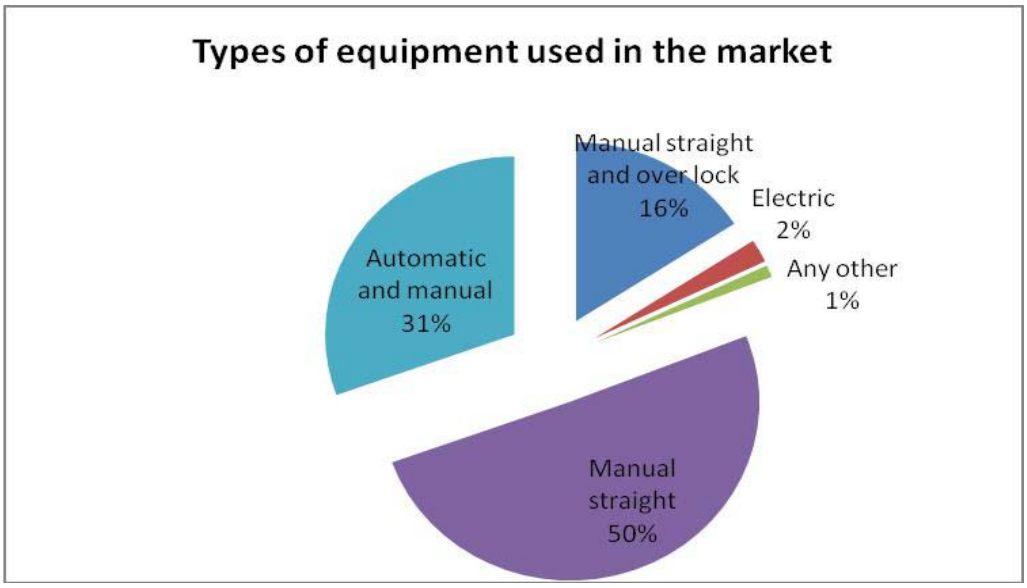

Figure 4. 5: Types of equipment used in the market

Investment in appropriate tools for business is seen to be an essential factor behind the success of business in terms of enhancing not only the quality of products but also the capacity and productivity of production. On emphasis, the research has shown that investments in required technology are essential to improve on the existing capacity and the quality of products, which generates higher profits and thus improves the competitiveness of SMEs (World Bank, 2012).

The study noted that 50% of the respondents employed the use of straight stitch, manually operated machines (Figure 4.5). These could be some of the reasons that have led to the slow adoption of CAD. This argument could be based on the fact that their levels of education are low, and some acquire their skills informally.

It further noted that the manufacturers use manually operated machines since they were readily available, cheap, and easy to use. Manually operated machines have been used from time to time, and this people may be resistant to change since most of them are less educated. These results are also consistent with Tegegne (2009), who noted that most of the SMEs use old machines which had served for some time, while some machines were considered backward. Some firms had to use local modifications to replace inputs and machinery.

He further argued that the choice of machines largely depended on convenience. On the contrary, Mbwambo (2009) argued that manufacturers who are motivated look for adequate working capital and take the trouble of being mobile to seek new ideas, information, and new market trends for the sake of better performance. It shows that the performance of SMEs largely depends on an individual‘s initiative, attitude, behavior, and capability. Besides, the level of education plays a role in making decisions that relate to manufacturing, and a substantial number of the respondents were of form four levels of education and below.

The type of equipment used determines speed, effectiveness; hence influence the quality of the end product as well as the quantity of output. Based on the findings, the study suggests that there is relationship between the method of production used and the level of output. It is an attribution to the fact that most of the production processes used manually operated machines resulting in low output.

An establishment of the study indicates that electric machines were not widespread and were useful to two percent of the respondents. The results also showed that 31% of the respondents use both automatic and manual machines. The argument is that the equipment used mainly depends on the product to be produced, which makes the end product a critical factor in the selection of a production method.

The type of equipment used varies from one manufacturer to another. The study also revealed that 16% used both automatic and manual machines, while one percent involved semi-automatic equipment for production. Semi-automatic equipment is operated both electrically and manually.

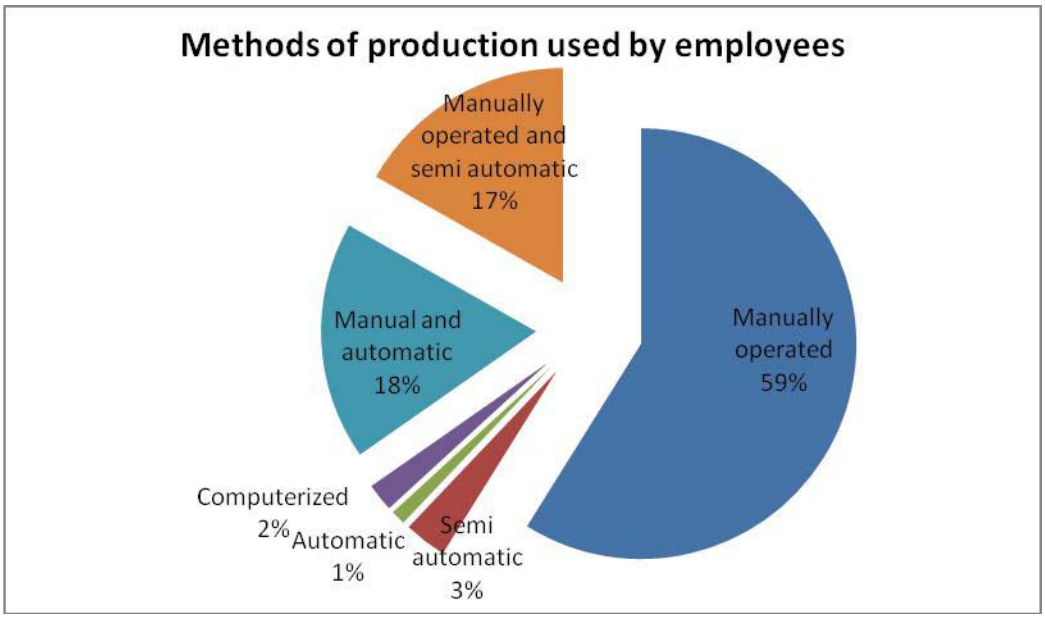

Figure 4. 6: Methods of production used by employee

On establishing the methods‘ of production employed by the employees, the study found that a large number of manufacturers do not use CAD for production (59%) as shown in Figure 4.6. These findings explain some of the reasons that contribute to the low adoption of CAD, since most of the respondents select manually operated machines.

As much as there are changes in technology, and new methods of production strategies are emerging, it is still clear that the small and medium scale apparel manufacturers have stuck to the indigenous methods of production. The high representations of the findings confirm this. The results are in line with Tegegne (2009), who noted that all the manufacturers used manual methods of production and required special assistance to enhance their capacity. Although the use of CAD by SME in Kisumu is low, Bilasis (2000) pointed out that today, CAD systems are

used in most of the activities in the design cycle, and as a platform for collaboration between remotely placed design teams. This observation is an indication that CAD techniques are critical skills for fashion designers.

The other challenges on methods of production are attributed to the kind of skills training acquired, or the socio-economic background of the trainees as well as their level of awareness. The socio-economic background of a trainee is also relevant in economic and social terms for the selection of a production method, especially for women. Anticipation is that the textile industry in the long-run provides countries with opportunities for sustained economic development, appropriate policies, and competitive advantage of textiles and clothing industry (Keane and Dirk, 2008).

On the contrary, the findings contradict Woodward (2002) who felt that despite advances in technology, it has been difficult to use automated equipment extensively in the apparel industry within East Carolina due to the soft properties of textile products. Besides, it is expensive to adapt existing technology to a wide variety of items produced due to frequent and seasonal changes in style. Technological developments, such as computer-aided equipment and automated material handling systems, have increased output. The SMEs who had adopted the use of CAD indicated positive progress on output.

The results of the study also revealed that 18% of the respondents use automatic and manual equipment for production. It is a positive growth since CAD could only be adopted and incorporated into electrically operated machines. Another 17% used semi-automatic and manually operated equipment. Only two percent of the respondent used computerized methods for production. The results of this study show that a proportion of the respondents have

incorporated CAD use in their production processes to design logos, screen printing, transfer printing, badges, banners, and embroidery.

The Inco-operation of these programs are seen to produce several positive outcomes to the production process. Other respondents reason that computers and computer software are too expensive, while some claim that the skills involved are too complicated for them to understand. The plate (4.2) shows specialized machines used for embroidery and (4.3) cutting. The embroidery machine uses computer programs to design logos and motifs, print, and finish. The machine operates in sets of 2, 4, 8 up to 12.

Plate 4. 2: **Specialized Equipment used for Embroidery (Kisumu National Polytechnic, 2017)**

Plate 4. 3: Specialized fabric cutting machine (Kisumu National Polytechnic, 2017)

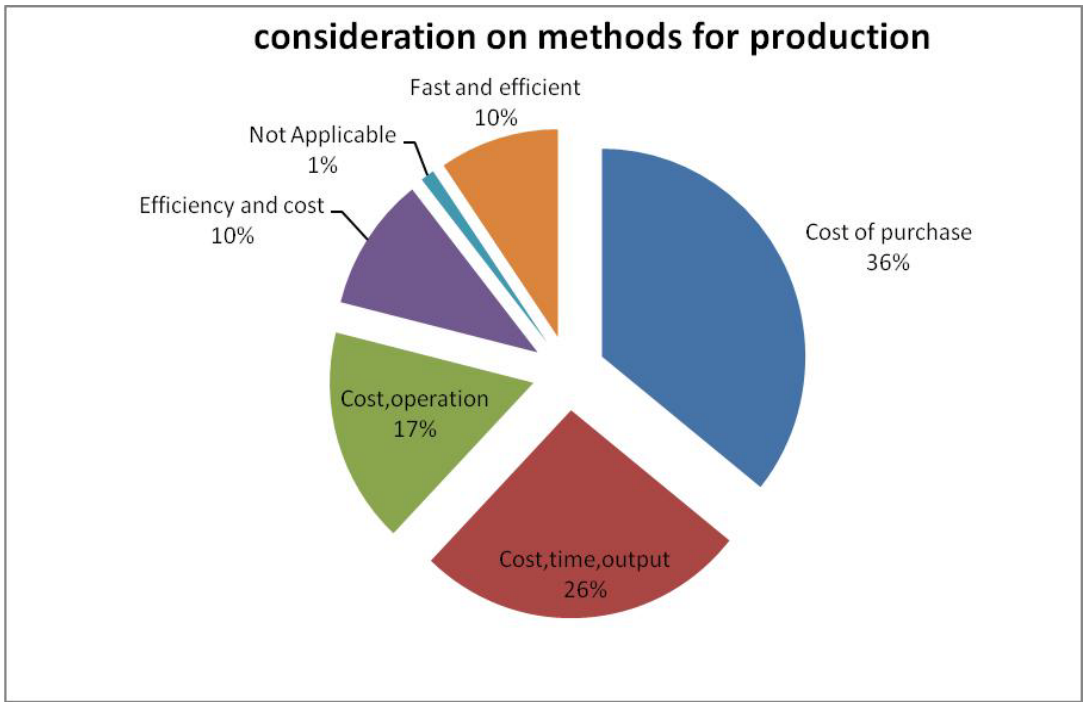

Figure 4. 7: Considerations for selection on methods for production

The main factors that determined the selection of a given method for production were considered. The study found that cost of purchase of a given machine was a significant factor that was considered by 36% of the respondents. Figure 4.7 recorded the price of the equipment as an essential factor that influenced its selection. It explained how the cost of equipment was the main concern for respondents irrespective of what it can do. It was important to note that if the right method was chosen for production, the assumption is that the result will give the required product. Only 26% of the respondents select a given technique for production based on cost of the machine, the time it takes to produce, and output, while 17% of the respondents consider cost and the operation process. The respondents were further asked to indicate whether the methods used for production provided variety and efficiency.

The study revealed that respondents chose different machines designed for various end uses; hence they considered the type product to be made before the purchase of given equipment. Efficiency and cost were considered by ten percent of the respondents, with a similar representation (ten percent) of the respondents believing speed and effectiveness as an essential aspect in the selection of production method.

It was also essential to recognize that the producers used given methods of production due to convenience with little emphasis on its efficiency. It, therefore, suggests that a manufacturer with little skills would only be able to apply the limited skills that he/she is conversant with it. It makes it difficult for manufacturers in this category to discover other important aspects of production that are not known or available to them. It is also difficult for manufacturers to face the challenges that present themselves in the market.

On the choices of production methods, the respondents considered the cost to determine the production method and type of machine used. It could be an indication that most of the machines available in the market confirm that the traders only avail machines and other equipment that are preferred or frequently bought by the manufacturers. It concurs with the study by Mc Cormick et al. (2009), which found that some small scale producers in Tanzania remained primarily local, producing local styles to address local needs and not traded internationally. However, observation of the study established convenience as a significant factor that determines the choice of a production method. Many of these producers were reluctant to explore new methods of production, but selected what was convenient. Only one percent of the respondents did not have any reason as to why they selected on given equipment.

a) Straight-stitch sewing machine b) Heavy-duty straight stitch sewing machine

Plate 4. 4:Basic machines used by the SMEs (Kibuye market 2017)

Plate 4.4 shows some of the machines used by manufacturers in the Kibuye market. The straight stitch sewing machine performs fundamental operations of joining seams, manually operated, and slows in production.

The heavy-duty sewing machine is electronically driven, first and can be useful for mass production. The use of an electrically driven machine is a positive indication of technological influence. In this scenario, electricity is vital in the operation process of the machine, which is an adequate base for computer-aided design (CAD) where less time is required to produce a given product.

Table 4. 10: Benefits of the chosen method

Benefits	Frequency	Percent
Fast	4	4.2
Efficiency and quality	49	51.6
Safety	2	2.1
Cheap	15	15.8
Fast and good quality	7	7.4
Fast and cheap	18	18.9

The study also found it essential to establish the benefits of a chosen method for production. The study noted that the methods chosen for production had several benefits. The study reports that 51.6% of the respondents consider efficiency and quality of a production method, even though they would want to spend the least amount of money when purchasing the same equipment (Table 4.10). It could be a conclusion that for SMEs to be successful, they should understand the need for flexibility in the design of their operating processes, as well as how easily their production systems can adapt to potential future changes.

The cost of equipment could be high but may have an influence on efficiency and accuracy. In a real sense, it‘s difficult to find cheap, efficient equipment. A study carried out by the open university of Hong Kong established that equipment efficiency refers to its ability to perform well. The study argued that the concept of equipment effectiveness relates to the ability to produce the same product repeatedly (Open University Hong Kong, 2016).

It noted that the more efficient the equipment, the more it can produce. It is an attribute to the increase in production output, which could be a realization in the total final products. The results have also revealed that 18.9% of the respondents consider the speed and the cost of purchase of equipment. Earlier, the findings of the study had indicated that the cost of equipment influenced equipment selection by respondents, as shown in Table 4.10. It suggests that the economic status of the respondents is vital in terms of equipment selection. The SMEs have been presumed to be a small part of the economy as regards to their economic status, yet they have the potential for growth. It confirms the ability to create jobs with a limited market size as compared to other high-value or high-capital investments.

Table 4. 11: Challenges in production method

Problems encountered	Frequency	Percent
Technical issues	34	35.8
Lack of skills	22	23.2
Slow in speed	16	16.8
Price is expensive	14	14.7
Customer demands	5	5.3
Unreliable staff	2	2.1
Health issues	2	2.1

Different production methods were available, of which they experienced some challenges. The problems encountered with the chosen methods in this study were necessary as it revealed the level of efficiency of the equipment used. The study found that 35.8% of the respondents consider technical issues when choosing a method for production (Table 4.11). Other issues that emerged from these findings were the respondents ‘inclination to equipment that they were used to, and this favored manual methods of production. The inclination enabled the manufacturers only to produce a limited number of products that manual machines could produce.

Since most of the employees train on the job, they have limited skills that did not enable them to operate the modern machines. The technical issues experienced in the study included; machine breakdown and the attendants ‘services. Machine breakdown could be some of the reasons that interfere with budget allocation for production since breakdown presents many emergencies. When asked to indicate other problems that they encountered with the chosen method, a total of 23.2% of the respondents had problems due to lack of skills in the operation of a chosen method; this is evident in cases where complicated machines were used. In such cases, observations revealed that the employer used the machine personally, or a specialized person was hired to operate it. It could be because certain products required specialized devices to perform certain operations.

Examples included buttonholes, bar tack, over-lock, and hemming. Such operations lead to high costs if the appropriate equipment has to be purchased. It is because many stages are involved in completing an operation process. Another 16.8% of the respondents considered speed when choosing a given method for `production. It implies that as much as funds are a limiting factor in the selection process for a given method, they still considered other aspects such as time taken to complete a task. Considerations on the speed of machine were necessary since it determined the time taken to complete a task. When a machine is slow, production is also slow, hence expensive in terms of production costs.

Only five-point three percent of the respondents indicated customers as the most important recipients of production. Customers are always considered to be right and regarded as kings in a free market. It, therefore, justifies that, the success of any business lies entirely on customer satisfaction. And these could also be some of the reasons why consumers opt for second hand goods which they tend to consider as well constructed. Only two percent of the respondents had

health issues with prolonged use of specific equipment and argued that the machines are strenuous. The respondents did not consider more comfortable and convenient options that were available but not known to the manufacturers. It confirms that primary education is significant to skills development and plays a crucial role in production achievements.

4.3.2 Intervention Measures to Improve the Method Chosen

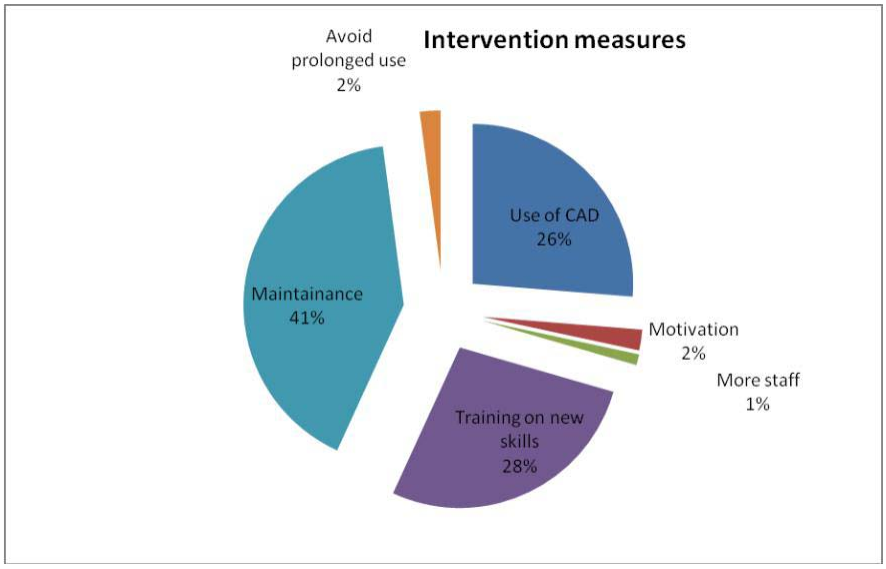

Figure 4. 8: Intervention Measures for Improvement

As much as machine breakdown is frequent, the elimination of such occurrences is managed by practicing preventive maintenance. The study revealed the practice of equipment maintenance, use of CAD, and training on new skills, motivation, and inclusion of more staff as some of the intervention measures. Out of these challenges, maintenance of equipment was the major challenge faced by the respondents. A total of 41% of the respondents complained about the maintenance of equipment as the significant challenge of production (Figure 4.8).

It could be an attribute to the fact that several employees do not poses technical skills; hence, maintenance challenges are an issue. Another 28% of the respondents considered training on CAD as a new skill to be the only intervention measure that could be adopted to improve on the

methods they choose for production. Such concerns were noted by respondents who were using manually operated equipment.

The other intervention measures suggested by the respondents included the use of CAD. There was an appreciation of 26% of the respondents. These respondents felt that involving the use of CAD was the only option to improve production methods. Saini and Kaur (2014) confirm that the use of automation and CAD systems increases production with excellent quality of the material and design in apparel. They further argued that fast sample production and higher productivity combined with the flexibility of the CAD system, there could be a considerable reduction with lead-time in a garment unit. However, the respondent's concern was that as much as CAD software was in use, they are not readily available in the market, making it difficult to access.

Only two percent of the respondent felt it necessary to motivate personnel for better results. This suggests that the willingness to adopt CAD could also be influenced by motivation. Jones (2017), indicates change as inevitable given the highlights on the rapid technological progress and increasing spotlight on efficiency. She further explains that the need for aspiring SMEs to recognize the driving forces behind the success of their firms since it is widely a recognition of resistance to change, which is often its downfall. A similar fraction considers avoiding prolonged use of equipment. Their reason was to express fear related to health problems. The believed that prolonged use affects the blood level. It can be reasoned that operating a sewing machine requires much energy, which could be well balanced by eating healthy. And could not be the real case in this scenario since their wages are low, and they may not be able to afford a healthy lifestyle. One percent of the respondents were not left; their argument was that the only way to improve on a method for production was to increase the number of employees.

This is a sign which portrays lack of information on modern technology. Given the fact that many employees acquired their skills on the job, they may not have got the opportunity to know about some of the specialized equipment. It could be some of the reasons for such levels of ignorance.

4.3.3 Use of CAD

Table 4. 12: Involvement of CAD

Involvement of CAD	Frequency	Percent
Yes	19	20.0
No	86	80.0
Total	**105**	**100.0**

The study seeks to investigate those who were involved in the use of CAD. Information obtained indicated that 80% of the respondents did not use CAD, as shown in Table 4.12. It confirms that the methods for production are either manually operated machines or indigenous methods. It could be an attribute to the fact that the apparel industry has traditionally consisted of production workers who perform specific functions in an assembly line.

However, currently, this organizational philosophy is increasingly being replaced by a mass concept, in which a group makes garments of sewing machine operators organized into production "modules, (Appendix: 10) in which some involve the use of CAD. "These changes have substantially altered the atmosphere and responsibilities from those of the traditional production methods (Woodard, 2002). It is in agreement with Gilmore (2000) who emphasized that mass customization of pattern development is made possible with enabling technologies such as computer-aided design (CAD), digital printing, single ply, automated cutting, and the body scanning. In most cases, a customer can provide measurements and define styling details &

fabric prints for unique clothing items that could be produced efficiently through mass customization processes and technology.

According to Vijayalakshmi (2012), the garment industry is undergoing enormous changes that end up in increased pressure on apparel manufacturers. The producers are challenged to compete, in terms of services offered as well as products produced. It has compromised efforts of meeting market demands; which has forced the firms to change their production methods to expand their productivity. The demands of today's market require flexibility and timely fashion, quality, and value which has made the manufacturers thinks of their production strategies.

The research has revealed that emphasis on CAD adoption needs to improve given that just a mere 20% of the respondents use Computer-Aided Design in their production processes, while observations revealed that some respondents involved use of Computer-Aided Design in their methods for production through securing these services from others. It was challenging since extra time was required to transport the products to the area of service acquisition.

Table 4. 13: Employees who did not use CAD

Employees who did not use CAD	Frequency	Percent
Lack of skills	34	35.8
Expensive	4	4.2
Lack of knowledge	43	45.3
Not sure	14	14.7

The study further sought to find out reasons why some of the respondents did not use CAD software. The study realized that out of these employees who did not use CAD, 45.3% lacked knowledge, while 35.8% lacked skills as shown in Table 4.13.

Lack of skills neither hindered some SMEs in achieving their entrepreneurial goals nor manages to compete in the global market. A study conducted by Equity (2006), confirms that the apparel manufacturers in Kenya have faced weak infrastructure, relatively low productivity as compared to Asian competitors. Outdated technology and slow communication norms, lagging human capital levels and political risk, and many of the old textile factories falling into disrepair, making it extremely hard to get locally-sourced fabrics and trims.

Only four point two percent of the employers had indicated that they did not use CAD because it was expensive. It was a sign of low capital investment among the manufacturers, which confirmed that indeed the businesses are small scale. Another 14.7% of the respondents did not have any reason as to why they did not use CAD and opted to remain silent. It is evident from the study that several respondents lacked information as well as resources, and this could be one of the many challenges faced by SMEs in Kenya.

It is evident in the study that the majority of these respondents (45.5%) had indicated earlier to have invested more than 70,000 Kenya shillings. The findings further suggest that the employee's lack of knowledge could be an attribute of the level of education. A limitation in education implies, the respondents are bound to select on equipment that could perform minimal tasks so long as they had prior knowledge of operation. It gives a selection of CAD minimal opportunity as an option for choice due to limited information.

Another factor in support is that most of the respondents in the study acquired skills on the job. Hence they would not select expensive machines which they were not conversant with its use. A study carried out by Omondi Imo, and Otina (2016) further explains that CAD technology requires a different kind of expertise than is needed for manual design production processes.

Thus, the weaknesses of management skills in the use of technology seem to be a significant barrier to the successful adoption of CAD. Managers are the primary decision-makers in an organization; hence, success or downfall depends on them. Successful managers tend to influence most decisions that determine the progress of the firm. The adoption of CAD requires aggressive managers to adopt and implement.

The study also observed that some respondents did not follow the correct stages involved in the production process. When asked, they indicated that they obtained their skills on the job and were only able to perform the skills they had acquired. Others got their training in formal apprenticeship programs, while others received their training in middle-level colleges that offer competency-based programs for the apparel industry. The study also noted that some designers and managers advance to their current skills after working in various production lines for several years, and did not involve the use of CAD.

Results further show that a good number of the apparel manufacturers had skills which they had acquired on the job; however, a reasonable number of the manufacturers in the study did not use CAD nor had specialization to produce one type of product. The lack of specialization could be assumed to influence the quality of the finished product. It could be that the influence confirms the success or failure of any manufacturing firm rests majorly on the adequate availability of competent, skilled, and dedicated personnel. These results, therefore, indicate the importance of relevant skills and involvement of CAD in a production process. The findings further suggest that the products made with inadequate skilled personnel may not meet the needs of the customers. These could be some of the reasons leading to the increase in popularity of second-hand items of clothing which are a result of specialized equipment with CAD software.

Kuzilwa (2009) revealed that entrepreneurs from relatively large enterprises are better educated and have easier access to information through a variety of sources, of which this factor has contributed to their business success. It suggests that the level of education could influence the quality of the products and production level. Kindiki (2009) explains that the regular training program available for production workers have no specialization but are of limited skills that the job requires. These skills are transferred from one person to another and largely depends on the latter's orientation. Additional studies (Nkonoki, 2010 & Casson, 1982) have also argued that lack of proper education, knowledge, skills and training, shortage of labor, not having the financial resources, not having access to the right technology and proper strategy or plan for growth can be limiting factors for SMEs to work with the aim of economic growth.

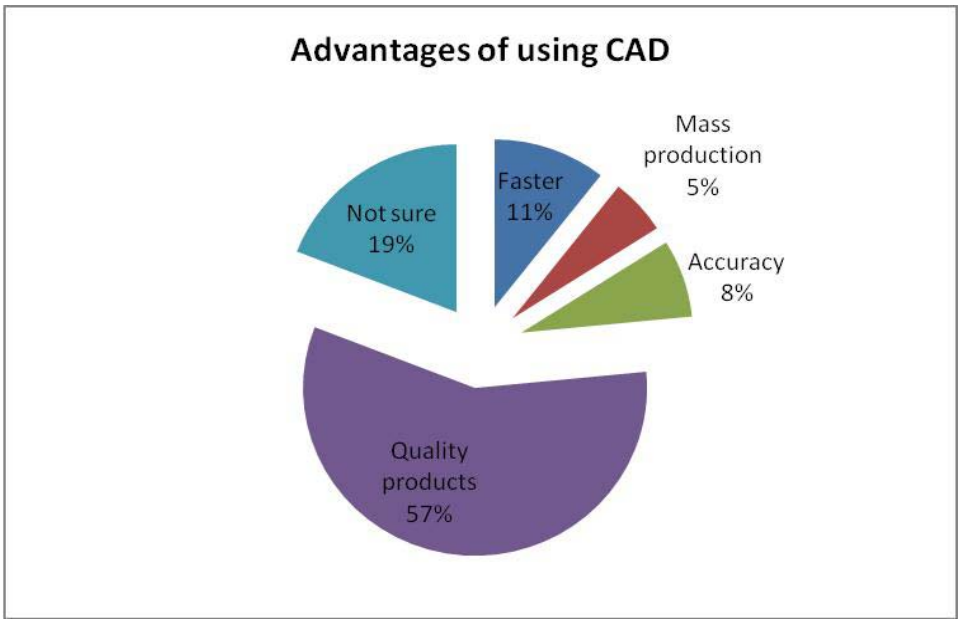

Figure 4. 9: The advantages of CAD use to employers

The study also noted that CAD had several advantages, and it was clear that the majority of the SMEs expressed their views on the advantages of CAD use in one way or another. A total of 57% of the respondents (Figure 4.9) recognized the advantages of CAD directly and indirectly.

From observations, the percentage of the respondents who used CAD-related methods in production had several advantages. CAD aided processes could multitask compared to human labor. Spencer (1989) explained CAD as a tool for efficient creation and development of designs that overcomes tedious and repetition tasks, enabling the realistic representation of garment designs and garment shapes to be prepared and quickly modified on the screen.

As shown in Figure 4.9, the results indicated that the respondents who had used CAD were sure of quality products. It makes it clear that the use of CAD technology is a process of designing and design documentation. It describes the process of drafting and designing with a computer and provides the user with input-tools to streamline the design processes. Drafting and designing with a computer also provides the user with input-tools to streamline the design processes, which includes drafting, documentation, and manufacturing processes. CAD output is often faster and of good quality as compared to other methods of production (Encyclopedia, 2012).

Further, many SME firms may aspire to embrace good quality constructed products, which are known to enhance clothing durability, aesthetic appearance, and comfort in wear. It is an assumption that suitable quality garments are more comfortable to sell. It means that sound quality is an essential contributor to a sellable garment. Omondi, Imo, and Otina (2016), demonstrated that in today's global market, manufacturers relied on new technologies to capitalize on current market trends and quality of the garment. Only eight percent of the respondents recognized accuracy as an advantage. The assumption could be that these respondents had not used CAD for a while, or they were not clear on the accuracy, given the low levels of education.

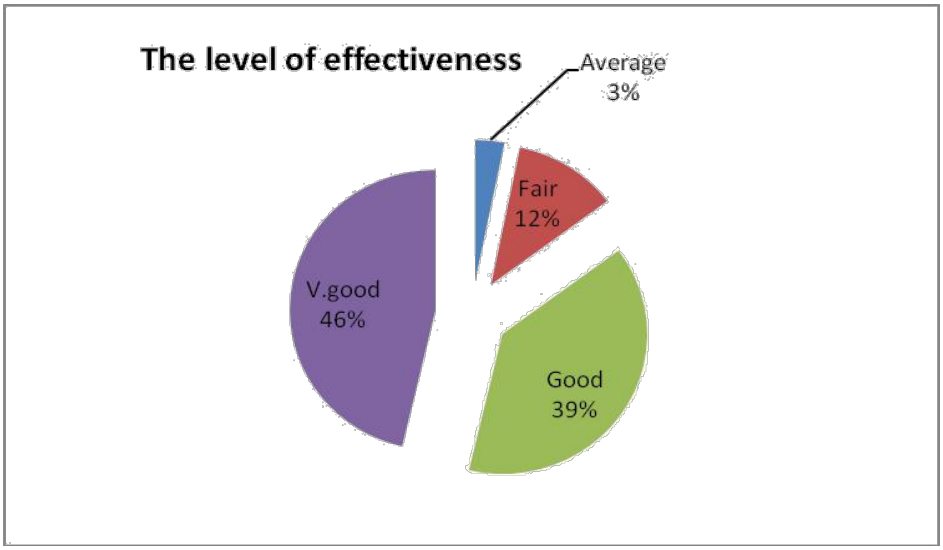

Figure 4. 10: The level of Effectiveness of the Method used

In establishing the level of effectiveness of the method used, Figure 4.10 indicates that 46% of the respondents confirmed that the level of effectiveness of the method they used is average. The manual methods of production pose challenges to yielding high levels of production. A total of 39% of the respondents felt that the effectiveness of the chosen method is considered to be good. It could be an attribution to the fact that the respondents use different types of techniques, and the quality of each technique varies from one technique to the other.

According to London (2017), his findings indicated that production techniques are critical to a fashion designer's concept into a garment, and each of these techniques serves the purpose of creating a style pattern. The study recorded 12% of the respondents who find the level of effectiveness of the method used to be fair while three percent of the respondents find the level of effectiveness to be very good. The least representation could be the percentage of respondents who have adopted or seek CAD services from other users while the higher percentage of those who did not use CAD are the ones who had not adopted.

The findings imply that the adoption of CAD has been initiated at different levels of apparel production even though the progress is meager. It further indicates that even though the progress is slow, its effectiveness is being experienced positively.

4.4 The Patterns of CAD use in Apparel Manufacture

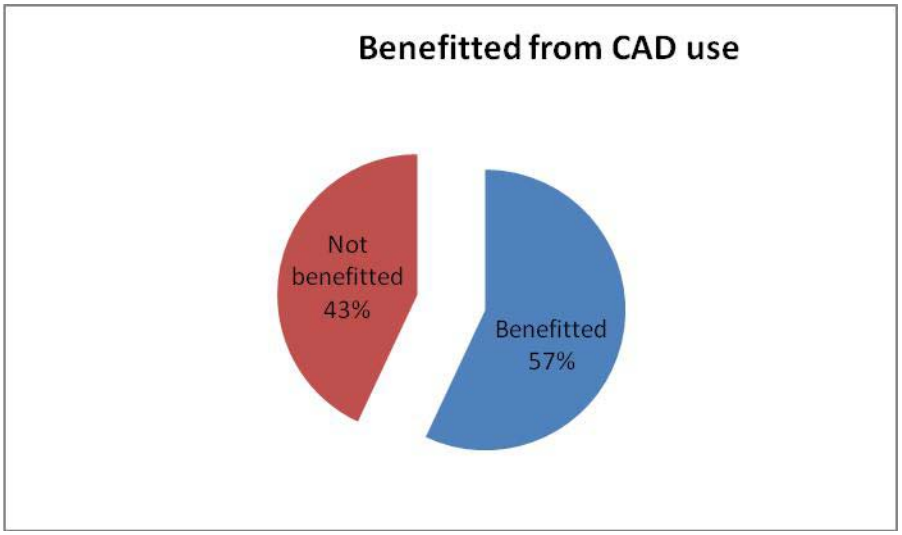

Figure 4. 11: Benefitted from CAD use

The patterns of CAD use, as presented in the study, indicate that 57% of the respondents had not benefited from CAD programs (Figure 4.11). The respondents argued that CAD programs are too advanced, and they needed CAD skills to operate the programs. The low representation is a justification given that more than half of the respondents had indicated earlier that they acquired their skills on the job, and these largely depended on the skills learned from the training provider. The study further realized that those who did not use CAD do not have specialized types of equipment. They seek other specialized services from other manufacturers who had those kinds of machines.

The majority representation of those who do not use CAD could be because they considered software to be expensive and not readily available. It is also an attribution to the fact that most of the operators are semi-skilled hence don‘t find CAD convenient in use. The low level of education limits the producers ‘chances of exposure to CAD skills, which could be due to limited knowledge. Yu (2001) clarifies that the absence of formal technical training may indicate that there is a lack of information about technical skills. The findings could suggest that the SME apparel production units had limited skills, which denies them opportunities to explore CAD skills.

4.5 The Acquisition of Software

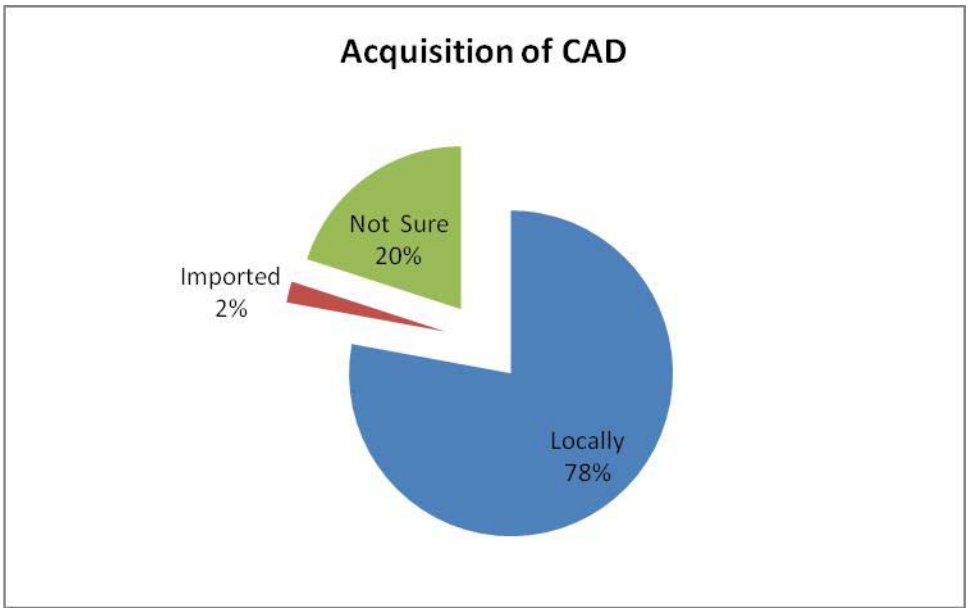

Figure 4. 12: Acquisition of CAD

The sources of CAD software and their availability was an essential aspect of this study. The respondents who indicated they had used CAD were asked to state their sources of acquisition and the ease of availability.

It was clear that 78% of the respondents who had adopted CAD acquired this software locally, while another 20% of the respondents' who had adopted CAD were not sure where this software is obtained (Figure 4.12). This representation applied to those who secured these services from other SMEs. These revelations confirmed that the SMEs had equipment that could only do basic production processes. This confirmation is as a result of outsourced specialized services from other manufacturers/vendors. Only two percent of the respondents do import this software. They stated that their friends mailed them from European countries or they downloaded them from the internet.

4.6 The Availability of CAD and Related Software

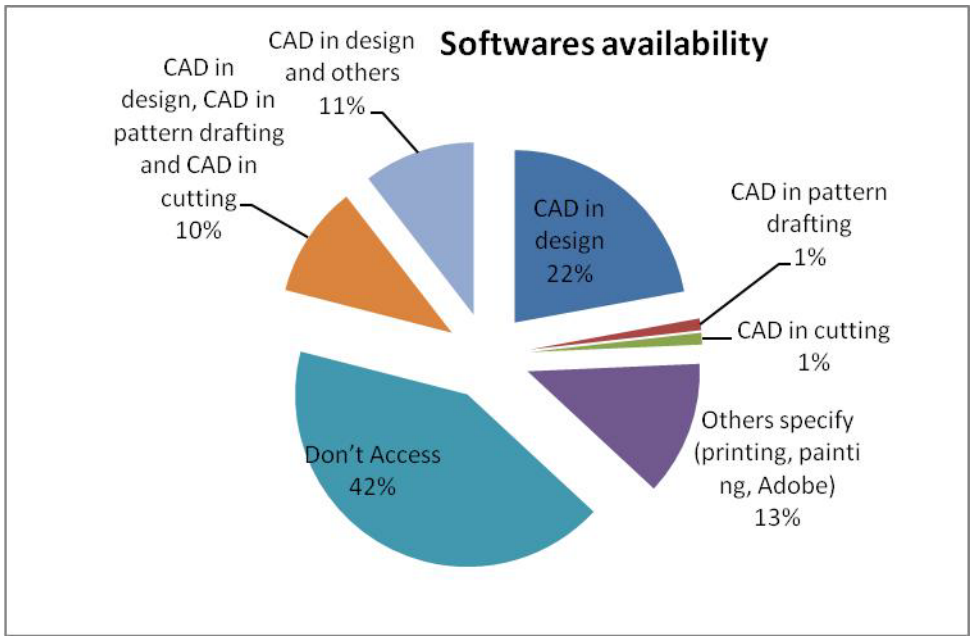

Figure 4. 13: Software availability

Being among the first studies on the adoption of CAD in Kisumu, the study sought to establish the readily available software and the ones not easy to find.

On inquiry of the availability of this software, Figure 4.13 indicates that 42% of the respondents who had not adopted CAD did not quickly get access to CAD programs nor did they use in their production processes.

This assumption could be valid since the majority of the respondents were not even aware of these programs, and those who were aware consider them to be very expensive. Ball (2013), reaffirms that apparel manufacturers considered CAD systems as typically complicated and expensive pieces of software, and their native file formats are equally complicated, and opaque. It could be an argument that since quite a number of the respondents had acquired their production skills informally, this had limited their level of exposure to modern technology such as CAD skills.

The respondents that did not get access to CAD-related software in their designing programs and other applications such as printing, adobe photoshop, and painting were 22%. Majority of the respondents who used CAD for designing accessed it through the internet. It was also an observation that the selection of these programs largely depended on what the SMEs required. Of the proportion of respondents who used CAD, only 11% found CAD in design as readily available while ten percent felt that CAD in design, CAD in pattern drafting, and CAD drafting were not easy to find. It meant that different software was necessary for apparel product development among SMEs since large scale industries are embracing technologies in their production processes.

Islam (2017) explains that computer-aided design played a significant role in achieving higher output. He further clarifies that there are different types of CAD software used in the apparel manufacturing sector.

The software includes GRAFIS, which is modern CAD software for garment design. It allows the creation and editing of cuts, their grading and the output on printers and plotters as well as the export of the finished cut patterns in different data formats, Audaces Create patterns on the computer screen quickly and easily.

Create base patterns within industry standards, including measuring tables, sewing areas adapted to the equipment, and shrinkage studies. TUKACAD is innovative apparel pattern design software that is perfect for manufacturers and designers of any size. TUKACAD allows the user to accurately build patterns, grade rules, and markers for single styles or entire lines. It is the advanced pattern making, grading, and marker making system streamlining the production process and reducing operating expenses. CAD Assyst creates entirely different advantages in terms of speed, efficiency, and cost. Modaris used for pattern-making, grading, and virtual prototyping to shorten the product development cycle, ensuring better finish, fit, and accuracy. Moreover, Acumark Gerber is software used to design, develop, and market products as quickly and efficiently as possible.

4.7 Stages of Production with CAD

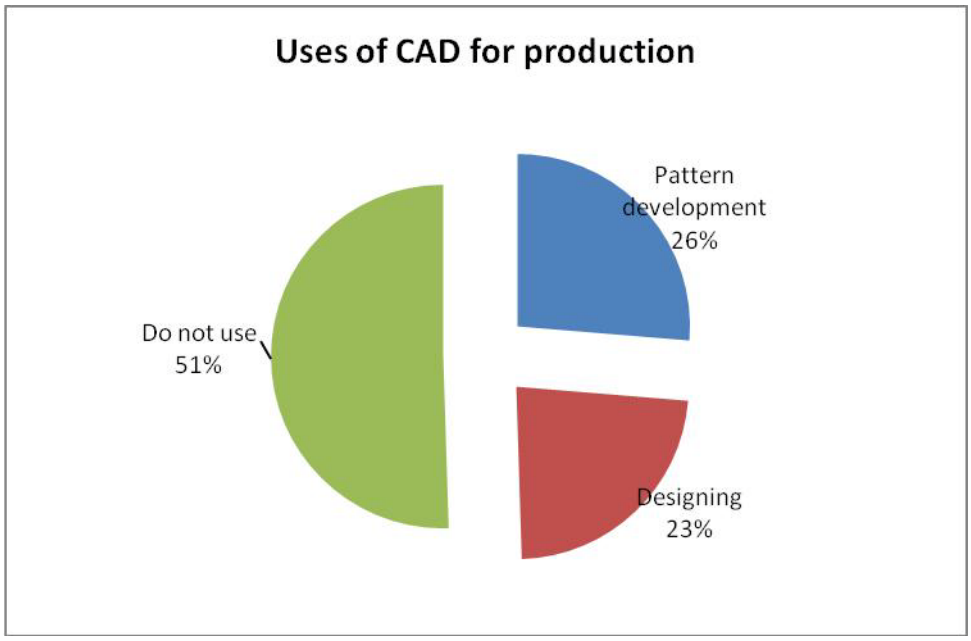

Figure 4. 14: Uses of CAD in stages for production

The observations on the study on uses of CAD for production show that the majority of the SMEs did not follow the required production process. The findings established that 51% of the respondents did not involve the use of CAD in their production processes. This indication could relate to the fact that a number of these respondents did not own the right skills needed for the SME industry. It confirms reasons as to why the respondent‘s lack of willingness to accept changes in technology. A total of 26% of respondents indicated, they draft patterns directly on the fabric. Another 23% involved the use of CAD in their designing processes (Figure 4.14). Those who involved the use of CAD in designing obtained their designs from the internet or design charts.

Studies have shown that the actual apparel production process involves several stages, starting from designing to pattern development before it is finally cut, stitched, and finished.

Vijayalakshmi (2012) had indicated that the elimination of unnecessary operations or handling that does not increase the value of a product reduces unnecessary delay in production. Each operation performed on a style should add value. It was necessary since different methods of production use different skills on specific products. More than 2 types of skills could assemble a single product.

Sewing machine ⟶ Neatening machine ⟶ Blind Hemmer

Plate 4. 5: Flow process of Garment Production (sewing, neatening and hemming)

The process in Plate 4.5 indicates a scenario observed among the SMEs. The first sewing machine was for joining seams; the second one for neatening the seam edges while; the third one was for hemming the lower edge of a finished garment. The flow process confirms that one garment could adopt different types of machines that perform different operations, at all levels of production; it is possible to incorporate CAD. It could support the importance of education as far as skills acquisition is concerned. It suggests that with education, the level of reasoning also improves; hence, one can operate different machines and apply different skills.

The use of CAD and other specialized machines is further elaborated by Harris (2017) who describes the garments manufacturing as an industry that requires investment in sewing machines, which aids in joining various parts of a garment.

He further explains that specialization in production requires individual sewing machines and CAD software, and depends on their specific applications. It includes the pocket sewer machine used for stitching pockets, chain stitch applied in sewing woven and knit fabric, Buttonhole sewing machine and a lock stitch machine that would suffice for all kinds of apparel.

The study, therefore, explains that SMEs did not have some specialized machines nor specialized in a production line. Lack of specialization makes competition difficult since the products keep on varying. In comparison to China, their products have directly competed with locally produced goods, making it difficult for SMEs who have not adopted CAD and are not specialized to compete. This is explained by Mc Cormick et al (2009) who indicated that the African SMEs had faced significant challenges when its market shifted from protected to liberalized market in the early nineties, when the markets opened and got flooded with alternative products from China and second-hand clothing, which have been made by modern equipment and CAD software.

The study established a significant difference in products made from primary machines and modern equipment. The products made by modern equipment were of better quality since the equipment does specialized techniques coupled with skills of standards. The pictures (Plate 4.6) show some of the fashions/mass-produced goods made by the manufacturers. It indicates that the kind of goods made varies from men‘s wear, women and children.

Plate 4. 6: Types of products produced (Kisumu Polytechnic production unit 2017)

Plate 4.7 shows sample obtained from small scale industries in Kibuye market. The plate explains the kind of quality manufactured by these producers.

Plate 4. 7: Types of products obtained from Kibuye Market

4.8 Advantages of CAD in Levels of Production

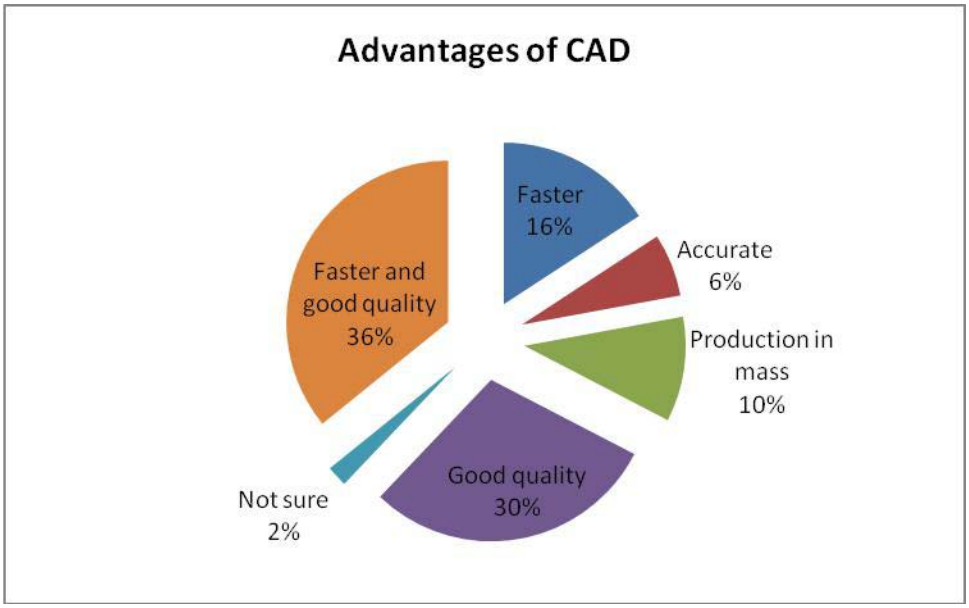

Figure 4. 15: Advantages of Using CAD

On the advantages of using CAD at different levels of production, 36% of the respondents considered CAD to be faster and good quality, as indicated in figure 4.15. Another 30% of the respondents considered CAD to be of good quality, while 16% consider CAD to be faster. It was, therefore, essential to note that speed and quality are an influence on the skills employed and are an essential aspect of production. It confirms that CAD skills are an efficient tool for production. A study done by Ball (2013), traced the scope of CAD operations to its systems as facilitators of communication among those involved in the design, manufacturing, and other processes. The study spelt out the importance of contracts, as it indicates cases where one firm contracts another to either design or perform a task. There was a clear indication that outsourcing was a significant trend among apparel manufacturers. It was a more natural option which could be a reason for not adopting CAD.

The respondents also confirmed that the use of CAD had several advantages as compared to manual methods (Figure 4.15). This finding concurs with Raymond (1988), who noted that the advent of low-cost/easy-to-use software applications had allowed an increasing number of small organizations to implement computer-based software‘s in their production processes. Shamika (2012), further confirms that CAD programs or software are convenient tools that are used to create and draft designs allowing users to draw objects with exact precision. The CAD programs have been used by large scale apparel industry to produce 3D representations of sketches not quickly done manually. The CAD software has increasingly been used by fashion designers when designing anything from simple sketches to elaborate ones.

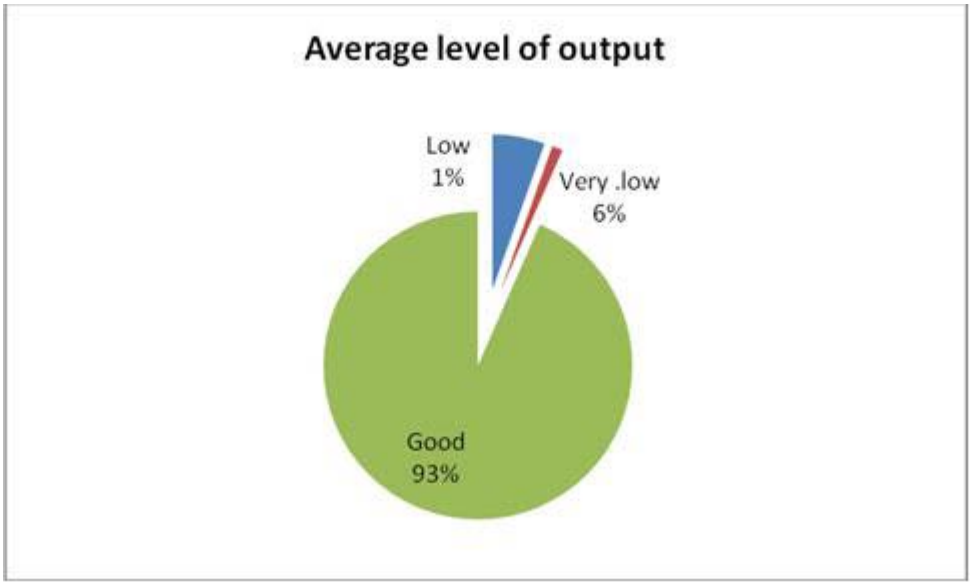

Figure 4. 16: Average level of output with CAD

The study also found it necessary to note the average level of output when the manufacturer used CAD. It was important in making significant decisions on its use.

The study noted that CAD use was not extensive, but the respondents who had used it recorded and rated it as better compared to other production methods (93%) in figure 4.16.

It explains that adequate implementation of CAD could have a positive impact on the overall production process. Only six percent of the respondents' rate the use of CAD as low. It could be a possible explanation that some of the respondent's source for specialized services from other manufacturers which makes the process too long to accomplish.

4.9 Suggestions of the Respondents on Areas to be Addressed in the Apparel Industry

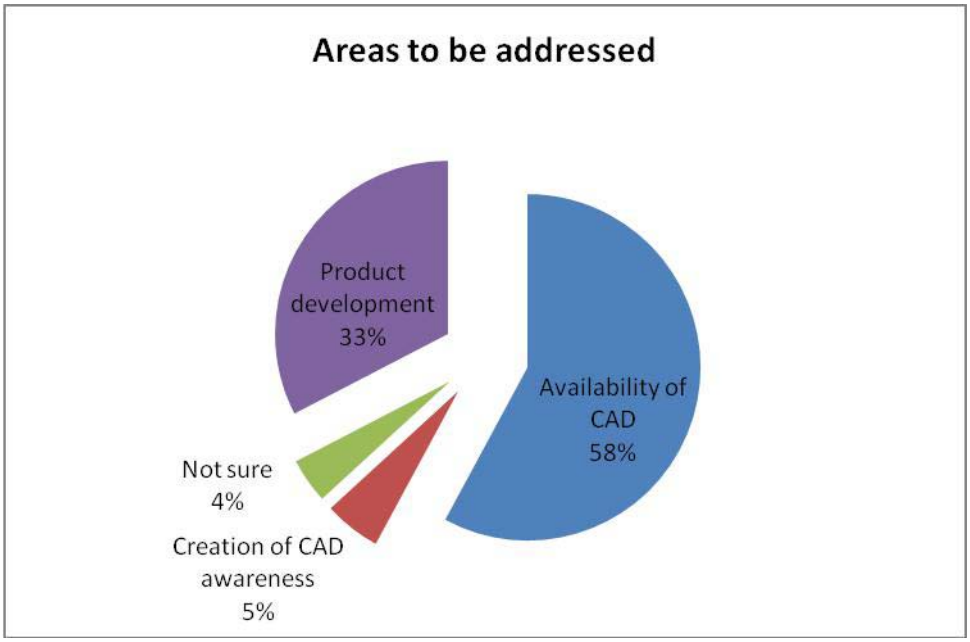

Figure 4. 17: Suggestions on areas be addressed in the apparel industry

On suggestions on areas to be addressed in the apparel industry, the study established that 58% of the respondents were for the idea that CAD should be available to the manufacturers (Figure 4.17). They argued that CAD is a new technology that is not readily available or known to several SMEs. The findings affirm that the adoption of CAD opens a vast field of possibilities in the creation of new products giving room to inclusive innovation and differentiation of patterns. In other opinions, in areas to be addressed, 33% of the respondent's concern was product development. They reasoned that apparel production involves several stages with different types of equipment used.

The respondents' further argued that with the introduction of CAD into their production processes; it is crucial to improve on the invention by providing further training since it is a new technology.

Other respondents suggested that such inventions could be in-cooperated into current training programs or offer seminars, and workshops to people in employment. It confirms that there could be no skill without training, which is either formally or informally.

Another percentage of the respondents (five percent) showed a high interest in the creation of awareness on CAD programs. They expressed concern that CAD programs should be made known to the employees. Only four percent of the respondents did not have any reason not addressed. As far as they were concerned the equipment and method used were ok. Their non-involvement was a result of observations concerning CAD use. In such situations, it was clear that ignorance was the determining factor.

The study also established the CAD skills used in the production process as a professional and was a challenge when acquired on the job. The acquisition of CAD skills are from training institutions and some cases may require primary education for easy understanding. It concurs to the study carried out on SMEs by Tegegne (2009) which found that a percentage of the respondents had a secondary level of education, a significant number had a primary level of education, and very few had a college level of education. Woodward (2002) further noted that machine operators are usually trained on CAD use within the workplace by more experienced employees or by machinery manufacturers' representatives. As machinery in the industry continues to become more complicated with the inclusion of CAD, some apparel workers would require training in the basics of computers and electronics.

Besides, the trend towards cross-training of operators could increase the time needed to learn CAD and different machines, while the rise of modular manufacturing would require workers to acquire the interpersonal skills necessary to work effectively as part of a team.

Table 4. 14: Suggestions that could be used to Improve on Skills in Apparel Production

Suggestions	Frequency	Percent
Skilled workers	1	1.1
Training	65	68.4
Availability of CAD	15	15.7
Use of books	1	1.1
Various production methods	1	1.1
Availability of CAD and training	8	8.4
Not sure	4	4.2

The respondents further gave suggestions on ways that could be used to improve on the skills used in the apparel industry. The study showed that 68.4% (Table 4.14) of the respondents felt that it was necessary to intensify training on CAD in the fashion industry. The acquisition of these skills could occur in colleges, on the job, or through seminars. Skills learned on the job need constant updating. Raymond (1988) asserts that a lack of training in computer skills can be a significant drawback to small and medium-scale manufacturers. For instance, lack of know-how about the possibilities, limits, and requirements of business computing can cause small and medium-scale manufacturers to depend on outsourcing CAD software and other related services.

On the types of skills used, skills and their impact on production are of vital importance. The study found out that 15.8% of the respondents felt that new technology should be availed locally and at affordable prices since this could help improve on skills. Only eight point four percent of the respondents felt that the availability of CAD should be emphasized and accompanied by training. It was an indication that the emphasis of training programs could achieve awareness of CAD use. CAD skills are essential if adopted within the training program. According to Bertalanffy's (1968) theory, he explained how skills worked: it indicated the studying of transactional processes happening between different parts.

He understood that the whole process was higher than the sum of its parts and that using this theory; we could observe patterns and the organization of relationships in a production system.

4.10 Factors Influencing the Adoption of CAD in Apparel Production

Table 4. 15: The CAD Software Available in the Market

CAD software (multi answers)	Frequency	Percent
CAD in design	2	2.1
CAD in design, CAD in cutting, CAD in pattern drafting, internet	6	6.3
Internet	47	49.5
CAD in garment making	1	1.1
CAD in design, CAD in cutting, CAD in pattern drafting	5	5.3
Others	2	2.1
Not sure	32	33.7

In establishing the CAD software available in the market, the findings in Table 4.15 revealed that the Internet was the most popular program that was used by 49.5% of the manufacturers to source their designs. This representation includes the respondents who use software such as Adobe Page Maker and Adobe Illustrator for designing. It could be an assumption that this mentioned software programs in the fashion industry, and they are of preferential due to their versatility and affordability.

It assumes that the adoption of CAD is as a result of exposure. The fact majority of these manufacturers is of form four levels of education and below, and acquires their skills on the job hence minimal exposure. The respondents also reasoned that this software such as the Adobe could easily be found or purchased online, while software for specialized machines such as computerized embroidery machines was not available locally.

It is supported by Encyclopedia (2012), which explained that computer-aided design software packages available in the market range from, 2D vector-based drafting systems to 3D stable and surface models. The new CAD packages frequently allow rotations in three dimensions; this allows viewing of a designed object from any desired angle. Computer-aided design software is one of the many tools used by designers, while others include CAD for the accurate creation of photo simulations. The features used in the CAD software systems are for a variety of tools for measurements such as tensile strength and yield strength.

Out of the respondents questioned as can be seen from Table 4.15, about 33.7% were not aware of the computer software available in the market for apparel manufacturers while a total of 14.8% were aware of CAD software used in different areas of production, which includes, CAD in garment making, CAD in design, CAD in cutting, CAD in pattern drafting and the Internet. Some respondents were aware of CAD, while others were not.

4.11 Source of Information about CAD Software-Employees

Table 4. 16: Source of information about CAD software (multi choices)

Source of Information on CAD	Frequency	Percent
Internet	42	44.2
Friends	9	9.5
Workplace	6	6.3
Books	3	3.2
Not sure	45	36.8

Information, as presented in Table 4.16, shows that the respondents were aware of computer programs and computer-related equipment that are available in the market. This known information was through the Internet which constitutes 44.2% of the respondents, followed by friends who constituted nine point five percent of the respondents, and workplace was six-point

three of the respondents and books were three-point two of the respondents. It was clear that the Internet was the primary source of information for most of the respondents. The Internet has made the world to be a global market, thus making it possible to access information from any part of its part.

Even though computer programs were penetrating the market, 36.8% of the respondents were not aware of these programs. The revelation is that they were not exposed or they lack knowledge about these programs.

4.12 Computer Software Available in the Employees Organization

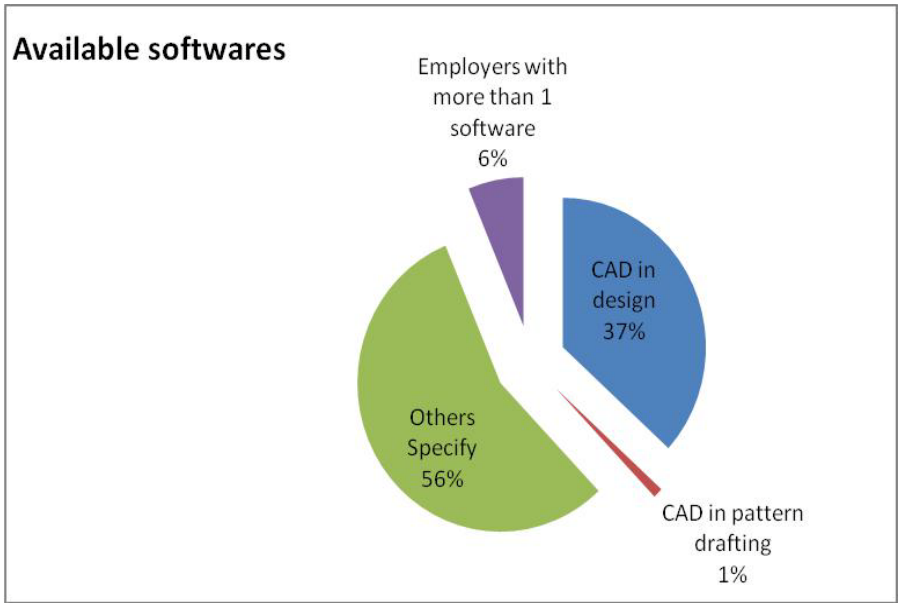

Figure 4. 18: Computer software available to employer

The results confirm that the respondents were aware of CAD use (Figure 4.18), and 56 % of the respondents confirmed the availability of different software and programs of CAD used within their organization for production processes. Of the respondents who were aware of CAD use, 37% employ CAD basically for designing (Figure 4.18).

The respondents indicated that some of the programs were costly, not readily available, or too advanced to learn. Only six percent of the respondents used CAD in more than one process, and they also applied CAD in pattern drafting (development). It was purposely to store sizes or source for size charts from the internet, print t-shirts, and to develop their patterns.

The software‘s that used included Adobe Page Maker, Adobe Photoshop, and Publisher. It enabled them to work on the patterns making them ready to be transferred on screens for printing. The software was recognized to be vital since they unleash the creativity of the designer. Computer-aided design technology not only enhances designing possibilities but also increases productivity by eliminating the manual procedures and time-consuming processes of designing (Raaz, 2017). The study established stages of production of which CAD could be an inclusion within the production process, but many SMEs did not adopt. In Figure 4.18, only CAD in design and pattern drafting were distinguished in use by apparel designers.

4.13 Software Used by Employees

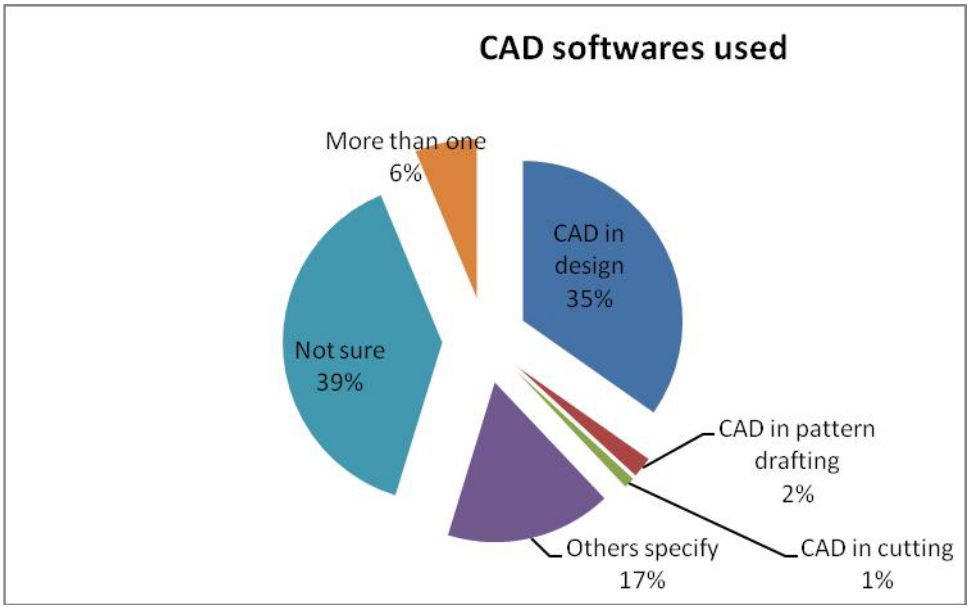

Figure 4. 19: CAD software used

In this section, the study sought to assess the software that the respondents were able to use. In Figure 4.19 the respondents who used CAD in various apparel production processes totals to 61%. Out of this percentage, CAD in design constituted 35% of the respondents, another 17% percentage of the respondents were able to use CAD software for different production processes. These included screen printing for the preparation of images and screens. Only six percent of the respondents were able to apply CAD software on more than two occasions. CAD embraced the creative design of new styles as well as the technical functions of pattern construction, grading, and lay plans. New garment styles are developed using computer color monitors and devices. The apparel industry uses 3D modelers to create detailed designs. It was evident in cases where two skills were combined to make one article. Examples included embroidery and finishing. A total of 39 percent were not sure of CAD software, and had not used any.

The Plates (4.8) below shows the prepared screens using CAD, and already printed cloth. The image was developed by the use of computer program

Plate 4. 8: Prepared photo coat screen

Table 4. 17: Reasons for Using CAD for Production

Use of CAD software	Frequency	Percent
Unique designs	36	37.9
Expensive	2	2.2
Lack of Exposure	18	18.9
Quality products	18	18.9
Not sure	21	22.1

The study tried to find out the reasons by employees who had used CAD for production. It was noticeable that the employees used CAD to get unique designs and quality products. It was represented by 37.9% of the respondents in Table 4.17. It shows that the inclusion of CAD embraces the creative design of new styles as well as the technical functions of pattern construction, grading, and lay plans.

It was clear that new garment styles are developed using computer devices, while the large scale apparel industry uses 3D modelers to create detailed designs. Ball (2013) justifies that CAD systems solve many efficiency problems: designers could easily copy and paste repeated design elements, run scripts instead of laying out everything by hand, and avoid or correct mistakes more easily. Another 22.1% did not indicate whether they had used CAD or not, while 18.9% had used CAD to obtain quality products, which could be an assumption that they seek such services from those who offer them. A similar percentage of the employees indicated that they had not used CAD. They expressed a lack of exposure as the deterring factor, which has not enabled them to use CAD. Only two point one percent had not used CAD, and they reasoned that the costs for the purchase of these programs were high. It could be an assumption that it is a representation of those who used purely manual machines, with little or no information about CAD.

Table 4. 18: Benefits of Using CAD for Production

Benefits of CAD	Frequency	Percent
Fast	16	16.8
Accurate	11	11.6
Quality products	55	57.9
Variety	3	3.2
Low cost	9	9.5
Quality products with low costs	1	1.1

The study further established that some of the respondents had used CAD software directly or indirectly (57.9%, as shown in Table 4.18). The respondents indicated that CAD is an assurance of quality products. The respondents further argued that CAD, when used, gives a variety of designs as well as options that increase productivity. Direct users of CAD use it during their production processes, while indirect users benefit from the direct users in one element of their production processes. They achieve by sub-contracting others to do part of the job as they work on the other elements. Out of those who had benefitted from CAD, 16.8% stated that CAD is fast when used. It justifies the need for adoption of these programs since some respondents had recognized its importance.

The finding revealed that the indigenous methods of designing using pencils and colors that would take much time could take less time if done by computers. Other respondents (11.6%) used CAD in their production process because of accuracy. Only nine point five percent felt that CAD was the right way of reducing costs in production. It demonstrates that CAD is ideal and faster compared to human labor. Other related studies have shown success in using CAD within the large scale industry.

4.14 Employees Views on Use of CAD

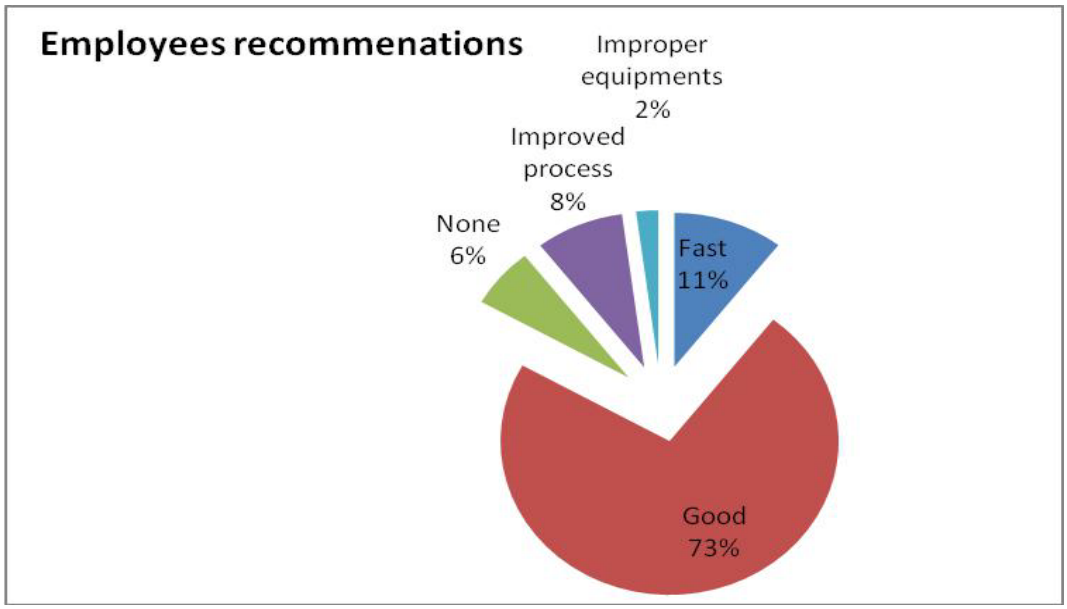

Figure 4. 20: Employees recommendations on use of CAD

The employees were further asked to give their recommendations on the use of CAD software. The results as presented in figure 4.20, indicated that 73% of the respondents that had used CAD in the apparel industry viewed it as useful, while 11% of the respondents felt that CAD as new technology is fast and had a better effect on the quality of the product produced. Eight percent of the respondents found it essential that the production process should be improved. It can be suggested that the achievement of this could only be obtained if new technology such as CAD are in cooperated within their production systems.

4.15 Employers recommendations on the use of CAD

Table 4. 19: The employers' recommendations on CAD use

Recommendations	Frequency	Percent
Skilled workers	1	1.1
Training	7	7.4
Computer literate	2	2.1
Availability of CAD	49	51.6
Various production methods	26	27.4
Not sure	10	10.5

The study established that 51.6% of the respondents found it necessary that CAD software should be availed easily to the apparel producers (Table 4.19). The use of CAD is a noticeable indication that SMEs appreciated its use. The findings further established that 27.4% of the respondents thought that varying methods of production was the only option to achieve improvement in apparel production. It confirms that different production methods and programs perform different tasks, while 10.5% were not sure on what to recommend. It was as a result that some of the manufacturers did not use CAD; therefore, it was not possible to recommend what they did not know.

Some of the respondents (seven point four percent) recommended intensified training on CAD in the fashion industry. Training on CAD demonstrates the uniqueness of a designer. Raaz (2017) noted that the adoption of CAD for modern designs is a skill that makes textiles more attractive and competitive to meet the rapidly changing needs of the consumer for fashionable designs both nationally and internationally. These findings concur with the study by Raymond (1988) who established that lack of training in computer skills could be a significant drawback to small and

medium scale manufacturers in the United Kingdom. For instance, lack of know-how about the possibilities, limits, and requirements of business computing could cause small scale manufacturers to depend too much on outsourcing other computer software-related services. However, outsourcing could also be a strategy that encourages the sharing of facilities rather than individual use.

The findings, therefore, conclude that even though there is a low adoption of CAD software in the apparel industry, the employees who have used CAD still recommends on its use.

4.16 Government Policies on the Quality of Apparel

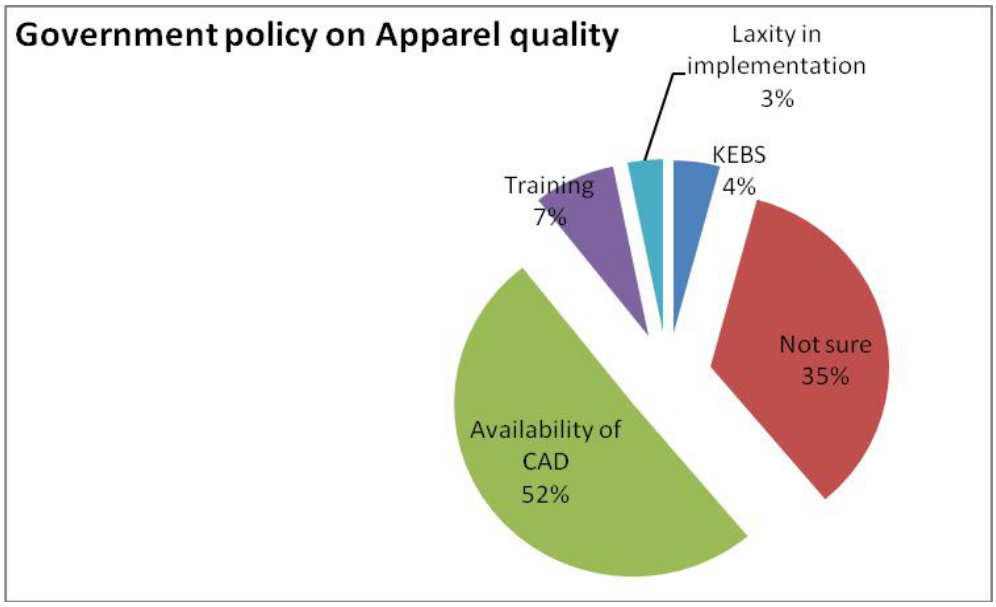

Figure 4. 21: Government policies on quality of manufactured apparel

On government policies, the study further tried to establish if there were government policies put in place to ensure that products are of good quality. It was revealed that there were policies put in place but the respondents were not clear if these policies were in force. More than half (52%) of the respondents (Figure: 4.21) indicated that the availability of CAD is appropriate if enforced as a policy to ensure the production of the right quality products. There were 35% of the

respondents who had no idea of any government policy as concerns apparel production. Meaning, the manufacturers were not even aware of systems meant for them. It indicated the high level of ignorance among the SMEs. Government policies are published to govern procedures, but in most cases, the stakeholders of the policy are not keen on its implementation. Seven percent felt that training should be done to create awareness of such systems since many people were not aware.

World Bank (2016) indicates that there are complex regulations for Non-EPZ companies. SMEs in Kenya suffer from poor labor productivity, given the high costs in labor, coupled with training systems that are not relevant or using equipment and technology that is outdated. Another study conducted by Equity (2006) expounded on the textile and clothing sector, as a contributor to GDP, and has been designated as a priority industry to drive Kenya's industrialization sector. To emphasize this, the Government has launched policy measures to create a conducive environment for mobilizing domestic investment and attracting higher levels of quality. It could also be emphasized by the Kenyan government strategy of the Big 4 agenda which focuses on manufacturing as one of the major pillars for development.

Another seven percent considered training as a key government policy. The respondents were a bit challenged on differentiating between policies and apparel needs and challenges. Only four percent identified the Kenya bureau of standards as an area for consideration as concerns policy regulations. This is true since Kenya bureau of standards is charged with the responsibility of regulating standards. Three percent noticed that there was laxity in the implementation of these regulations. This laxity could be a failure on the part of the relevant ministries. A policy brief by the Institute of Economic Affairs (2006) recognizes the Ministry of Agriculture as the arm responsible for the formulation of policies, regulating and advising the industry, while the

Ministry of Trade and Industry is responsible for policies affecting investments and promotion in the manufacturing sector.

The small and medium scale apparel manufacturing sector has remained undercounted in official statistics and poorly understood in development circles. The industry requires a range of policy interventions to govern and protect the employment relations of the manufacturer. Dickerson (1995) noted that to date, few policy-makers have explicitly addressed the opportunities and constraints faced by small and medium scale apparel manufacturers in the context of production. Policies noted were those ensuring functional quality specifications on the end product and good relations with customers.

In the past few years, the economic planners in Kenya have realized the importance of SMEs in achieving economic development in the manufacturing industry. The government of Kenya and development organizations has since focused on promoting and supporting the SMEs as a way of enhancing and encouraging broader participation in the manufacturing industry (Kamwela, 2016). It is further confirmed by Equity bank (2006) who emphasized the Kenyan governments' efforts to compelling new sourcing destinations for global brands.

The reason that Kenya has a deep well-spring of talent among fashion designers and small scale tailors, who can serve both the global, domestic, and regional markets. Embassy of Lesotho (2016), further confirms the importance of garment firms in Lesotho, who specializes in the production of some garments which they produce in masses. It is an estimate that Lesotho's 42 apparel firms each year make 90 million knitted garments, 26 million pairs of jeans, about 6,300 tons of denim fabric and 10,800 tons of cotton yarns which is suitable to make knit fabrics.

Finally, to implement policies, qualified human resources at all levels is a must. Policies with good intentions fail due to a lack of qualified people to implement them. It is mainly true in developing countries where more severe problems exist. It could, therefore, be a conclusion that it is crucial for the Kenyan Government to emphasis on policies that regulate the quality of products produced by the SMEs. The argument that quality is of prime importance in any aspect of the business since customers demand and expect value for money. The manufacturers of apparel must, therefore, produce work of good quality to fulfill the needs of the consumers. It can, therefore, be concluded that many factors influence the decisions on the adoption of CAD use, and this ranged from the selection of methods of production, available skills as well as government policies.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary, conclusions and recommendations of the study based on the research objectives.

5.2 Summary of Findings

Relevant research studies carried out in Kenya have identified the need for SME apparel manufacturers to boost the country's employment sector and to promote the industry. It has become clear that Kenyans prefer imported fashion items whose construction results from CAD-related equipment. A higher proportion of the clothing items in Kenyan markets today are either imported as new or second-hand goods. Kenyan clothing manufacturers encounter challenges with their production processes as well as the equipment they use. The purpose of the study was to assess the proportion of CAD adoption in apparel production among SMEs apparel manufacturers in Kisumu city.

The study provided information for strengthening production in the SME apparel manufacturing sub-sector within Kisumu City and among similar enterprises in Kenya. The following research objectives were addressed:-

i. Establish the proportion of CAD adoption in apparel production among small and medium scale apparel manufacturers in Kisumu city
ii. Determine the patterns of CAD use in apparel production among small and medium scale apparel manufacturers in Kisumu city
iii. Explore factors influencing the adoption of CAD in apparel production among small and medium scale apparel manufacturers in Kisumu city

5.3 Major Findings of the Study

In summary, the demographic details of the study have revealed that most of the employees were female. The majority being form 4 leavers or below. Most of the firms were located within the CBD. There was no specialty among the products manufactured by both employers and employees, and they used simple lockstitch machines. The results indicated that more than half of the respondents acquired their skills training on the job, and did not hold any certificate. These findings revealed that the level of education influenced the quality of the products. The sizes of the industry were mostly small scale with low capital investment.

On the proportion of adoption of CAD, the adoption was noted as low on the side of employees as compared to employers, with half of the respondents using straight stitch manually operated machines. More than half of the employees did not use CAD for production, while some employers outsourced CAD and other specialized services from other manufacturers. The selection of a given method for production and equipment depended on its cost. Some of the respondents were aware of CAD, and more than half recognized its benefits.

On the patterns of CAD use in apparel manufacture, more than half of the employees had not benefited from CAD use. Some of the respondents did not quickly get access to CAD services nor applied it in their production processes. The majority of the employees did not follow the correct production process but started with designing. Employers specifically, experienced the advantages of CAD at different levels of production. The average level of output when using CAD in a production process was very high and was considered suitable as compared to manual methods. More than half of the employees felt the need for CAD software availability, while a minimal percentage was concerned with product development. Some of the respondents suggested intensified training of CAD in the fashion industry.

On factors influencing the use of CAD, the study found that the employees lacked skills, and most of them were not aware of CAD software. Their decision on CAD adoption was determined by the cost of the equipment. The most popular software in the market used by the employees was CAD in design. This information was known to the respondents through the internet. In different organizations, the employers confirmed the availability of different software and programs of CAD within their production processes. On government policies, the study found that there were policies put in place to ensure that products are of good quality, but there was laxity in enforcement. More than half had not benefited from the use of CAD in their production processes

5.4 Conclusion

The study concludes that the apparel manufacturing industry has been revolutionized by new technology. The findings concluded that there is limited knowledge of CAD use. Even though manufacturers are aware of its existence, most of them have not adopted its use. On establishing the proportion of CAD adoption in apparel production among small and medium scale apparel manufacturers, the study has shown that CAD is being adopted at different levels of production, even though the proportion of adoption is deficient. Most of the SMEs were aware of CAD software and programs available in the market, but very few had adopted its use.

While on the patterns of CAD use in apparel production among small and medium scale apparel manufacturers, the study discovered that the patterns of CAD use were useful at different levels of production. They used CAD in designing as compared to other levels of production. Some respondents were not aware of software in use, nor their availability. The respondents mostly used machines which were manually operated with limited techniques.

On factors influencing the adoption of CAD in apparel production among small and medium scale apparel manufacturers, the study established that the respondent's decisions to the adoption of CAD were influenced by the level of skills training and capital available. Most of the SMEs were of low economic status with form four levels of education and below, and the majority of the respondents obtained their skills on the job. Skills are considered as a powerful tool in terms of decisions and can influence the direction of an organization. Skills and skills formation were indispensable parts of production, and lack of it affects the quality of products. While on training and skills, the formation was not a pre-condition for entry into this line of business. It established that most respondents did not use the correct procedure, but were using processes which were convenient for them. As much as there was low adoption of CAD among the SMES, the apparel manufacturers were capable of coping with the new changes of technology which are influenced by market demands.

5.5 Recommendations

Based on the findings of the study and available literature, the study proposes the following guidelines and strategies that SMEs apparel manufacturing could adopt to boost their performance:

On the adoption of CAD use, the researcher recommends that concerned Ministries should use these findings to sensitize the manufacturers on CAD use, and other methods of production evolving in the clothing industry. It could be an achievement through seminars, publicity, and marketing.

On patterns of CAD use, the researcher recommends, the SME apparel employers should insist on recruiting employees with CAD skills. The Kenya Bureau of Standards should also introduce

a rule that items made by the SMEs should have a label as a way of branding the local clothing products. The findings of this study could also be used to advice on the implementation of CAD in the TVET curriculum, the type(s) of CAD system(s), and the plans for CAD in the TVET curriculum concerning the apparel industry.

On factors influencing the adoption of CAD, market-related problems that affect the clothing industry should be addressed. The Kenyan government should see to it that manufacturers are registered and allowed only to produce the specified items within their registration guidelines. Relevant bodies should enforce policies that relate to apparel production.

5.6 Suggestions for Further Research

The researcher proposed the following:-

There should be a replication with a larger sample but at a later date to establish whether any changes shall have occurred

On adoption of CAD, a similar study to this should be carried out in other urban areas to establish their positions as concerns the patterns of CAD use. The results would also assist in making comparisons between different towns.

On patterns of CAD use a comparative study should be done to establish the relationship between skills and level of production.

While of factors influencing the use of CAD, another study could be done on the relationship between education level and production methods.

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APPENDICES

Appendix 1: Participant Information

RESEARCHERS CONTACT:

Grace Apondi Titi Masters Student,

Department of Design

Maseno University

P O Box 333 Maseno, Kenya

Email: titidanuk@gmail.com

Cell phone: +254-723826434

INTRODUCTION: I am a graduate student at Maseno University, Department of Art and Design; conducting research on an assessment of Computer-Aided Design adoption in apparel production among Small and Medium Scale manufacturers in Kisumu City, Kenya. You are invited to participate in this study because you are involved in apparel production as a manufacturer. Your participation is entirely voluntary. Truthfully answer the set of questions as names or addresses will not be recorded. The information given will be held in confidence and used for the purposes of this study only.

Appendix 2: Consent form and declaration

DECLARATION

I understand the purpose and procedures of this study as described, and I voluntarily agree to participate. I understand that at any time during the investigation, I will be free to withdraw without jeopardizing any employment or educational opportunities. I have had the opportunity to ask questions and have received satisfactory answers to all inquiries regarding this study.

TO BE COMPLETED BY INTERVIEWER/RESEARCH ASSISTANT

I certify that I have read the above consent procedure to the participant.

--- ---

Signature of Investigator Date:

TO BE COMPLETED BY RESPONDENT

--- ---

Signature of respondent Date:

Appendix 3: Employees Questionnaire

In the study to the purpose of the study is to assess the proportion of CAD adoption in apparel production among small and medium scale apparel manufacturers in Kisumu city, your views as a manufacturer within this industry play an important part in determining the adoption of CAD use and hence will help in making recommendations for the future. Thank you.

Section A Date:

Instructions: Answer the questions by filling the answers in the spaces provided. In case of choices, tick one.

1.0 Demographic Characteristics

1.1 Gender:

Male ☐

Female ☐

1.2 Highest level of education attained (tick one)

i) University ☐

ii) College/Diploma ☐

iii) Certificate ☐

iv) Form four ☐

v) Standard 8 ☐

vi) Any other specify ☐

1.3 Skill training/professional training level

i) University degree ☐

ii) Diploma ☐

iii) Craft/Technician Certificate ☐

iv) Trade Test ☐

v) Any Other Specify----------

1.4 Period of experience in the industry: (months/years) ----------

1.5 Location of the Firm: ----------

1.6 What is the size of your industry under the following?

(Number of employees)

1.7 Which types of apparel products do you make?

i) Children's wear

ii) Ladies wear

iii) Men's wear

iv) Uniforms

v) Households

Section B:

2.0 The proportion of adoption of CAD in apparel production among small and medium scale apparel manufacturers

2.1 Which types of equipment do you use in the apparel production process?

2.2 Which methods of production do you use?

2.3 What do you consider when choosing a given method for production?

2.4 What are the benefits of the chosen method?

2.5 List the problems encountered with the chosen method?

2.6 Suggest Intervention measures to be put in place to improve on the method chosen?

2.7 Does the method chosen involve use of computer software?

Yes ☐

No ☐

2.8 If your answer in 2.7 is yes what are the advantages of using computer software in design?

2.9 If your answer in 2.7 is No what are the reasons for not using computer software in design? --

---

2.10 Can you rate the level of effectiveness of the method used?

Excellent 5	V. good 4	Good 3	Fair 2	B. average1 1

Section C

3.0 The use patterns of CAD in Apparel Manufacture

3.1 Do you use CAD/ CAD software in apparel manufacture?

Yes ☐

No ☐

3.2 If your answer in 3.1 is yes, which software do you use?

i) CAD in design ☐

ii) CAD in pattern drafting ☐

iii) CAD in cutting ☐

iv) CAD in garment making ☐

v) Others specify ☐

3.3 Where do you normally buy this computer software from?

……....

3.4 Are this software easily available in your workplace?

Yes ☐

No ☐

3.5 If the answer in 3.4 is NO which ones are not easy to find?

……

3.6 In which stages of production do you use CAD in apparel Manufacturing?

……

3.7 What are the advantages of using CAD in different levels of production?

……..

3.8 What is the average level of output when CAD is used in a production process?

V. High 5	High 4	Fair 3	Low 2	V. Low 1

3.9 From your own observations what are the areas in production that should be addressed in the apparel industry?

3.10 Suggest ways that can be used to improve on the suggestions in 3.9 above?

Section D:

4.0 Factors influencing the adoption of CAD in apparel production among small and medium scale apparel manufacturers in Kisumu city

4.1 What is the computer software that are available in the market for apparel? Manufacturer?

4.2 How did you get to know about this software?

4.3 Which of the following computer software are available in your organization?

i) CAD in design ☐

ii) CAD in pattern drafting ☐

iii) CAD in cutting ☐

iv) CAD in garment making ☐

v) Others specify ☐

4.4 Which of the listed Software are you able to use

i) CAD in design

ii) CAD in pattern drafting

iii) CAD in cutting

iv) CAD in garment making

v) Others specify

4.5 Identify policies that are put in place by the government to ensure that apparel manufactured is of good quality?

4.6 What would you comment on the use of CAD in the apparel industry?

4.7 a) Have you benefited from use of CAD in your production process?

Yes ☐

No ☐

4.8 b) Explain ----------

4.9 What are the benefits of using computer software in apparel production?

4.10 What are your recommendations as far as CAD use is concerned?

Appendix 4: Employers Key Informant Interview Schedule

In the study to determine the adoption CAD in apparel production among small and medium scale apparel manufacturers in Kisumu city, your views as a manufacturer within this industry play an important part in determining the level of use and hence will help in making recommendations for the future. Thank you.

Section A Date:……

5.0 Demographic characteristics

5.1 Personal Details

5.2 Gender:

Male ☐

Female ☐

5.3 Highest level of education attained (tick one)

i) University ☐

ii) College/Diploma ☐

iii) Certificate ☐

iv) Form four ☐

v) Standard 8 ☐

vi) Any other specify ☐

5.4 Skill training/professional training level

i) University degree ☐

ii) Diploma ☐

iii) Craft/Technician Certificate ☐

iv) Trade Test ☐

vi) Any Other Specify ☐

5.5 Experience in Business: ----------

5.6 Location of the Firm: ----------

Section B:

6.0 Factors influencing the adoption of CAD in production among Small Scale Apparel Manufacturers

6.1 What is the size of your industry under the following?

Number of employees	1-10	11-20	21-30	31-50
Output of garments per day	1-10	21-30	31-40	41-50
Total capital investment in Kshs	Below 10,000	10,001-30,000	30,001-50,000	50,001-70,000	Above 70,001

6.2 Which types of equipment do you use in apparel manufacture?

6.3 Does the method involve use of CAD? ----------

6.4 If No, why don't you use CAD? ----------

6.5 Where do you normally buy this software from? ----------

6.6 How would you rate the effectiveness of the method used? ----------

6.7 Comment on reasons of choice of a given production method? ----------

6.8 What is the average level of output in relation to the method used? ----------

6.9 What is your general view as far as change in technology is concerned in the apparel industry? ----------

6.10 Any other relevant information that you would recommend to be put in place in the apparel industry? ----------

Appendix 5: Observation Checklist

No	Activity	Application	Tick as appropriate
1	The equipment used	Manually operated Semi- automatic Fully automatic With aid of CAD	
2	Do the employees make reference to Computers	CAD in design CAD in pattern drafting CAD in cutting CAD in garment making Others specify	
3	The workshop layout	Space arrangement Flow Available equipment	
4	Stages involved in production process	i) CAD in design ii) CAD in pattern drafting iii) CAD in cutting iv)CAD in garment making	

Appendix 6: Authorization Letter

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471, 2241349,3310571,2219420
Fax:+254-20-318245,318249
Email:dg@nacosti.go.ke
Website: www.nacosti.go.ke
when replying please quote

9th Floor, Utalii House
Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/17/38762/15762**

Date: **9th March, 2017**

Grace Apondi Titi
Maseno University
Private Bag
MASENO.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Adoption of computer aided design in apparel production among Small and Medium Scale Manufacturers in Kisumu City, Kenya,"*** I am pleased to inform you that you have been authorized to undertake research in **Kisumu County** for the period ending **9th March, 2018.**

You are advised to report to **the County Commissioner and the County Director of Education, Kisumu County** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

DR. STEPHEN K. KIBIRU, PhD.
FOR: DIRECTOR-GENERAL/CEO.

Copy to:

The County Commissioner
Kisumu County.

The County Director of Education
Kisumu County.

National Commission for Science, Technology and Innovation is ISO 9001:2008 Certified

Appendix 7: Certificate of Authorization

CONDITIONS

1. You must report to the County Commissioner and the County Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit.
2. Government Officer will not be interviewed without prior appointment.
3. No questionnaire will be used unless it has been approved.
4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.
5. You are required to submit at least two(2) hard copies and one (1) soft copy of your final report.
6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice

REPUBLIC OF KENYA

National Commission for Science, Technology and Innovation

RESEACH CLEARANCE PERMIT

Serial No.A 13120

CONDITIONS: see back page

THIS IS TO CERTIFY THAT:
MS. GRACE APONDI TITI
of MASENO UNIVERSITY, 0-40100 KISUMU,has been permitted to conduct research in *Kisumu County*

on the topic: *ADOPTION OF COMPUTER AIDED DESIGN IN APPAREL PRODUCTION AMONG SMALL AND MEDIUM SCALE MANUFACTURERS IN KISUMU CITY, KENYA*

for the period ending:
9th March,2018

Permit No : NACOSTI/P/17/38762/15762
Date Of Issue : 9th March,2017
Fee Recieved :Ksh 1000

.....
Applicant's Signature

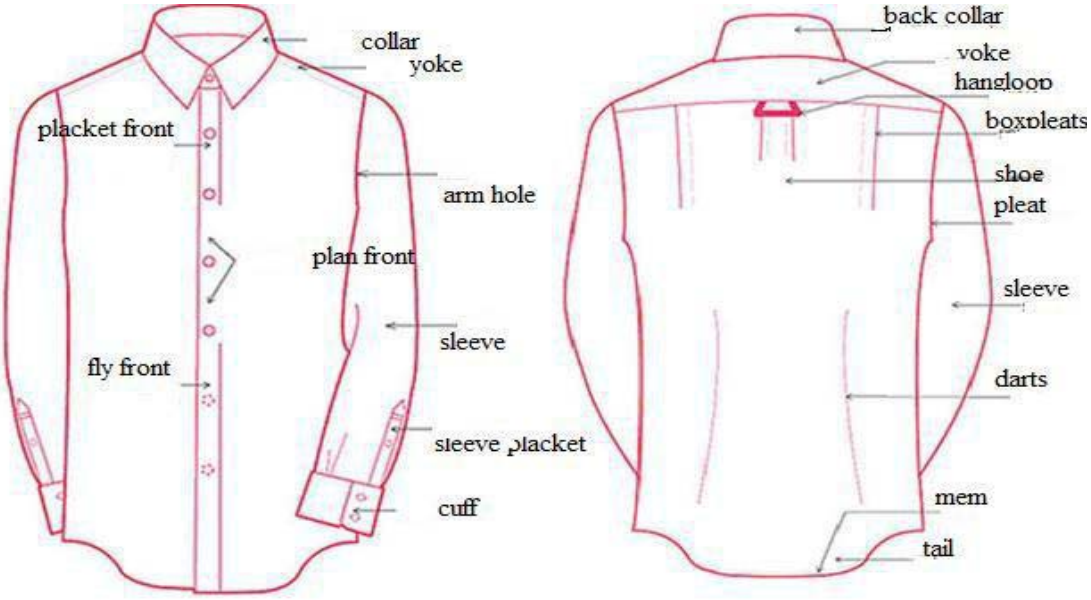
.....
Director General
National Commission for Science, Technology & Innovation

Appendix 8: photo 1: showing branded shirts using computer aided machine

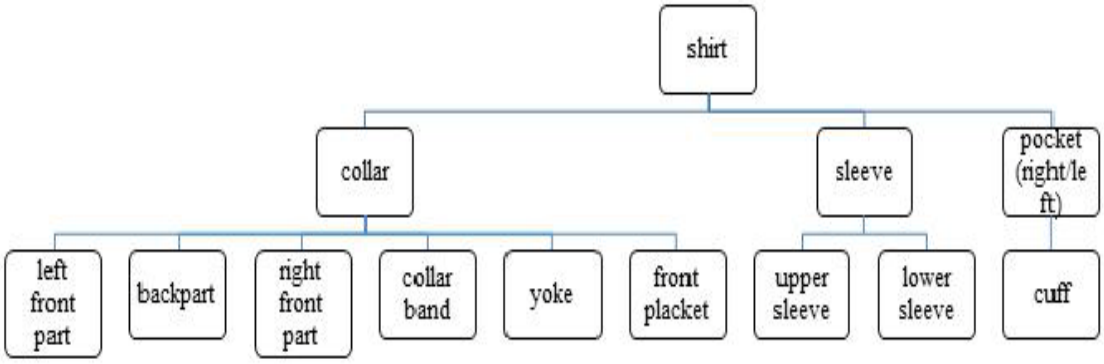
Photo 2: showing collections of assorted products

Appendix: 9 Production module of a shirt

The various parts of shirt



The Anatomy of a Full Shirt



Appendix 10: Winda pattern cutter and plotter