ELECTRICAL ENGINEERING TECHNICIAN TRAINING RELEVANCE FOR ELECTRICAL EQUIPMENT SERVICING IN MANUFACTURING INDUSTRIES IN UASIN-GISHU AND NANDI COUNTIES OF KENYA

BY

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DECLARATION

Declaration by the Candidate

This thesis is my original work and has not been presented to any other institution of learning for the award of any degree or diploma.

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This thesis has been submitted for examination with our approval as the university supervisors.

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DEDICATION

This work is dedicated to my parents Benjamin and Mary Keter and my sister Eunice and my wife Eucabeth for all the moral, academic and financial support in my education.

ABSTRACT

The research sought to investigate whether electrical engineering technicians were equipped with skills and knowledge relevant for the changing industrial needs. The purpose of the study was to evaluate whether electrical engineering technician training offered at public TVET institutions is relevant for electrical equipment servicing in manufacturing industries in Nandi and Uasin-Gishu counties of Kenya. The findings are beneficial for developing policies that will ensure effective implementation of engineering technician training that is relevant to the needs of the labor market. Quantitative research methods were used with purposive sampling techniques used to achieve the required sample size. The research focused on electrical engineering technicians working at the selected industries and technical trainers in public TVET institutions, teaching at the electrical engineering departments. Data was collected by use of three sets of questionnaires, targeting trainers, technicians and employers, and these instruments were pre-tested to ensure its validity by determining the internal consistency of the research instruments. Based on the findings from data analysis, electrical engineering technicians perceived the training acquired at TVET institutions as good. The electrical engineering trainers perceived the availability of resources including modern automation and control training equipment and participation of the industry in engineering technician training to be fair. Employers consider engineering manipulative and skills required for operation of automated machinery as important. The study recommends that adequate training resources be allocated to achieve training relevant for the needs of the industry, the TVET institutions need to strengthen linkages and collaboration with the industries to ensure the training offered is up-to date with the needs of the industry, KICD in collaboration with CDACC and SSACs should develop a curriculum that addresses the competence requirements and occupational standard needs of the manufacturing industries.

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LIST OF ABBREVIATIONS

ANN	Artificial Neural Network
AUTOCAD	Automated Computer Aided Drawing
CDACC	Curriculum Development Assessment and Certification Council
CNC	Computer Numerical Control
ICT	Information Communication Technology
ILO	International Labor Organization
KAM	Kenya Association of Manufacturers
KICD	Kenya Institute of Curriculum Development
KNEC	Kenya National Examinations Council
NACOSTI	National Commission for Science Technology and Innovation
OECD	Organization for Economic Cooperation and Development
SSACs	Sector Skills Advisory Committees
SDGs	Sustainable Development Goals
TVET	Technical, Vocational Education and Training
UNESCO	United Nations Educational, Scientific and Cultural Organization

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CHAPTER ONE

INTRODUCTION TO THE STUDY

1.1 Introduction to the study

This chapter presents the background information of the study, problem statement, purpose of the study, research questions, hypothesis, justification, assumptions, scope, significance, theoretical framework, conceptual framework and definition of operational terms.

1.2 Background of the study

The national education sector support program report of 2018, indicates that engineering technician training at TVET institutions continues to face challenges of having a curriculum content that is outdated, not flexible to meet the changing demands of the manufacturing industry and exhibits a mismatch between skills acquired by the trained engineering technicians and the skills required by the manufacturing industries (INSEAD, 2018).

Technical and vocational education and training (TVET) comprises education, training and skills development relating to a wide range of occupational fields that are linked directly with production, services and livelihoods. TVET also includes a wide range of skills development opportunities attuned to national and local contexts. This includes learning that leads to attaining the development of literacy and numeracy skills, transversal skills and citizenship skills that are integral components of TVET (UNESCO, 2015).

The engineering technician training acquired at TVET institutions is required to be a solution to the needs for the current technological innovations and changes in the needs of the industry. Technical education and training is an area that has been widely researched on, with most of the studies looking to address the role of TVET in reduction of poverty and sustaining economic development as well as its role in providing relevant engineering technician skills as per the needs of the world of work as espoused by Bullard et al (2008).

However, the UNESCO-UNEVOC TVET strategy (2016) illustrated the major criticism about engineering technician training in Africa as the training that yields high unemployment rate among technicians, while disregarding of the needs of the labor market. TVET has been cited both as a system for developing skills and competencies necessary for socio-economic development, national development, employment and job creation and as a mechanism for poverty alleviation, self-employment and wealth creation (Ansah & Ernest, 2013).

According to Deloitte and the Manufacturing Institute (2011), many manufacturers have redesigned and streamlined production lines while increasingly automating processes. This is an illustration that the criticisms facing engineering technician training can be reduced by equipping the engineering technicians with technical skills that are relevant to the needs of the manufacturing industry.

While much attention has been given to the emerging industrial innovations and trends in electrical engineering technology for TVET institutions, one of the most critical issues has remained to be the curriculum content that should facilitate relevant training that equips the electrical engineering technicians with the modern cutting edge skills which include developing electrical schematics, data collection and analysis, operation of computer systems, electrical and electronic equipment maintenance and upkeep among others (Onoh, 2017).

According to Stevens (2001), the major cause of obstruction to skills development and the desired innovations across most of the developing nations has been lack of relevant curriculum at TVET institutions that reflects the changing technological needs of the labor markets. Reddan and Harrison (2010) argued that TVET institutions need to restructure their programs to be responsive to the needs of the industry. To achieve this goal, TVET curricula must focus on outcomes in terms of the skills, knowledge and attitudes required by the industry.

This study therefore was focused on establishing if the electrical engineering technician training offered at TVET institutions is relevant for electrical equipment servicing at the Kenyan manufacturing industries.

1.3 Statement of the Problem

Relevance is a key requirement for adoption or use of virtually anything. According to Farrant (2006) if the technicians who are the products of the process do not possess the right knowledge, attitudes and skills that are required by the job market, then they are not relevant to the job market. In Kenya, TVET Act of 2013 created CDACC with the mandate of designing and developing curricular for training institutions, examinations assessment and certification. Factors noted to hamper performance and responsiveness of TVET was the lack of coherence between the technical skills acquired in training institutions and technical skills required in the industry and also offering of generic courses by training institutions as opposed to specialized training as required by the needs of the manufacturing industry.

A comprehensive report on the status of engineering technician training in Kenya (INSEAD, 2018) showed that Kenya is lagging behind the Sub-Saharan mean in several key indicators, including vocational and technical skills, retention of skills relevant for performance in the manufacturing industry. It further indicates that only 34% of trainees enroll to TVET institutions with the expectations of getting job opportunities after graduation while only 22% enroll because of the quality of education offered. This is an indicator that there is skepticism about the quality of training offered in TVET institutions and its relevance to the job market. This study therefore sought to examine the electrical engineering technician training relevance for electrical equipment servicing in Kenyan manufacturing industries.

1.4 Purpose of the study

The purpose of this study was to evaluate whether electrical engineering technician training offered at public TVET institutions is relevant for electrical equipment servicing in manufacturing industries in Nandi and Uasin-Gishu counties of Kenya.

This was done by assessing the relevance of training acquired by electrical engineering technicians, how the trainers rated the adequacy of training equipment and collaboration between TVET institutions and the manufacturing industries and the skills considered by the manufacturing industries as relevant for electrical equipment servicing.

1.5 Objectives of the study;

The main objective of the study was to establish if electrical engineering technician training offered at TVET institutions is relevant for electrical equipment servicing in manufacturing industries in Kenya.

The specific objectives of the study were;

i) To determine how the electrical engineering technicians rate their acquired training in TVET institutions' relevance to the electrical equipment servicing in manufacturing industries in Kenya.
ii) To determine how trainers rate the adequacy of training equipment and collaboration for electrical engineering technician training relevance to manufacturing industries.
iii) To establish the skills the employers consider relevant for electrical equipment servicing in manufacturing industries in Kenya.
iv) To evaluate the relationship between electrical engineering technicians' acquired skills and the skills required for electrical equipment servicing in manufacturing industries in Kenya.

1.6 Research questions;

From the objectives of the study, the following research questions were obtained.

i) How do electrical engineering technicians rate their acquired training in TVET institutions' relevance to the electrical equipment servicing at manufacturing industries in Kenya?

ii) How do the trainers rate the adequacy of training equipment and collaboration for electrical engineering technician training relevance to the manufacturing industries?

iii) What are the skills the employers consider relevant for electrical equipment servicing at manufacturing industries in Kenya?

iv) What is the relationship between electrical engineering technicians' acquired skills and the skills required for electrical equipment servicing in manufacturing industries in Kenya?

Hypothesis

Ho: There is no significant relationship between electrical engineering technicians' acquired skills and the skills required for electrical equipment servicing in manufacturing industries in Kenya

1.7 Justification of the study

Empirical studies around the world shows that the technical content that has been recommended to be incorporated in TVET curriculum to address the modern needs of the industry include upgrading automation and controls, additional power systems simulation laboratory, alternative energy distributed generation, ANN, Flexible AC Transmission Systems (FACTS), substation automation among others.

In Australia, the development of commercial automation processes, sensor fit-outs, tailored PLC programming and SCADA systems, industrial process automation services and devices has led to an increase in demand in specialist skills for this new technologies requiring revised training strategies in Australia. The major manipulative skills set required for the new technologies is maintenance and equipment servicing.

In Nigeria, maintenance and servicing skills are prerequisite for the preparation of technician trainees for the world of work. The critical skills postulated are diagnosing basic faults, evaluation of electrical test equipment effectively, understanding the basic regulatory planners for training of requirements in maintenance, use of circuit diagrams as an aid to maintenance among others (Onoh, 2017).

In Kenya, empirical studies on engineering technician training have been majorly centered on the status of collaboration between TVET institutions and the industries and the adequacy of training facilities, while very little attention has been given towards addressing the skills mismatch between skills acquired by engineering technicians and the skills required by the manufacturing industries.

A critical evaluation of the TVET modular curriculum for electrical engineering technician training in Kenya reveals the key missing competencies that are the basics of electrical equipment servicing and maintenance, which include motor rewinding, content on high voltage D.C supply, power system protection schemes and protective gear, machine mechanical design aspects among others. This therefore indicates that the relevance of electrical engineering technician training for electrical equipment servicing has not been widely researched on.

1.8 Scope and delimitations of the study

The research was carried out in TVET institutions and manufacturing industries within Uasin-Gishu and Nandi counties in Kenya. These regions were chosen because majority of the technical training institutes within the region are known to produce a large population of electrical engineering technicians working with the Kenyan manufacturing industries located in the region.

This study was restricted to electrical engineering technician training among public TVET institutions since they are government funded. Other than a few industries not accepting this research to be conducted in their premises, no other limitations were encountered. The researcher overcame this limitation by increasing the number of manufacturing industries to be sampled to meet the required sample size.

1.9 Assumptions of the Study

(i) The respondents provided true responses as per their personal experiences and observations.

(ii) The manufacturing industries in Kenya have adopted modern electrical equipment.

(iii) The respondents were objective in their responses.

1.10 Significance of the study

The findings from the study are beneficial to the society in many ways. The ministry of education, state department for technical and vocational training can draw on the research findings to build up policy that will guarantee efficient implementation of engineering technician training at the TVET institutions as in order to facilitate the achievement of industrial development as postulated by the Government big four agenda and vision 2030 development blueprint.

Moreover, the curriculum development assessment and certification council (CDACC) in conjunction with the sector skills advisory committees (SSACs) may use the findings to develop occupational standards that address the skills requirement of the manufacturing industries, in order to guide curriculum implementation in TVET institutions. By highlighting the skills the manufacturing industries consider relevant to electrical equipment servicing, KICD, CDACC and KNQA in conjunction with the TVET institutions will be able to develop competence based training that would ensure engineering technicians are employable.

The engineering technician trainers at the TVET institutions will be able to use the research findings to ensure the institutions' management acquires the relevant training resources that will facilitate training for the modern needs of the industry. The TVET institutions will use the research findings to foster proper collaboration with the industries in order to be up-to date with the modern skills requirement.

From the literature on engineering technician training in Kenya, the research findings will present valuable information for others who would like to research about electrical engineering technician education.

1.11 Theoretical framework

This research was guided by the human capital theory of school effectiveness as espoused by Hargreaves (2001). The theory has four major ideas: expected results, influence, intellectual input and social input, which as a result establishes the eminence of training offered acquired at TVET institutions. The major ideas used from this theory are the expected results, influence and social input.

The cognitive expectations can be of many forms of knowledge, skill and understanding. According to this theory, the competencies exhibited by an individual is not solely dependent on one's individual capabilities or talent, but is more about how the individual chooses to practice a skill and to act on it. The major objective of education and training is to therefore initiate, expose and guide the trainees towards achieving these competencies, where they can satisfactorily acquire the ability to execute resonant academic and ethical career decisions.

In terms of the influences, which is the relationship between the trainer input and the expected outcomes of training, these influences can be termed as the eminence of the effective transformation of trainee intellectual capabilities in retrospect with the level of the trainers' input. Trainers in efficient training institutions constantly utilize these influences in order to critically evaluate the demands of the labor market.

A training institution that constantly seeks to offer better training for relevance must therefore know how to point out and use efficient and ethically justifiable relationships and collaborations in order to facilitate intellectual and skill excellence. However, majority of the institutions of learning do not know how to improve these collaborations. This leads to the lack of capacity to apply the relevant knowledge into practice and increase the capacity to innovate and experiment for better skills to be imparted on the trainees. These forms of relationships and collaborations are mostly established and developed by the individual trainers through individual exposure and connections rather than from research or planned collective linkages and communications through institution-based research. The human capital is therefore quantified through the skills outcomes of the acquired training of the trainees graduating from the system.

According to Hargreaves, the curriculum content should facilitates the delivery of the relevant skills that are in coherence with the needs of the industry, which is elaborate and offers trainees with skills to cope with the academic demands of the world of education and training and the ability to establish proficient relationships among fellow trainees and among others.

According to Charles Leadbeater (1999) the production, relevance and utilization of acquired technical skill and knowledge has always been meant to propel a cost-effective trade and industrial growth and the most extraordinary aspect of this growth is its capacity to generate non-stop development of new services and products, which makes it very essential to redesign the educational and training needs to establish the potential to create and disseminate knowledge and skill throughout any given population or generations. Given that the trainers have little capacity to develop the required relevant skills to the trainees, they have to develop new methods of research as well as creating the appropriate linkages with other researchers and industries (Hargreaves, 2001).

1.12 Conceptual framework

It is argued that at TVET institutions, engineering technicians acquire technical skills using the facilities available in the institutions. The skills gained should match the modern industrial market. After graduating, the technicians are expected to be employed in the industries and fit seamlessly into the industrial technological set-up. But due to the existing mismatch in skills, the industries are forced to hire trainers that are conversant with the new technology to re-train these technicians.

However, to achieve a seamless transition from TVET institutions to the modern industrial needs, there are factors which determined that achievement. The framework is graphically represented in figure 1.1 below.

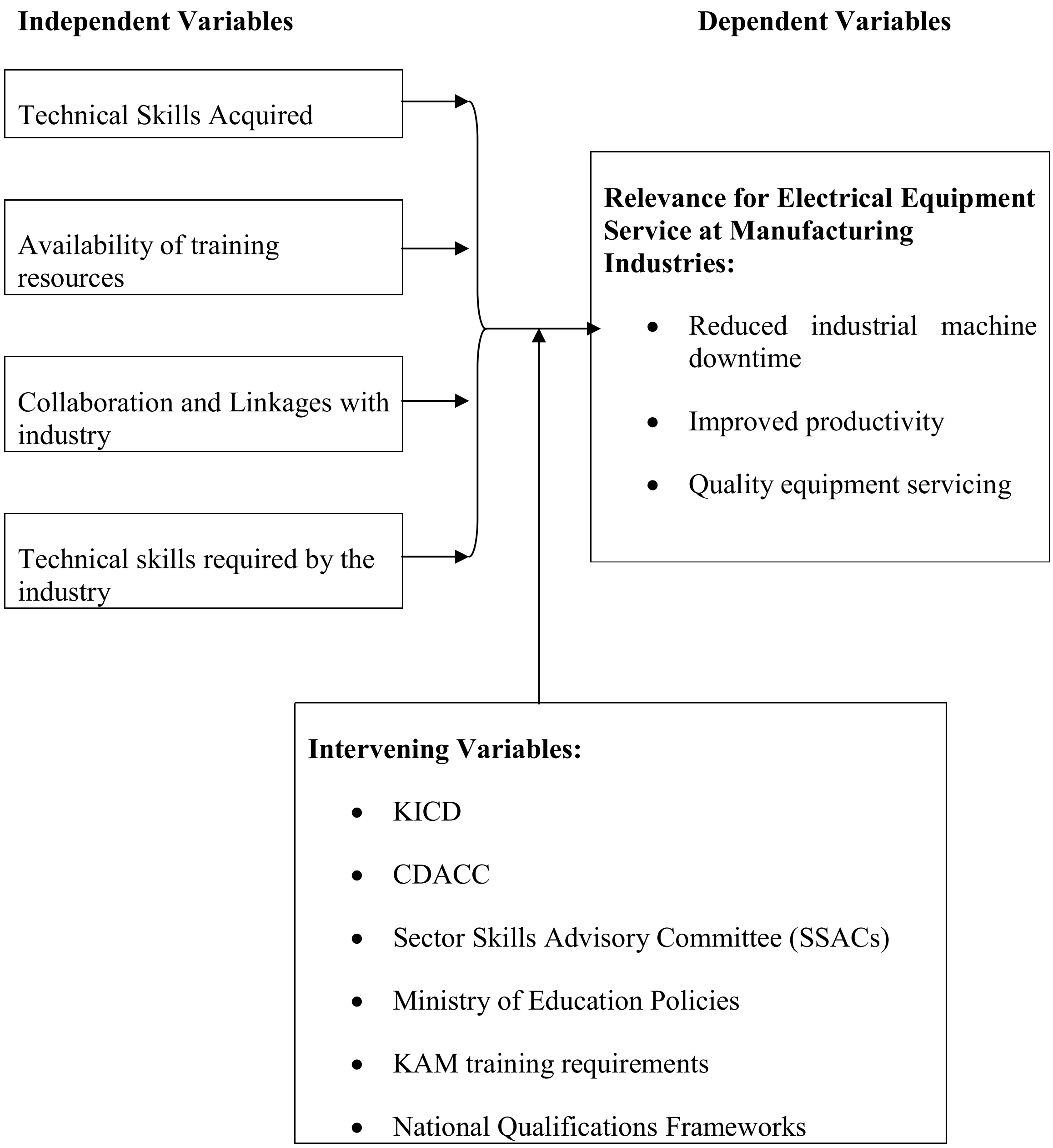

Figure 1.1 Conceptual framework (Source; Author, 2019)

Influences on the framework were collaboration between TVET institutions and the industries and relevant electrical engineering technician training. The relevant engineering technician training encompasses technical skills acquired and should satisfy the technical skills required by the industry. The engineering technician training progression should not only encompass an illustration of what technical content is to be delivered, but should also describe how the technical content is to be effectively imparted and the mandatory training and learning resources that should be adequately provided (Anderson & Rogan, 2011). The conceptual framework emphasizes that the academic content delivered should be efficiently integrated with the necessary practical skills in any curriculum that is in place. The theoretical knowledge imparted and the relevant technical skills acquired simultaneously will facilitate the acquisition of high level intellectual skills and at he same time prepare the trainees for higher education as explained by Arthur-Mensah & Alagaraja (2013).

Rojewski (2002) illustrates that engineering technician training programs need to be designed to make available linkages between training institutions and the relevant labor market. As illustrated by the conceptual framework, the engineering technician training should be able to present wide-ranging information concerning the required competencies of the ideal workforce and recommend occupational consciousness to the trainees. This means that the curriculum developers, KICD, CDACC and SSACs must be able to be in synch with the TVET institutions and be informed about the occupational standards developed by the industries for every area of competence in order to ensure the curriculum content is relevant for the needs of the trainees and the manufacturing industries.

1.13 Definition of operational terms

Artisan Certificate: According to the KNQA, the level qualifies individuals who apply integrated technical and theoretical concepts in a broad range of concepts to undertake advanced skilled or paraprofessional work and as a pathway for further learning. The minimum entry requirement is a KCPE certificate or KCSE with a minimum grade of D- (minus).

Craft Certificate: According to KNQA, the qualifications relevant to this level is a pass at the artisan certificate level or an equivalent as illustrated by the national qualifications framework, and attaining a minimum D (plain) at the Kenya certificate of secondary education (KCSE) examination. At this level the application of knowledge and skills to transfer theoretical concepts and technical skills is demonstrated in a range of situations.

Diploma: According to the KNQA, at this level the technician will demonstrate the application of knowledge and skills with depth of areas of specialization and an initiative in planning, designing and technical functions and to adapt a range of fundamental principles and complex techniques.

Electrical equipment servicing: This is the practice of conducting routine inspections, tests and servicing of electrical equipment in order to detect and reduce, or eliminate impeding troubles.

Electrical equipment: This is a general term applied to materials, fittings, devices, fixtures and apparatus that are part of, or are used in connection with, an electrical installation. This includes the electrical power generating system, substations, distribution systems, utilization equipment and associated control, protective and monitoring devices.

Engineering technician: A professional trained in the skills related to a branch of engineering, with a practical understanding of the relevant engineering concepts and assists an engineer or a technologist

Relevance: this is the concept of one topic being related to another topic in a way that makes it useful to consider the second topic when considering the first.

Skill: The ability to perform a specific task competently as per the requirements of the level of competency acquired by the technician

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The context of electrical engineering technician training around the world, the historical developments of engineering technician training in Kenya and the empirical studies on electrical engineering education is illustrated in this chapter. It also focuses on the status of collaboration between TVET institution and industries based on the objectives of the study and hypothesis.

2.2 Engineering Technician Education in the Global Perspective

Maraghy (2011) illustrates that in accordance with the rapid technological advancements and changes over the past 10 years, many industries are faced with extensively advanced technological requirements that require specialized skills to suffice these requirements and at the same time improve on research and other relevant development projects. Consequently, institutions of learning across the globe have continuously been focusing on the education of technology and engineering, so as to establish constant relevance with the skills requirements of the manufacturing industries and at the same time adequately prepare trainees for their future occupations (CBI, 2014).

2.2.1 Europe

As illustrated by the organization for economic development report on the demand for engineering technician skills across European countries, the public and private sector has experienced a shortfall in the number of graduating skilled engineering technicians while there has been an increase in technological advancements (OECD, 2013). However, there are various opportunities presented since the engineering technician curriculum remains to have the highest probability in providing technicians with employment opportunities, despite the fact that there's dissatisfaction in the remuneration amongst mot engineering technicians according to Monastersky (2004).

Engineering technicians employed in technical fields feel they are not remunerated as well as employees in other departments such as marketing since the their skill contribution has not been receiving appropriate appreciation by the current manufacturing setups. The state of the labor market has been ever changing, implying that engineering technicians do not possess future projections on better opportunities in the technical field that would rather be a source of compensation if remuneration is not improved (Vines, 2005). The labor market has been commercialized therefore prompting the skilled engineering technicians to seek attractive job opportunities away from the technical career path in order to take up management positions.

Recurrent shortages of STEM skills in the European economy are also often reported and these are believed to have arisen because of the low attractiveness of jobs in the manufacturing sector. Restructuring of the industrial sectors because of economic crisis has been the possible cause for existence of unemployment and skill shortages for specific skills in the manufacturing industries (European Commission, 2014).

In Spain, guidelines illustrated by the Education Ministry concerning engineering technician training is that engineering technicians should be able to analyze, design, implement and improve complex systems composed of machinery, technology and energy. This involves drafting, designing and the development or installation of electrical or energy equipment (Marin-Garcia et al., 2010). The engineering technician competencies required by the manufacturing industries include but not limited to the ability to draft, design and develop projects, construction, alteration, repair, maintenance, installation, assembly or operation of electrical equipment, energy facilities, electrical and electronic installations and manufacturing and automation processes.

An employer's skill survey in the United Kingdom indicates that skills shortage vacancies has been linked to a lack of technical, practical or specialized skills for a specific job especially amongst most machine operators. The shift to greener technologies in manufacturing has posed critical concerns with respect to the need for specific engineering skills for example the manufacture of electric hybrid cars and the need for photovoltaic installers, insulation workers among other skills (UKCES, 2014).

Based on the European projections with regards to remaining competitive and creating a sustainable society, this has been impeded by a sustained and increased shortfall of engineering technician skills. The European Federation of National Engineering Associations (FEANI) therefore finds it urgent to address the shortage problem both within each European country and on an overall European level. Many European countries have already taken national actions by expanding and utilizing the pool of engineering manipulative skills.

2.2.2 Americas and the Caribbean

In the United States, the changing business imperatives and an associated increase in the occupational responsibilities in American engineering technicians has led to an increasing demand for engineering technician graduates with very strong and industry relevant professional and technical skills (Brunhaver et al, 2017). For the past 25 years, American technology-intensive industries have been in need of employees with deep knowledge and technical skills in a specific area of specialization with broad, interdisciplinary and collaborative skills (Miller, 2015).

NAE (2013) reiterates on the attributes of the engineering technician of 2020 that include having the ability to design a system, component or process with the desired needs and within the realistic constraints such as environmental, manufacturability and sustainability and have the ability to use the techniques, skills and modern equipment and machinery for engineering practice. Barret et al. (2015) explained that in order to meet these skills demand, the education system has been changing to ensure the trainees are exposed to ill-defined problems and competing constraints that ensure the learners solve these problems the best they can. This includes provision of equipment that facilitates rapid prototyping and supports hands-on design experiences for the trainees in order to promote development of technical and professional skills.

This has necessitated the majority of the institutionalized organizations which comprises manufacturing industries and training institutions in order to recognize the need for and the importance for implementation of drastic but continuous and sustainable changes in engineering technician training. The Accreditation Board for Engineering and

Technology (ABET, 2018) continues to come up with new ways of building the capacity of the engineering technician training institutions on order to have the possibility of modifying and improving their curricula to reflect the technological changes of the labor markets.

Some of the suggestions that have been piloted and tested include but not limited to intensifying research-based learning techniques for the engineering technician curriculum (NAE, 2013), as well as stressing on not only technological advancements but also technology for the benefit of the society in achieving sustainable development goals (SDGs) and environmental conservation.

In Brazil, Vicente Ferreira de Lucena et al. (2011) illustrate that the engineering technician curriculum follows constrained requirements that have been drafted by the ministry of education, which makes it difficult for the electrical engineering technician curriculum to be modified. Da silva (2015) however explains that the only way that the institutions of higher learning have tackled this hurdle is through an extensive linkage and collaboration between the training institutions and the industries so that investments on co-operative training programs can be able to fulfill the required relevant skills acquisition by the engineering technician trainees. Furthermore, research has indicated the significance of relevant practical skills experiences during the training duration in that the trainees sharpen their occupational skills which translate to a positive economic impact for the society (Schuurman, 2005).

Canada leads the OECD in proportion of the population that has acquired tertiary education, and this factor contributes to the overall strength in research in the fields of science and technology. In articulating the status of engineering technician education with regards to if there's a shortage of supply of a skilled labor force or if there's an overall surplus, Plesca and Summerfield (2020) indicate that aggregate shortage of skilled labor is an overall difficulty in finding workers that can fill positions across the economic divide, while an existence in mismatch means that the employment opportunities do not match the skills of the trained and unemployed labor force.

McDaniel et al. (2015) agree that in Canada there's no aggregate shortage, but there is an existing mismatch. Their findings indicate that the unemployment rate for youth cohorts aged 25 to 34 years stood at an overall 32.8% due to skills mismatch in engineering and technology. In terms of future projections on the skills that will be required by the Canadian industrial labor market, Brynjolfsson and McAfee (2014) agree that fundamental skills, practical skills and complementary skills for Science Technology Engineering and Mathematics application will be relevant to the needs of the industry.

In bridging the skills required by the industry and the training offered at tertiary institutions, Smith (2014) indicated that work-integrated training, which encompasses internships and field placement, as well as c-operative training, has improved the trainees to develop critical practical and complementary skills. Integrative training programs enhance the development of the much needed technical skills which would otherwise not be sufficiently addressed by institution-based training.

2.2.3 Asia-Pacific

Skills mismatches are a major problem in the Asia-Pacific and a main factor in explaining why young people in the region are between three and six times more likely than adults to be unemployed (ILO, 2014). Skills gaps are now reported by around half of all employers across the region, including in some fast-growing economies. More than half of all employers in Japan, Hong Kong, India and Taiwan report difficulties locating adequately skilled candidates to fill job vacancies (Manpower Group, 2015).

Core skills are skills that enable individuals to constantly acquire and apply new knowledge and training. They build upon and strengthen the skills developed through basic education; the technical skills needed for specific occupations or to perform specific tasks or duties; and personal attributes such as honesty, reliability, punctuality and loyalty. Examples of core skills include: the abilities to learn and adapt; to read, write and compute competently; to listen and communicate effectively; to think creatively; to solve problems independently; to manage oneself at work; to interact with co-workers; to work in teams or groups; to handle basic technology; and to lead effectively as well as follow supervision' (ILO, 2013). The ILO uses the terms 'core skills' and 'transversal skills' interchangeably when referring to the generic skills sets of workers.

A recent study of nine Asian countries sheds light on attitudes towards evidence-based approaches in some parts of the region (UNESCO and UNESCO-UNEVOC, 2013). The nine countries are Bangladesh, Cambodia, Laos PDR, India, Indonesia, Kazakhstan, Mongolia, Philippines and Viet Nam. The study found that some governments believe that simply expanding access to TVET programs and raising the quality of training will automatically improve technicians' employability. In other words, they do not fully understand the concept of TVET relevance or appreciate the importance of aligning skills training with labor market needs.

A low opinion of the efficacy of evidence-based approaches can lead to a lack of commitment in implementing these measures, and partly explains why only minority of the countries in the Asia-Pacific regularly conduct TVET technician tracer surveys or skills forecasts/skills mapping exercises. This finding is validated by a recent study on the information infrastructure supporting school-to-work transitions in nine Asian countries (UNESCO and UNESCO-UNEVOC, 2013).The study found that few of the nine countries have sustained programs for tracking technicians, and even where countries had policies in place to implement technician tracer surveys, their efforts were often hindered by a lack of resources, low capacity for data collection and/or lack of expertise among staff on how to conduct these surveys. In addition, while all nine countries collect data on employers' skills needs, some do so irregularly and few undertake national-level employer surveys on skills needs.

The main reason why many countries in the region do not regularly conduct technician tracer surveys or skills forecasts/mapping exercises is Lack of financial or human resources for conducting these exercises. The main skills deficit cited by survey respondents, as well as by Asia-Pacific employers participating in the Manpower Group's Talent Shortage Survey 2015, is a lack of technical skills and competencies (Manpower Group, 2015) 34 per cent of Asia-Pacific employers in 2014, up from 31 per cent in 2013, reported difficulties finding candidates with relevant industry-specific certifications and/or professional qualifications.

In addition, in many countries, TVET technicians' problem solving/analytical skills and creative/critical thinking skills are said to fall below employers' job requirements. These skills, referred to as higher order thinking skills, are considered essential for countries' transition to a knowledge-based economy (Majumdar, 2011). The main way of teaching these skills is by adopting learner-centered, applied and/ or experiential pedagogies. Yet over half of all respondents to the lead ministry survey said that their ministry or government has not yet adopted student-centered approaches to prepare TVET learners for their country's transition to a digital and/or knowledge-based economy. Survey respondents pinpointed problem solving/analytical skills as the most important core skill for employment over the next 10 years, so TVET pedagogies will need to change.

2.2.4 Sub-Saharan Africa

The engineering technician training research in Africa has primarily concentrated on issues in relation to building capacity and the significance of research on science, technological and engineering innovations towards sustainable advancements. This research is a valuable source of information for the majority of the engineering programs which as a result has benefitted from the activities of the Engineering Councils in countries such as South Africa. Apart from South Africa, the vast majority of the nations in the Sub-Saharan Africa has been lagging behind and therefore are found wanting in terms of their capabilities to do research and innovations in science, technology and engineering.

According to Juma (2006) in order for African countries to build capacity for research in technological and engineering fields, engineering training institutions must be created prioritized in order to provide recognition to promising innovators, as well as acquiring internationally funded research projects so as to serve as learning sites. In Nigeria, the Federal Republic of Nigeria (2013) illustrates that the main objective of engineering technician training among others is to provide the technical knowledge and vocational skills necessary for agricultural, industrial, commercial and economic development and to give training and impart the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant.

While various efforts have been made by the Nigerian government to ensure that the engineering technician training system is functional and relevant, education stakeholders and the various industrial employers have growing concerns that the graduates of this training system still lack adequate and relevant technical skills that are required by the manufacturing industries (Ideh, 2013). The Federal government in an attempt to improve the quality of engineering technicians and prepare grounds for the privatization of the power sector established the National Power Training Institute of Nigeria (NAPTIN) in 2009 whose primary purpose is to provide training for engineering technicians and coordinate training activities in the sector, under its technicians Skills Development Program.

Abdulkadir and Kagara (2013) indicated that in a bid to address the technical skill deficiency among technician trainees, the industrial employers subject the engineering technicians to retraining programs, and in circumstances where the industrial employers cannot employ and retrain, it is convenient for the industries to employ international experts to do the same job. It has been found out that the collaboration and linkages between the training institutions and the industries has been poor therefore addressing the mismatch in the skills has not been achieved for quite some time.

2.3 Engineering technician training in Kenya

Karimi et al. (2015) indicate that the country has an inadequate number of technicians that is necessary to help in Kenya achieving the middle income economic status through the manufacturing sector. This means that there is uncertainty in the future of these growth projections despite the major investments in infrastructural projects that cannot be well facilitated since as noted by the vision 2030 blueprint, there is still an existing shortfall the supply of technicians. Raihan (2014) notes that insufficient collaboration between engineering technician training institutions and the manufacturing industries, has been the main cause of mismatch between the skills demanded by the industries and the skills acquired from TVET institutions.

2.3.1 Historical Development of TVET in Kenya

The history of Technical Vocational Education and training in Kenya is based on the British Government's need to generate relevant and important labor force required to develop its colony. As observed by the Koech commission, there was need to have a trained labor force for construction, for furniture development and workers in the Agricultural sector. The specific specialized skills acquisition from industrial training institutions began as early as 1921 as illustrated by Sifuna (1992).

In order to ensure the increasing labor force is taken care of, UNESCO in 1961 facilitated the conference in Addis Ababa for African countries the agenda being the development and training of the workforce. This was meant to ensure that an adequate section of the vast population received at the secondary and tertiary levels the type of skill relevant for the changing economic development needs (UNESCO, 1961).

It was deliberated that the labor force should be trained and emphasis be put on training relevant for the development of the economy. The importance of having an economic development that was diversified and that would translate to a need to have a labor force with the correct and relevant skills to drive this growth was underscored. During the early times after Kenya's independence it was noted that the driving force to achieve a human resource that have the required technical skills relevant for the world of work was the development of technical curricula for the formal education system. This meant that TVET had to be strengthened at various levels in order to ensure the individuals were equipped with the relevant skills that would enable them adapt to the changing demands of the economy. It was therefore necessary to expand the TVET programs so as to have qualified technical experts to operate the existing economic requirements and future projections (UNESCO, 1961).

Based on the need to establish TVET institutions to implement the required curricula that will equip the human resource that has the relevant technical skills, the G.O.K (1981) initiated the conversion and establishment of technical training institutes, that were improved from technical high schools, with the view of having them train on practical skills that will enable a skilled labor force and provide direct employment opportunities whether through formal, informal or self-employment. Despite these recommendations being implemented, Kerre (1992) noted that the trained youth graduating from these TVET institutions still lacked employable skills as confirmed by an ILO report of 1992.

The Kenyan parliament through the TVET Act of 2013 established CDACC and gave it the responsibility to design and develop curricula for TVET institutions and also for assessment and certification. This was due to the perceived lack of relevance between the technical skills acquired by graduates from TVET institutions and the technical skills required by the labor market, which meant that the TVET institutions now had the opportunity to realign there training programs to meet the needs of the manufacturing industries.

A comprehensive report on the status of engineering technician training in Kenya (INSEAD, 2018) showed that Kenya is lagging behind the Sub-Saharan mean in several key indicators, including vocational and technical skills, retention of skills relevant for performance in the manufacturing industry. It further indicates that only 34% of trainees enroll to TVET institutions with the expectations of getting job opportunities after graduation while only 22% enroll because of the quality of education offered. This is an indicator that there is skepticism about the quality of training offered in TVET institutions and its relevance to the job market.

2.3.2 Engineering technician training Process in Kenya

According to GOK (2019), TVET institutions have been given the major prerogative of developing and coordinating a system that will generate a skilled labor force for the development of the Kenyan economy. Apart from curriculum implementation, the training disseminated should be able to bring forth skilled artisan, craftsmen and technicians that have acquired the required technical skills through practical training and integrated learning. The learning institutions should also be able to effectively transfer technological needs assessment through appropriate collaboration mechanisms between the TVET institutions and the industry.

TVET institutions are required to facilitate training that offers engineering technicians with modern and up-to date skills that meet the needs of the manufacturing industry. The lack of constant linkages between the industrial employers and TVET institution trainers in providing input to develop standards relevant to developing a curriculum relevant to the skills requirement of the manufacturing industry, has been the major contributing factor to the existence in disparities between skills acquired by engineering technicians and the skills required by the manufacturing industries (Akplu & Amankrah, 2008).

A weak policy framework that is meant to provide guidelines on how to achieve efficient linkages between curriculum developers and the important stakeholders is another factor that contributes to the existing skills gap according to Biggs (2005). Skills mismatch is contributed by inadequacy of training equipment and resources in training institutions meant to provide hands-on skills for an employable workforce. A deeper inquiry is therefore important in order to establish other contributing parameters that cause the evident skills mismatch.

To achieve this, a proper knowledge about the current industrial trends and the needs of the existing labor market, as well as the existing occupational standards developed by the manufacturing industries must be achieved in order to present these requirement and develop a communication platform between the industries, KAM, TVET institutions and the national qualifications framework so as to facilitate future skills and career development (Bolaane et al., 2010). Reducing the skills gap between the skills acquired by the engineering technicians and the skills required by the manufacturing industries should therefore be a priority in order for the training programs to be relevant to the current world of work.

2.3.3 TVET Curriculum Development in Kenya

The Kamunge report of 1988 indicated that TVET had been established in the 8:4:4 system of education with the aim of laying the basis for the acquisition of technical skills required for the socio-economic development, exposing the trainees to technological trends as well as inculcating skills that are applicable to various trades, professions and other vocations.

KICD (2013) illustrates that in addition to developing the curricula implemented by the TVET institutions, its mandate also includes continuous review, approval of programs and curricula support materials that are in synch with the international TVET standards as well as implementing policies related to tertiary institutions. Nyerere (2009) noted that private TVET institutions have been offering British and American Curricula to address the gaps created by the deficiencies in the KICD designed curriculum. While such externally sourced curricula may be cost effective, KICD notes that it can be of low quality and fail to meet the specific training needs of the Kenyan labor markets.

The national training structure should therefore be made to involve all the relevant stakeholders in order to have a harmonized curricula that is used and implemented equally across all TVET institutions, whether public or private in order to efficiently meet the needs of the industry (KICD, 2013)

2.4 Empirical Studies on engineering technician Curriculum Implementation

Frankel (2008) indicates that engineering technician training in developed countries has been changing for over the years with the engineering technician curriculum in most institutions of higher learning now focusing on training that meets the technological industrial needs.

2.4.1 State of electrical engineering training around the world

Internationally, new industries that were not traditionally in power engineering have entered the arena, with computer applications and software development firms now hiring electrical engineering technicians to serve the industry including a host of auxiliary industries such as automotive, environmental, alternative energy sources and instrumentation industries. Potentially, the largest and greatest impact in the long term is the power electronics industry.

This area has the potential of radical and major changes in power engineering and it is clear that the focus of power engineering needs to be broadened considerably to accommodate these needs (Sharma et al., 2020). The technical content that has been recommended to be incorporated in the curriculum to address the modern needs of the industry include upgrading automation and controls, additional power systems simulation laboratory, alternative energy distributed generation, ANN, Flexible AC Transmission Systems (FACTS), substation automation among others.

According to Electrical comms data (2015), the development of commercial automation processes, sensor fit-outs, tailored PLC programming and SCADA systems, industrial process automation services and devices has led to an increase in demand in specialist skills for this new technologies requiring revised training strategies in Australia. The major manipulative skills set required for the new technologies is maintenance and equipment servicing.

In Nigeria, Onoh (2017) indicates that maintenance and servicing skills are prerequisite for the preparation of technician trainees for the world of work. The critical skills postulated are diagnosing basic faults, evaluation of electrical test equipment effectively, understanding the basic regulatory planners for training of requirements in maintenance, use of circuit diagrams as an aid to maintenance among others.

2.4.2 Critical evaluation of the Kenyan situation

Electrical engineering technician training focuses on training to equip trainees with skills relevant to power generation, transmission and distribution, as well as installation, commissioning, repair and maintenance of electrical equipment and accessories. The curriculum content must therefore be such that it reflects not only the basic engineering principles but also meet the changing technological needs of the industries and the consumer market.

Gottlieb et al. (2019) therefore illustrated the fundamental objectives of electrical engineering technician training to include but not limited to; enabling trainees comprehend the fundamental principles of electrical engineering, enabling trainees develop competencies relevant to problem formulation and solutions, while focusing on design of practical functional devices or systems, producing electrical engineering technicians competent to serve the needs of the industry, government or education, among others.

However, electrical engineering technician training has been averagely the same for several years, despite the major changes in the technological needs of the industry with most manufacturing industries adopting modern machinery and equipment. The modular programs introduced by KICD seem to address small proportions of the skills required to operate and service automated industrial machinery by only offering introductory theoretical content on PLC's without the required practical equipment and sufficient sessions to execute this content effectively. A brief illustration on the Kenyan modular diploma curriculum is as shown below.

MODULE I – ELECTRICAL INSTALLATION SYSTEMS

1. 1.0.1 Introduction
2. 2.0.1 General Objectives
3. 3.0.3 Communication skills (66 Hours)
4. 4.1.0. Life Skills (66 Hours)
5. 5.1.0. Information and Communications Technology (99 Hours)
6. 6.1.0. Entrepreneurship (66 Hours)
7. 7.1.0. Engineering Mathematics (66 Hours)
8. 8.1.0. Physical Science (48 Hours)
9. 9.1.0. Mechanical Science (66 Hours)
10. 10.1.0. Materials, Processes and Workshop Practice (66 Hours)

11. 11.1.0. Engineering Drawing (66 Hours)
12. 12.1.0. Electrical Engineering Principles (66 Hours)
13. 13.1.0. Electrical Installation Practice (117 Hours)
14. 14.1.0. Solar Installation Systems (66 Hours)
15. 15.1.0. Analogue Electronics I (66 Hours)
16. 16.1.0. Electrical Measurements and Fault Diagnostics (66 Hours)

MODULE II - ELECTRICAL POWER GENERATION AND TRANSMISSION

1. 1.2.0 Control Systems (66 Hours)
2. 2.2.0 Analogue Electronics II (88 Hours)
3. 3.2.0 Engineering Mathematics II (66 Hours)
4. 4.2.0 Digital Electronics (66 Hours)
5. 5.2.0 Engineering Drawing and Design (44 Hours)
6. 6.2.0 Industrial Programmable Logic Controllers (66 Hours)
7. 7.2.0 Business Plan (44 Hours)
8. 8.2.0 Electric Circuit Analysis I (66 Hours)
9. 9.2.0 Building Services and Protection (66 Hours)
10. 10.2.0 Electric Power Generation and Transmission (88 Hours)

MODULE III-INDUSTRIAL MACHINES AND CONTROLS

1. 1.3.0 Engineering Mathematics III (88 Hours)
2. 2.3.0 Microcomputer Technology (44 Hours)
3. 3.3.0 Industrial Organization and Management (66 Hours)
4. 4.3.0 Microprocessor Systems (66 Hours)

5. 5.3.0 Estimating, Tendering and Engineering Services Contracts (66 Hours)
6. 6.3.0 Trade Project (44 Hours)
7. 7.3.0 Electromagnetic Fields Theory (44 Hours)
8. 8.3.0 Machines and Utilization (88 Hours)
9. 9.3.0 Electrical Power Transmission and Distribution (88 Hours)
10. Power Electronics (66 Hours)

A critical evaluation of this curriculum reveals the key missing competencies that are the basics of electrical equipment servicing and maintenance, which include motor rewinding, content on high voltage D.C supply, power system protection schemes and protective gear, machine mechanical design aspects among others. The hourly allocations for key areas such as illumination and industrial programmable logic controllers cannot meet the requirements to implement the curriculum content as is required to produce a competent electrical engineering technician.

2.4.3 Adequacy of Training facilities and Equipment

According to Simiyu (2009) there are sufficient workshop and laboratory facilities and adequate machine and workshop hand tools and equipment relevant to a given population of trainees in any given TVET institution in Kenya. Sharma (2008) illustrates that limited institutional budgets necessary to acquire the latest tools and equipment and also the lack of a sustained maintenance program for the repair of old equipment, which leads to irregular sessions for practice with these required equipment has continued to obstruct effective training of engineering technicians at TVET institutions. The UNESCO report

(2010) shows that outdated training equipment being used by Kenyan TVET institutions has for a long time compromised the training of engineering technicians.

The literature illustrates that there is an existing relationship between the adequacy of funds for efficient provision of relevant and modern training resources and equipment that will ensure there's no impediment to the desired outcomes from the engineering technician training program. It is therefore evident that inadequate training equipment impedes an effective training process since the trainees would not have enough opportunities to practice with the required modern training equipment as postulated by Mbiti & Miguel (2011).

Engineering technician curricula therefore has to ensure that the engineering technicians trained can adequately meet the modern demands of the industry. This means that they have to be capable of acquiring new skills based on the changing requirements of their employers and be able to participate in long-term training programs in collaboration with these industries.

2.5 Linkages and Collaboration between TVET institutions and the industry

The TVET institution linkages with the manufacturing industry is a critical aspect en route for making certain about the relevance of the engineering technician training at the institutions and its role in producing qualified engineering technicians that provides an easy institution to industry transition (Rauner, 2009). The involvement of the manufacturing industries in engineering technician training through a strong linkage will at a larger extent increase and in the long run corroborate the technical skills offered at the training institutions with the needs of the manufacturing industries. For engineering technician training to be successful the quality of collaboration has to be excellent. The collaboration between engineering technician trainers and the industries ensures that TVET trainer skills enhancement is strengthened (Davidoff, 2019).

If the collaboration between TVET institutions and the industry fails, both sectors are set to lose. The engineering technician training will cease to produce a skilled labor force, while at the same time the industries will have to invest on on-the-job training for all new employees, since the employment sector cannot afford to risk employing an inadequately skilled labor force. The end result of a failed collaboration is that the community suffers by having to pay more for the inefficiency; higher prices for goods due to an inefficient workforce and at the same time pay more to cover the costs of unproductive engineering technician training processes. This eventually leads to detrimental consequences for both the labor force and the economy (Lauglo and Maclean, 2005).

UNESCO has recommended that for TVET institutions to improve there's an urgent need to establish and strengthen closer relationships between the training programs offered and the needs of the labor market. Internationally, industrial attachment was the most pronounced linkage while a lack of initiative by TVET institutions and poor response from the industries were among the major challenges facing the collaboration of TVET and industry according to New Strait Times (2012).

The collaboration between the rate of technical progress and the quality of human intervention has become increasingly evident as has the need for those active in the economy to be trained to use the new technologies to innovate. New skills are needed and educational institutions are required to meet the need by providing not only the minimum of schooling or vocational training, but also training for scientists, innovators and high level specialists (GOK, 2019).

Hoeckel (2008) noted that most industries needed a trained labor force that were able to adapt to technological changes and therefore the engineering technicians must be trained by TVET institutions with the capacity of establishing the necessary linkages with the industries. This means that for the training offered by TVET institutions to be successful, continuous collaborations with the industries have to be established.

2.5.1 TVET trainers need to cooperate with industry.

Majority of the engineering technician trainers in TVET institutions in less industrialized countries have very little linkages with the industry. A study conducted by Obwoge (2013) on the status of linking TVET institutions with the industry in Kenya showed that only 8% of the linkages were based on staff exchange, while only 6% of the collaborations were based on trainers' industrial experience.

Practical experience in industry allows trainers to have an elaborate view into the modern labor market and to be able to reframe the training process to meet the needs of the manufacturing industries (ILO, 2014). The collaboration established with the industries is important for the trainers for effective implementation of the competencies relevant to the demands of the industries.

Trainers, while selecting their training resources, must be able to comprehend the skills and competencies needed at the industries. The understanding of which theoretical content is to be delivered and how to link it with the present technological needs of the industry is paramount, which translates to the trainers comprehending whether the skills being imparted are still relevant or already outdated as espoused by Davidoff (2019).

2.5.2 Today's TVET institutions' - Industry linkage

In Kenya, the linkages between TVET institutions and the industry is so minimal resulting in a mismatch between the skills acquired at the institutions and the skills needed by the manufacturing industries. A report on the human resources development of 2014, indicates that key among the TVET challenges is that the engineering technician training curriculum and design has little relationship with the needs of the industry.

Obwoge (2013) illustrates that For Kenya therefore to have a TVET sector tailored to meeting the demands of the country and be abreast with the global changes in technology, major reforms need to be carried out especially in formally linking up TVET institutions with the industry.

A survey conducted in 2014 among Kenya private firms and supported by USAID, reported that some of the skills in short supply are engineering technicians skilled to operate some machines and technicians who can repair and service electrical equipment. According to Beck and Halim (2008) collaboration between TVET institutions and the industries is beneficial to the trainees, trainers and prospective employers. It exposes the trainees to real work environment and helps in implementing theory into practice.

2.6 Government Policy on Engineering Technician training

Majority of the TVET institutions are sponsored by the Kenyan government, while at the same time the government, through sessional Paper No. 6 of the Presidential Working Party on Education and Training (GOK, 1988) encouraged the private investors to venture into vocational education and training. This however provided a window of opportunity for private TVET institutions to be established leading to irregular curriculum implementation since the required oversight structures and authorities had not been put in place to check on the infrastructural and resource adequacy relevant for effective training (Ngerechi, 2003).

TVET Act of 2013 created CDACC with the mandate of designing and developing curricular for training institutions, examinations assessment and certification. In view of the ever changing demands of the industries and an increasing diversity of the needs of the trainees, it has become necessary to redesign the curriculum to meet these needs.

GOK (2019) through the Ministry of Education Sessional paper No. 1 of 2019 on a policy framework for reforming education and training towards realizing quality, relevant and inclusive education and training for sustainable development in Kenya, has outlined the government's plan to formulate and develop Competency Based Education and Training (CBET) framework for both basic and tertiary education in order to form the foundation for a new curriculum. The curricular will be industry based, demand driven and will be offered in modules. It will be developed together with the industry where the occupational standards will form the training programs.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The research design of the study, target population and methods of collecting and analyzing data is illustrated in this chapter. It also discusses how the internal consistency of each research instrument was tested and the ethical considerations.

3.2 Research Design

According to Creswell (2009) a research design explains the concept from which a study is conducted. It illustrates the plan that will guide the research process. Quantitative research techniques were adopted in this study. Quantitative methods emphasize objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, and surveys, or by manipulating pre-existing statistical data using computational techniques.

Quantitative research focuses on gathering numerical data and generalizing it across groups of people or to explain a particular phenomenon (Babbie, 2010). Quantitative research designs are either descriptive or experimental. A descriptive study establishes only associations between variables while an experimental study establishes causality (Sharpe, 2008).

Descriptive designs were used to establish associations between variables in the skills acquired by the electrical engineering technician, skills required by the industries and the existing mismatch between these skills. The data was collected by using questionnaires which allowed the researcher to gather information, analyze, present and interpret (Orodho, 2009).

3.3 Study area

The study was conducted in Nandi and Uasin-Gishu counties in Kenya. These counties have 7 TVETA registered and licensed public Technical Training Institutions offering Diploma, Craft Certificate and Artisan electrical engineering courses. The selection of these public institutions is because they have been in existence for long, with many industries that create formal employment opportunities for engineering technicians and receive students and technicians from all over the country and therefore are a true representation of engineering technician education in Kenya.

3.4 Target population and sampling techniques

According to Ogula (2005), a population refers to any group of institutions, people or objects that have common characteristics. Based on the information required, the respondents in this research study were electrical engineering technicians working at the manufacturing industries and Technical Trainers at public Technical Training Institutions, teaching at the electrical engineering departments.

From the government sponsored TVET institutions in Nandi and Uasin-Gishu counties, an expected 65 electrical engineering trainers were targeted. From the selected industries within the two counties, 96 electrical engineering technicians and their employers were targeted.

According to Schomburg (2007), a 30% sample size of the target population is representative enough in conducting a survey. Table 3.1 illustrates the target population and the sampling plan.

Table 3.1: Target Population and Sampling Size

Respondents	Target population	Number sampled
Electrical engineering technician trainers	65	29(44.6%)
Electrical engineering technicians	96	50(52.08%)
Employers at the manufacturing industries	15	7(46.67%)

The 96 electrical engineering technicians targeted were estimated to be employed in the 15 manufacturing industries located in Uasin-Gishu and Nandi counties. However only 7 manufacturing industries could allow the researcher to conduct the survey therefore a total of 50 electrical engineering technicians (52.08% of the target population) responded to the technician's questionnaire. All the 7 employers/supervisors at the manufacturing industries responded to the employer's questionnaire.

Of the 65 electrical engineering technician trainers teaching in the public technical training institutes within Uasin-Gishu and Nandi counties, only 29(44.6% of the target population) could respond to the trainer's questionnaires.

3.5 Data collection instruments

Data was collected using three sets of questionnaires as guided by the parameters in the research questions and the conceptual frameworks. The questionnaires that were designed to collect data with respect to the objectives of the study were developed for the electrical engineering technicians, the electrical engineering trainers and the employers at the manufacturing industries. Orodho (2009) explains that a questionnaire is the most efficient research instrument that can collect a large set of data within a short period of time. From the questionnaires, it was possible to measure the major variables that were illustrated in the conceptual framework.

3.5.1 Electrical engineering technician's Questionnaire

The electrical engineering technician questionnaire had four sections, with section A gathering information about the demographic characteristics of the engineering technicians which included age, gender and educational qualifications. Section B gathered information about the training process, in which the electrical engineering technicians were to evaluate on the scale of 1 to 5 the parameters that were listed to represent the training process. Section C contained elements that gathered information about the technicians' rating of the skills required by the industry while section D had open ended questions about the Technicians' opinions on collaboration and follow up questions regarding competencies that should be strengthened.

3.5.2 Electrical Engineering Trainer's Questionnaire

This questionnaire was used to gather information about the trainers rating of the electrical engineering technician training process, addressed in section A, the linkages and collaboration between technical training institutions and the manufacturing industries illustrated in section B, and the suggestions they would recommend as necessary to improve collaboration and relevance of the training for the manufacturing industry in section C. It also gathered the demographic characteristic of the trainers in terms of length of training, level of education and acquisition of pedagogical skills.

3.5.3 Employers' Questionnaire

It was used to gather information about the organizational profile of the industries in section A, the rating of the skills required in section B, including the frequency with which machine failures occur (downtime) and the mean time to repair.

The term downtime in the manufacturing or industrial context is related to the period that a system or machine is critically unavailable due to planned or unplanned stoppages. Typical cases for unplanned downtime are equipment breakdown. Planned downtime is associated with planned maintenance, setups, adjustments, inspections, shutdowns, trainings, breaks, cleaning, standby states, software and hardware upgrades or updates (Muchiri, 2008).

It also gathered the opinions of the employers on the skills they would consider important when employing technicians. Section C contained open ended questions that sought to gather information about the strategies the employers feel should be put in place to ensure electrical engineering technician is relevant for electrical equipment servicing at the manufacturing industry.

3.6 Validity and reliability of Instruments

Mugenda & Mugenda (2003) postulates that for the results of the research instrument are to be valid, the parameters indicated must represent the phenomenon under study. The primary purpose of a validity and reliability test is to increase the internal consistency of the research instrument by eliminating and controlling many variables that cannot be easily measured therefore allowing for a better level of internal consistency (Hardy, 2009).

3.6.1 Validity of the research instruments

This was tested by subjecting the research instruments to thorough scrutiny by the supervisors and lecturers in the department of Technology Education, University of Eldoret and colleagues. In order to evaluate the content validity of the instruments, the researcher came up with elements that constituted adequate coverage of the conceptual framework as guided by the research objectives.

Face validity is the extent to which a test is subjectively viewed as covering the concept it purports to measure. It refers to the transparency or relevance of a test as it appears to test participants (Holden, 2010). A test can therefore be said to have face validity if it looks like it is going to measure what it is supposed to measure. The research instruments were face validated by subjecting them to experts to obtain suggestions for modifications. The suggestions were therefore used to make necessary changes to promote the quality of the research instruments.

3.6.2 Reliability of the research instruments

Before the actual data collection exercise took place, the researcher undertook a pilot study in Bomet County, which has similar characteristics with the study areas. For a research instrument to be reliable, most professionals recommend a Cronbach's alpha of 0.7 and above, with 0.6 being the lowest acceptable value.

The three questionnaires administered to the trainers, technicians and employers were tested using SPSS for internal consistency and their respective coefficient alpha illustrated as shown by the table 3.2 below.

Table 3.2: Reliability test coefficients for research instruments

Research Instrument	Cronbach's Alpha	Internal consistency
Electrical engineering technician trainers Questionnaire	0.911	Highly acceptable
Electrical engineering technicians Questionnaire	0.927	Highly acceptable
Employers at the manufacturing industries Questionnaire	0.982	Highly acceptable

3.6.3 Data Analysis

After data collection, the researcher coded and entered the data into the computer for analysis using the Statistical Package for Social Sciences (SPSS) version 20.0. Descriptive statistical techniques such as Frequencies, percentages, means and standard deviation, inferential techniques using the Pearson Product Moment correlations. Research questions 1 to 3 were analyzed and presented descriptively using means and standard deviations, frequencies and percentages, whereas research question 4 was analyzed using the Pearson Product Moment Correlation analysis, with the level of significance set at 0.05.

3.7 Ethical considerations

This study adopted the acceptable research as articulated in literature of Johnson & Christensen (2004). The ethical principle refers to obligation on the part of the researcher to respect respondents as individuals capable of constructing associate and enlightened contributions to the area under study.

The researcher obtained an introductory letter from the Board of Post Graduate studies and a research permit from the National Council of Science Technology and Innovation (NACOSTI) before proceeding to data collection. The respective county government administrative authorities were also issued letters allowing the researcher to conduct the research within the identified study areas. The researcher ensured that the respondents were well informed concerning the nature of the study, significance and the assurance that the data obtained will only be used for educational purposes.

CHAPTER FOUR

DATA ANALYSIS PRESANTATION AND INTERPRATATION

4.1 Introduction

This chapter describes the analyzed data using the presentation techniques illustrated in chapter three. It therefore sought to describe how electrical engineering technicians rate the training acquired at TVET institutions, how the trainers rated the adequacy of training facilities and collaborations with the industry, what skills the employers consider relevant to the needs of the industry and the relationship between skills acquired by the technicians and the skills required by the industry. The chapter provides a summary of the demographic information, descriptive statistics and the correlation results.

4.2 Demographic information of the Respondents

The overall demographic information as summarized in the corresponding tables includes gender, age, highest academic qualifications and work experience.

4.2.1 Demographic characteristics of electrical engineering technicians

The demographic information about the electrical engineering technicians assessed in this study include: age, sex, area of training, and the mode of examination. Fifty (50) electrical engineering technicians across the 7 manufacturing industries accessed the questionnaires.

4.2.1.1 Gender and age distribution of electrical engineering technicians

Table 4.1 below illustrates the distribution of electrical engineering technicians based on gender and age.

Table 4.1: Demographic characteristics of electrical engineering technicians

Variable		**Age**					
		25 years and below	26 years to 28years	29 years to 31 years	32 years to 34 years	35 years and above	Total
Gender	Male	1	4	5	8	29	47(94%)
	Female	0	0	3	0	0	3(6%)
Total		1 (2%)	4 (8%)	8 (16%)	8 (16%)	29 (58%)	50 (100%)

The table 4.1 above shows that majority of the electrical engineering technicians employed at the manufacturing industries are male, with 47 (94%) of the technicians interviewed being male. 1(2%) of the electrical engineering technicians were aged 25 years and below, while 29(58%) of the respondents were 35 years or more. This shows that most of the technicians employed are middle aged adults, 35 years or older. In reference to the ILO findings (2014) skills mismatch is a major problem and a main factor in explaining why young adults are between three and six times more likely than middle aged adults to be unemployed.

4.2.1.2 Distribution of electrical engineering technicians by area of specialization

The demographic information about electrical engineering technicians based on area of expertise is a shown by table 4.2 below;

Table 4.2: Distribution of technicians by area of specialization

Variable	**Area of specialization**			
	Electronics	Power	Instrumentation and control	Total
Total	5 (10%)	45 (90%)	0	50 (100%)

The table shows that 45 (90%) of the respondents specialized in electrical engineering power option while only 5(10%) did electronics technology. this shows that majority of the technicians enrolled for courses that are popular with the service provision, which is electrical power supply, and may not have been suitable to tackle the needs of manufacturing and process industries that require skills relevant to electronics and instrumentation and control, for example the bottling industries. In order to tackle such problem, TVET institutions should pursue for partnerships with industry in order to invest in co-operative education programs to fulfill the gap in the educational process of their engineering students, as corroborated by Vicente Ferreira de Lucena et al. (2011).

4.2.1.3 Distribution of electrical engineering technicians by qualifications

The distribution of electrical engineering technicians by level of qualifications is shown by the table 4.3

Table 4.3: Distribution of technicians by qualifications

Variable	Qualifications			
	Certificate	Diploma	higher diploma	Total
Total	20 (40%)	25 (50%)	5 (10%)	50 (100%)

The table 4.3 shows that 20(40%) of the respondents had craft certificate qualifications, 25(50%) had diploma qualifications while only 5(10%) had higher diploma. it indicates that most of the technicians are diploma holders probably due to high enrolment at the entry level or high transition from craft certificate to diploma level at TVET institutions. craft certificate courses are 80% manipulative skills while 20% theoretical and based on the technicians and trainers responses, practical skills impartation is largely hampered by lack of enough facilities, especially for motor rewinding skill which is mostly acquired through on the job training rather than at the training institutions.

4.2.1.4 Distribution of electrical engineering technicians by year of completion and examining body

Engineering technician training at TVET institutions is evaluated by the Kenya National Examinations Council (KNEC). From the responses of electrical engineering technicians, only 2(4%) were evaluated by the National Industrial Training Authority (NITA) while

48 (96%) were examined by the Kenya National Examinations Council (KNEC) as illustrated by the table 4.4 below.

Table 4.4: Distribution of technicians by year of completion and examining body

Variable		**Year of graduation**			
		2009 and below	2010 to 2013	2014 to 2017	Total
examining body	KNEC	20	12	15	48 (96%)
	NITA	2	0	0	2 (4%)
Total		23 (46%)	12 (24%)	15 (30%)	50 (100%)

The table also shows that 27(54%) of the technicians graduated from TVET institutions between 2010 and 2017 and therefore were trained according to the latest electrical engineering technician curriculum which offers the modular mode of study.

4.2.2 Demographic characteristics of electrical engineering trainers

The demographic information of the electrical engineering trainers in technical training institutes in Uasin-Gishu and Nandi counties that were; gender, highest qualification levels, and length of experience in the technical field, as illustrated in the subsequent categories below.

4.2.2.1 Distribution of trainers by gender and level of qualification

The trainers comprised of 27(93.1%) male and only 2(6.9%) female as displayed in the table 4.5 below.

Table 4.5: Gender and level of qualification distribution of trainers

Variable		**Highest level of qualification in engineering/technology**			
		Masters	Bachelors	Dip (Tech Ed.)	Total
Gender	Male	2(6.9%)	19(65.5%)	6(20.7%)	27(93.1%)
	Female	0	2(6.9%)	0	2(6.9%)
	Total	2(6.9%)	21(72.4%)	6(20.7%)	29(100%)

Similar to the electrical engineering technicians, the electrical engineering trainers is a male dominated field. The table shows that 21(72.4 %) had bachelor's degrees, 6(20.7%) had diploma in technical education and only 2(6.9%) had a Masters degree. This shows that majority of the trainers are degree holders. According to the findings of Simiyu (2009) most of the TVET trainers (67%) were comfortable teaching theory more than practical. This is illustrated by the results of table 4.5 that explains that majority (72.4%) of the TVET trainers acquired bachelors' degree without having to study up through the TVET institutions. Therefore, there is need to streamline the teaching methods used by trainers for effective technical education in engineering courses since practical skills are essential industrial workplace needs.

4.2.2.2 Distribution of trainers by pedagogical training

The findings illustrate whether the respondents were trained through integrated training, PGDE or untrained. It was found out that 23(79.3%) were trained trainers through the integrated training and 6(20.7%) had to obtain a PGDE. None of the respondents was untrained. Table 4.6 displays the findings.

Table 4.6: Distribution of Trainers by pedagogical training

Variable		**Training in pedagogy**		
		Integrated training	PGDE	Total
Gender	Male	21(72.4%)	6(20.7%)	27(93.1%)
	Female	2(6.9%)	0	2(6.9%)
	Total	23(79.3%)	6(20.7%)	29(100%)

For an effective training of the engineering technicians, pedagogical skills are an essential factor in teaching profession (UNESCO, 2010).

4.2.2.3 Distribution of trainers by gender and teaching experience

The demographic information about engineering technician trainers on training experience indicate that out of 27 trainers who responded, 19(48.7%) had an experience of 5 years and below, 13(33.3%) had 6 to 10 years, 4(10.3%) 11to 15 years, while 4(10.2%) had a teaching experience of 16 years and above.

Table 4.7: Distribution of trainers by gender and experience

Variable	Teaching experience in years						
		5 years and below	6 to 10 years	11 to 15 years	16 to 20 years	21 years and above	Total
Gender	**Male**	13(44.8%)	5(17.2%)	4(13.8%)	2(6.9%)	2(6.9%)	27(93.1%)
	Female	0	2(6.9%)	0	0	0	2(6.9%)
	Total	13(44.8%)	7(24.1%)	4(13.8%)	2(6.9%)	2(6.9%)	29(100%)

The findings in table 4.7 above shows that there's a range of experiences amongst TVET trainers in Kenya, with majority of the trainers being the youth, with a cumulative percentage of 68.9% having a teaching experience of less than 10 years.

4.3 Research question one: How do electrical engineering technicians rate their acquired training in TVET institutions' relevance to the electrical equipment servicing at manufacturing industries in Kenya?

The objective of this research question was to determine how electrical engineering technicians rate their training acquired in TVET institutions' relevance to electrical equipment service at the manufacturing industry. The perception scale is as illustrated by the table 4.8 below.

Table 4.8: Perception Scale and Weighting for RQ 1

Perception scale	Weight
1.00 – 1.49	very poor
1.50– 2.49	Poor
2.50– 3.49	Fair
3.50– 4.49	Good
4.50 – 5.00	very good

The variables that were identified and scored by the electrical engineering technicians to make up the training acquired at TVET institutions are; Capability of trainer to deliver subject content, relevance of technical skills acquired, adequacy of training equipment, collaborations with the manufacturing industries and availability of modern automation and control training equipment for training.

Descriptive techniques in form of frequencies, means and standard deviations were used to present the findings.

4.3.1 Rating of the competence of the trainers to deliver subject content

The findings that addressed the above aspect of training acquired as perceived by the technicians was rated using four important parameters as shown by table 4.9 below.

Table 4.9: Rating of competence of the trainers to deliver subject content

Variable	N	Mean	Std. Deviation
Capability of trainers to deliver practical lessons	50	3.80	0.670
Capability of trainers to use teaching and learning resources (such as visual aids, real objects	50	3.76	0.716
Availability of the trainers for consultation	50	3.90	0.763
Trainers general understanding of the subject content	50	4.06	0.620
Average rating on capacity of trainers to deliver subject content	**50**	**3.88**	**0.498**

From these findings, the respondents' average score on capacity of the trainers to deliver is good with a mean of 3.88 and a standard deviation of 0.498. This is an indicator that the electrical engineering technicians were satisfied with the competence of their trainers.

4.3.2 Rating of technical relevance of skills acquired

The table 4.10 illustrates the rating of the electrical engineering technicians based on five important parameters that make up relevant skills acquired from TVET institutions.

Table 4.10: Rating of relevance of skills acquired

Variable	N	Mean	Std. Deviation
The relevance of the acquired technical skills to the job market	50	3.90	0.863
The length of training	50	4.02	0.553
The profundity of the content taught	49	3.78	0.685
Opinion on the testing system in final examinations	50	3.66	0.872
Programming techniques and technical knowledge of circuit boards, processors, chips and electronic equipment	50	3.28	0.927
Average Relevance of technical skills acquired	50	3.73	0.504

The data from table 4.10 therefore indicates that technical skills acquired from training institutions as perceived by the electrical engineering technicians are relevant to the needs of the manufacturing industry, with a rating of good with a mean of 3.73 and a standard deviation of 0.504.

4.3.3 Rating on the adequacy of training equipment

The adequacy of training resources and equipment was rated by four important aspects as illustrated by table 4.11below

Table 4.11: Rating on the adequacy of training equipment

Variable	N	Mean	Std. Deviation
The adequacy of machines for workshop practice	50	3.46	0.908
The adequacy of bench and hand tools for workshop practice	50	3.52	0.931
Suitability and adequacy of the lecture halls	50	3.72	0.904
Adequacy of engineering reading materials in the institution	50	3.50	0.909
Average adequacy of training equipment	50	3.55	0.747

The findings from the table 4.11 indicate that the electrical engineering technicians rated the availability of training equipment for effective training as good with a mean of 3.55 and a standard deviation of 0.707. However, on the availability of machines for workshop practice, the average score was fair with a mean of 3.46 and a standard deviation of 0.908. This is in agreement with research findings of Miguel et al. (2011) that inadequate investment in instructional equipment for training hinders the expected learning outcomes among trainees as they would have less opportunity to practice with these hand tools, machines and equipment.

4.3.4 Rating on collaborations between the TVET institutions and the manufacturing industries

The status collaboration between TVET institutions and the manufacturing industries was rated using five aspects as illustrated by table 4.12 below.

Table 4.12: Collaborations with manufacturing industries

Variable	N	Mean	Standard deviation
Relationships between TVET institutions and industry	50	3.70	0.707
Capability of the TVET institutions to place trainees for industrial attachment	50	3.52	1.199
Opportunity for trainees to access internship programs	50	3.04	1.068
Exposure of the trainers on new technologies in industries	50	3.06	0.793
Opportunities for trainee exchange programs with other institutions and industries	50	2.96	0.989
Average rating on collaboration between TVET institutions and the manufacturing industries	50	3.26	0.780

From table 4.12, the electrical engineering technicians rated the collaboration between TVET institutions and the manufacturing industries as fair with a mean of 3.26 and a standard deviation of 0.780. However, the electrical engineering technicians rated the capability of the TVET institutions to place them for industrial attachment as good with a mean of 3.52 and a standard deviation of 1.199 and also indicated that the collaboration between TVET institutions and the manufacturing industries is good, with a mean of 3.70 and a standard deviation of 0.707.

The electrical engineering technicians were also required to indicate how placement for the industrial attachment at the manufacturing industries was secured. The findings indicate that 16(32%) of the technicians were able to access industrial attachment through the help of the TVET institutions, while 22(44%) of the technicians were placed through recommendations from friends.

This is a pointer that there is a fair collaboration between the TVET institutions and the manufacturing industries, but not strong enough to achieve effective assessment of the technical skills requirements of the manufacturing industries. Lauglo and Mclean (2005) indicated that if the collaboration between TVET institutions and the industry fails, the engineering technician training will cease to produce a skilled labor force, while at the same time the industries will have to invest on on-the-job training for all new employees, since the employment sector cannot afford to risk employing an inadequately skilled labor force.

4.3.5 Rating on the ICT application in training and adequacy of modern automation and control equipment at TVET institutions

The electrical engineering technicians were required to rate seven parameters that summarized ICT application in training and the adequacy of modern automation and control equipment for training at TVET institutions, key among them being internet access, use of and adequacy of computers as training aids, adequacy of CNC training equipment among others, as illustrated by table 4.13

Table 4.13: ICT application in training and availability of modern automation and control training equipment

Variable	N	Mean	Std. Deviation
Accessibility of Internet in the institution	49	2.76	1.217
Application of computers and projectors as teaching aids by the trainers	49	2.53	1.174
Adequacy of computers during practical sessions to undertake computer aided drawing	47	2.47	1.195
Adequacy of computer numerically controlled machines or models	49	2.27	1.016
Adequacy of Programming equipment and other relevant electronic equipment	49	2.59	1.039
Knowledge acquired on design of technical plans and blue prints	50	2.76	1.080
Skills acquired necessary to detect and solve problems in case of any machine failure	50	3.44	1.033
Average ICT application in training and availability of modern automation and control training equipment	47	2.65	0.870

The table 4.13 illustrates the electrical engineering technicians' rating on ICT application in training and adequacy of modern automation and control equipment as part of the necessary training equipment. The adequacy of computer numeric control machines or models was rated poor with a mean of 2.27 and a standard deviation of 1.016, while the skill acquired in the use of computers to undertake simulation was also rated poor with a mean of 2.47 and a standard deviation of 1.195. According to Sharma (2008) limited institutional budgets necessary to acquire the latest tools and equipment and also the lack of a sustained maintenance program for the repair of old equipment, which leads to irregular sessions for practice with these required equipment has continued to obstruct effective training of engineering technicians at TVET institutions. Mbiti & Miguel (2011) further illustrates that poor investment in the required equipment for instruction negatively affects the expected training outcomes among trainees as they would have fewer opportunities to improve their manipulative skills through the necessary practice with these tools and equipment.

The average ICT application in training and adequacy of modern automation and control training equipment was rated as fair with a mean of 2.65 and a standard deviation of 0.870. However, on the availability of computer numerically controlled machines and models, the respondents rated it as poor with a mean of 2.27 and a standard deviation of 1.016.

Kingombe (2011) indicates that ICT application in training engineering concepts increases the conceptualization of technical concepts applicable for use in simulations. It therefore makes it convenient to demonstrate various machine concepts or components in a classroom set up, which enhances trainee confidence when opportunities for manipulating the real machine arises.

4.3.6 Overall Rating of the training acquired by the electrical engineering technicians

Based on the research findings illustrated by the parameters described to form the training process, the electrical engineering technicians rated the training acquired as fair with a mean of 3.41 and a standard deviation of 0.531. The competence of the trainers to deliver subject content, relevance of skills acquired in TVET institutions and the adequacy of training equipment was rated as good, with an average mean of 3.88, 3.73 and 3.55 with standard deviations of 0.498, 0.504 and 0.747 respectively.

However, collaboration between TVET institutions and the manufacturing industries, ICT application by trainers in training and adequacy of modern automation and control equipment for training was rated as fair, with a rating of 3.26 and 2.65 with standard deviations of 0.780 and 0.870 respectively as illustrated by the table 4.14.

Table 4.14: Rating of the training acquired

Variable	N	Mean	Std. Deviation
Average rating on capacity of delivery by trainers	50	3.88	0.498
Average rating on relevance of skills acquired	50	3.73	0.504
Average rating on availability of training resources	50	3.55	0.747
Linkage and collaboration with the industries	50	3.26	0.780
Application of ICT and availability of modern automation and control training equipment	47	2.65	0.870
Average rating on the training acquired	49	3.41	0.531

For the acquired training to be relevant to the needs of the manufacturing industries, trainees have to be equipped with relevant and adequate technical skills. The findings in table 4.14 above agree with the survey conducted in 2014 among Kenya private firms and supported by USAID, reported that some of the skills in short supply are the technical skills required for engineering technicians to operate some machines, to repair and service electrical equipment.

Lauglo and Mclean (2005) indicate that one of the direct impacts of poor industry-technical education collaboration is that technical education will fail to generate qualified skilled workers, and the industries will be forced to invest in providing in-house training for their workers.

This shows that the training acquired by electrical engineering technicians at TVET institutions is not as satisfactory as it should be in order to meet the requirements to service electrical equipment at the manufacturing industries, therefore the TVET institutions need to ensure the relevant training equipment especially on modern automation and control training infrastructure is adequate, and collaboration between TVET institutions and the manufacturing industries should be enhanced.

4.4 Research question two; How do the trainers rate the adequacy of training equipment and collaboration for electrical engineering technician training relevance for the manufacturing industries?

The objective of this research question was to find out how TVET trainers rate the conditions necessary to achieve an effective training of the electrical engineering technicians. These conditions are adequate training equipment and an efficient collaboration between TVET institutions and the manufacturing industry. The perception scale and scoring is as illustrated by table 4.15 below.

Table 4.15: perception Scale and weighting

Perception scale	Weight
1.00 – 1.49	Very poor
1.50– 2.49	Poor
2.50– 3.49	Fair
3.50– 4.49	Good
4.50 – 5.00	Very good

4.4.1 Trainers' rating on adequacy of the training equipment

The rating on the adequacy of training equipment by trainers was described by five parameters which include; adequacy of machines for workshop practice, adequacy of bench, hand tools and equipment for workshop practice, ease of access to workshop equipment for practical sessions, adequacy and suitability of the lecture halls and adequacy of engineering reading material in the institution as shown by table 4.16 below.

Table 4.16: adequacy of training equipment

Variable	N	Mean	Std. Deviation
The adequacy of machines for workshop practice	29	3.62	0.820
The adequacy of bench, hand tools and equipment for workshop practice	29	3.52	0.911
Ease of access to workshop equipment for practical sessions	29	3.69	0.806
Suitability and adequacy of lecture halls	29	3.55	0.686
Adequacy of engineering reading material	29	3.52	1.022
Average rating of adequacy of training equipment	29	3.58	0.653

The trainers rated the availability of resources as good, with a mean of 3.58 and a standard deviation of 0.653. This indicates that the trainers find the resources needed for effective training as satisfactory. These findings are consistent with how the electrical engineering technicians rated the adequacy of training equipment at the TVET institutions based on the findings of table 4.11. Therefore, for the electrical engineering training to be effectively implemented to complement the electrical engineering technician needs of the industry, there should be adequate resources necessary to facilitate training.

4.4.2 Trainers' evaluation of adequacy and use of ICT infrastructure in training and adequacy of modern automation and control equipment for training

The trainers rated use of ICT infrastructure and adequacy of modern automation and control equipment for training based on five parameters which are; Accessibility of internet in the institution, application of computers and projectors as teaching aids by the trainers, adequacy of computers during practical computer sessions for computer aided drawing, adequacy of computer numerically controlled machines and availability of computers to undertake simulations by trainees as shown by table 4.17.

Table 4.17: Application of ICT in training by trainers and availability of modern automation and control equipment for training

Variable	N	Mean	Std. Deviation
Accessibility of Internet in the institution	29	3.79	0.819
Application of computers and projectors in training	29	3.59	0.946
The adequacy of computers during practical computer sessions for computer aided drawing	29	3.38	0.862
Availability of computers to undertake simulations by trainees	29	3.00	0.926
Adequacy of computer numerically controlled machines for training	29	2.69	0.806
Application of ICT and availability of modern automation and control equipment	29	3.29	0.714

The respondents overall rating on the application of ICT and availability of modern automation and control equipment for effective curriculum implementation was fair, with a mean rating of 3.29 and a standard deviation of 0.714. Internet connectivity and use of projectors in teaching were both rated as good with means of 3.79 and 3.59 and standard deviations of 0.819 and 0.946 respectively. However, the availability of computers for computer aided drawing, availability of computers to students for simulation and computer numerically controlled machines or models were rated as fair, with availability of computer numerically controlled machines or models having the lowest rating with a mean of 2.69 and a standard deviation of 0.806 . Similarly, these findings concur with the views of the electrical engineering technicians as illustrated in table 4.13, where adequacy of computer numerically controlled equipment was rated poor. This shows that while the electrical engineering technicians might have graduated from the TVET institutions for quite a while, not much has been done by the TVET institutions to improve the state of the required training equipment. While general ICT application on training seems satisfactory, a major investment has to be put in place to ensure that trainers have the right training material and trainees get to possess the right skills necessary for operation and service of modern automation and control equipment.

4.4.3 Trainers' evaluation of collaboration between TVET institutions and manufacturing industries

The trainers rated collaboration between TVET institutions and manufacturing industries based on five parameters which are; the relationship between TVET institution and the industry, Capacity of the TVET institution to place trainees for industrial attachment, availability of opportunities to review the curriculum at KICD, frequency of attending industrial attachment and opportunity for trainer exchange programs with other institutions and industries.

Table 4.18: collaboration between TVET institutions and industries

Variable	N	Mean	Std. Deviation
Relationship between TVET institution and the industry	29	3.38	0.775
Capacity of TVET institutions to place trainees for industrial attachment	29	3.59	0.907
Opportunity to review the curriculum at KICD and other bodies	28	2.54	0.881
Frequency of attending industrial attachment	29	3.48	0.829
Opportunities for trainer exchange programs with other institutions and industries	29	2.72	0.996
Average collaboration between TVET institutions and industries	29	3.12	0.619

From the findings of table 4.18, the average rating by the trainers on collaboration between TVET institutions and industries was fair, with a mean of 3.12 and a standard deviation of 0.619. The institutions ability to place trainees for industrial attachment was rated as good, with a mean of 3.59 and a standard deviation of 0.907 while the opportunity to review curriculum and the participation in staff exchange and joint programs were both lowly rated. According to Rauner (2009) collaboration between TVET institutions and the manufacturing industry is an important component that facilitates the effectiveness of training in TVET institutions and enhances the realization of qualified and skilled graduates relevant for the needs of the industry.

The involvement of the manufacturing industries in TVET training through the strong collaboration therefore significantly improves and the quality and relevance of the engineering training. The success or failure of a technical training is highly dependent on the quality of linkages.

4.4.4 Trainers' average rating of the adequacy of training equipment and collaboration between TVET institutions and the industry

The overall rating of how electrical engineering technician trainers evaluated the adequacy of training equipment including availability and application of ICT infrastructure and modern automation training equipment, and collaboration between TVET institutions and the industry is as illustrated by the table 4.19 below.

Table 4.19: Rating on the availability of training resources by trainers

Variable	N	Mean	Std. Deviation
Average rating on the adequacy of training equipment	29	3.58	0.653
Average rating on ICT application in training and availability of modern automation and control equipment for training	29	3.29	0.714
Average rating of collaboration between TVET institutions and industries by trainers	29	3.12	0.619

From the findings, the overall rating by the respondents on linkage and collaboration between training institutions and industries was fair, with a mean of 3.12 and a standard deviation of 0.619. This is an indication that the link between the TVET institutions and industries in Kenya is not strong. This is in agreement with international recommendations of the United Nations Educational, Scientific and Cultural Organization for the improvement of technical education and vocational training systems that lack of initiative by TVET institutions and poor response from the industries were among the major challenges facing the collaboration of TVET and industry according to New Strait Times (2012). There's therefore an urgent need to forge closer links between training and the labor market.

The overall rating of the trainers on ICT application in training and adequacy of modern automation and control equipment for training was fair, with a mean of 3.29 and a standard deviation of 0.714. However, as indicated in table 4.15 the adequacy of computer numerically controlled machines or models was rated the lowest with a mean of 2.69 and a standard deviation of 0.806. Sharma (2008) explains that a limited institutional budget for acquiring up to date tools and equipment, and the high cost of practical training materials and equipment generally curtails the curriculum implementation efforts in TVET institutions.

4.5 Research question three: What are the cutting edge skills the employers consider relevant to the electrical equipment servicing at manufacturing industries in Kenya?

The skills under investigation were summarized into two sets of skills namely; engineering manipulative skills and modern automation and control related skills, as illustrated by table 4.20

Table 4.20: perception Scale and weighting

Perception Scale	Weight
1.00 – 1.49	Not important
1.50– 2.49	Fairly Important
2.50– 3.49	Important
3.50– 4.00	Very Important

4.5.1 Rating of importance of engineering manipulative skills by industries

The manufacturing industry employers were required to rate if a variety of technical skills were required relevant to electrical equipment servicing. Table 4.21 illustrates this.

Table 4.21: Importance of manipulative skills by employers

Variable	N	Mean	Std. Deviation
Skills to operate machines, equipment and tools	7	3.14	1.069
Knowledge of engineering mathematics	7	3.29	1.113
Skills to interpret engineering drawings and blueprints	7	3.14	1.069
Skills to diagnose and rectify machine faults	7	3.43	1.134
Skills to read and monitor gauges and other indicators	7	3.29	1.113
Routine and planned preventive maintenance	6	3.33	1.211
Importance of engineering manipulative skills	7	3.28	1.139

The overall rating on the importance of engineering manipulative skills was rated as important with a mean of 3.28 and a standard deviation of 1.139. Skills to diagnose and rectify faults in case of machine failure received a higher rating with a mean of 3.43 and a standard deviation of 1.134. This shows that the manufacturing industries need electrical engineering technicians that are equipped with skills to diagnose and rectify problems related to machine failure.

4.5.2 Rating of importance of modern automation and control related skills by industries

The importance of modern automation and control related skills by the industries was summarized using five parameters which are; skills to do computer aided drawing, skills to operate an automated machine, skills to operate computer numerical controlled machines, knowledge of programmable logic controllers, knowledge of processors and repairing of electronic devices and general computer programming techniques.

Table 4.22: Importance of modern automation and control related skills by employers

Variable	N	Mean	Std. Deviation
Skills to do computer aided drawing	7	2.86	0.900
Skills to operate of an automated machine	7	3.14	1.069
Skills to operate computer numerical controlled machine	7	3.14	1.215
Knowledge of programmable logic controllers	7	3.00	1.155
Knowledge of processors and repairing of electronic devices	7	3.00	1.000
General computer programming techniques	7	3.14	1.069
Importance of modern automation and control related skills	7	3.05	0.985

From table 4.22, the importance of modern automation and control related skills was rated important by the manufacturing industries with a mean of 3.05 and a standard deviation of 0.985. The findings from tables 4.18 and 4.19 show that manufacturing industries rate both engineering manipulative skills and modern automation and control related skills as important in hiring electrical engineering technicians. This is despite the fact that both electrical engineering technicians and trainers rated the acquisition of these skills as not satisfactory as outline in tables 4.13, 4.14, 4.16 and 4.17 respectively. Kitainge (2009) indicates that majority of the engineering technicians find it hard to get job opportunities because they don't have the necessary manipulative skills.

According to Electrical comms data (2015) indicate that the major manipulative skill set required for the new technologies as a result of tailored PLC programming and SCADA systems, industrial process automation services and devices, is the skills for maintenance and equipment servicing among other skills.

Onoh (2017) indicates that maintenance and servicing skills are prerequisite for the preparation of technician trainees for the world of work. The critical skills required are skills to diagnose basic faults, evaluate electrical test equipment effectively and use of circuit diagrams as an aid to maintenance among others.

This is an indication that for the electrical engineering technician training to be relevant to the needs of the industries, the engineering technicians must possess engineering manipulative skills and modern automation and control machine repair and maintenance skills.

4.6 Research question four: What is the relationship between electrical engineering technicians' acquired skills and the skills required for electrical equipment servicing in manufacturing industries in Kenya?

Two sets of similar parameters representing the technical skills acquired from electrical engineering technician training and the technical skills required for electrical equipment servicing were identified. The electrical engineering technicians rated the skills acquired at the TVET institutions and the technical skills required at the manufacturing industries. The perception scale and weighting of the skills acquired and the skills required are as illustrated by table 4.23 below.

Table 4.23: Perception Scale and Weighting for skills acquired versus skills required

TECHNICAL SKILLS ACQUIRED		**TECHNICAL SKILLS REQUIRED**	
Scale	**Weight**	**Scale**	**Weight**
1.00 - 1.49	Very poor	1.00 - 1.49	Strongly Disagree
1.50 - 2.49	Poor	1.50 - 2.49	Disagree
2.50 – 3.49	Fair	2.50 - 3.49	Undecided
3.50 – 4.49	Good	3.50 – 4.49	Agree
4.50 – 5.00	Very Good	4.50 – 5.00	Strongly Agree

The electrical engineering technicians therefore rated the technical skills acquired at TVET institutions and the technical skills required by the manufacturing industries relevant to electrical equipment servicing as illustrated by table 4.24 below.

Table 4.24: rating skills acquired versus skills required

	Technical skills Acquired at TVET institutions			Technical skills Required at Manufacturing Industries		
Variable	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**
Skills to do computer simulation	47	2.47	1.195	48	3.83	1.059
Skills to operate Computer Numeric Controlled Machines	49	2.27	1.016	49	3.90	1.065
Programming Techniques and repair of electronic equipment	49	2.59	1.039	50	3.82	0.962
Knowledge on design and interpretation of engineering plans and blueprints	50	2.76	1.080	50	3.86	1.030
Skills to Diagnose and repair faults in case of machine failure	50	3.44	1.033	50	4.28	0.834

From the findings of table 4.24, the technical skills acquired by electrical engineering technicians were all lowly rated, with the skills required to operate computer numeric controlled machine rated as poor with a mean of 2.27 and a standard deviation of 1.016, whereas the electrical engineering technicians agree that the same skill is required at the industry, with a mean of 3.90 and a standard deviation of 1.065.

Skills acquired for computer simulation, programming techniques and knowledge on design and interpretation of engineering blueprints were all lowly rated fair, with means of 2.47, 2.59 and 2.76, with standard deviations of 1.195, 1.039 and 1.080 respectively. Consequently, the electrical engineering technicians agree that these skills are required at the industry, with means of 3.83, 3.82 and 3.86, with standard deviations of 1.059, 0.962 and 1.030 respectively.

However, the skills required to diagnose and repair faults in case of machine failure was highly rated as fair, with a mean of 3.44 and a standard deviation of 1.033, with the technicians also agreeing that the same skill is required at the industry with a mean of 4.28 and a standard deviation of 0.834. This indicates that the only technical skill acquired at the TVET institutions that was closely related to the skills required at the manufacturing industry is the skill to diagnose and repair faulty machines.

4.6.1 Ho: There is no significant relationship between electrical engineering technicians' acquired skills and the skills required by the manufacturing industries

Electrical engineering technician training was defined by the technical skills acquired by the electrical engineering technician at the TVET institutions at the time of completion of studies. The Pearson's Product Moment correlation was therefore found sufficient to establish the strength of the relationship between the technical skills acquired at the TVET institutions, and the technical skills required by the manufacturing industries for electrical equipment serving. The findings are presented in the table 4.25.

Table 4.25: Correlations of technical skills acquired and technical skills required

Correlations

		Technical Skills acquired	Technical Skills required
Technical Skills acquired	Pearson Correlation	1	.408**
	Sig. (2-tailed)		.004
	N	49	47
Technical Skills required	Pearson Correlation	.408**	1
	Sig. (2-tailed)	.004	
	N	47	47

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

From table 4.25 above, the analysis of correlation of the technical skills acquired at the TVET institutions and the technical skills required by the manufacturing industry, the technical skills acquired had a Pearson correlation of 0.408 and 0.004 sig. (2-tailed) when correlated with the technical skills required at the manufacturing industry.

The result is an indication that there is a significant positive relationship between the technical skills acquired by the electrical engineering technicians at TVET institutions and the technical skills required by the manufacturing industries for electrical equipment servicing because the significance level of 0.01, is greater than the 0.004 sig. (2-tailed) in the correlation, hence the null hypothesis is rejected.

While much attention has been given to the emerging industrial innovations and trends in electrical engineering technology for TVET institutions, one of the most critical issues has remained to be the curriculum content that should facilitate relevant training that equips the electrical engineering technicians with the modern cutting edge technical skills which include developing electrical schematics, data collection and analysis, operation of computer systems, electrical and electronic equipment maintenance and upkeep among others (Onoh, 2017).

This shows that for the electrical engineering technician training to be relevant for the manufacturing industry, the curriculum and training equipment at TVET institutions should be up-to date with the technical skills requirements of the manufacturing industry.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter illustrates the summary of the findings, conclusion and recommendations which were drawn from the analyzed and interpreted data as per the objectives of the study.

5.2 Summary of the findings

The main objective of the study was to establish if electrical engineering technician training offered at TVET institutions is relevant for electrical equipment servicing at manufacturing industries in Kenya.

Based on the basic information about the respondents, 94% of the electrical engineering technicians were male, while 90% of the technicians were specialized in electrical engineering (power) option. The main examining body at TVET institutions is KNEC, with the electrical engineering training offered o a full-time basis. The trainers' demographic information indicates that the mainstream part of the trainers have bachelor's degrees in engineering and technology, with 92.6% of the trainers being male while only 7.4% were female.79.3% of the trainers were trained through the integrated training (engineering specialization skills and pedagogical training concurrently) while 20.7% trained in pedagogy after acquiring specialized engineering education at the university level.

The study addressed four research questions and one research hypothesis that were developed from the objectives of the study.

The first objective sought to determine how electrical engineering technicians rate their acquired training in TVET institutions' relevance to the electrical equipment servicing at manufacturing industries in Kenya. The electrical engineering technicians perceived the training acquired as good. Specifically, the technicians rated the capability of their trainer to deliver subject content and relevance of skills learnt as good. The rating on adequacy of training equipment was good. The collaboration between TVET institutions and the industries and ICT application in training and the adequacy of modern automation and control equipment for training was rated as fair.

The second objective sought to find out how the trainers rated adequacy of training equipment, collaboration between TVET institutions and the industries and ICT application in training and adequacy of modern automation and control training equipment. The study found out that adequacy of training equipment was rated good. The collaboration between TVET institutions and the industries, ICT application in training and adequacy of modern automation and control equipment for training were rated as fair.

The third objective sought to determine the skills employers consider relevant for electrical equipment servicing at manufacturing industries. The findings indicate that employers consider engineering manipulative skills as well as modern automation and control related skills as important. Engineering manipulative skills required to solve causes of electrical equipment failure as well as routine planned and preventive maintenance were highly rated as important. Modern automation and control related skills required for operation of automated machines, computer numeric controlled machines and general computer programming skills were highly rated as important.

The fourth objective sought to determine the relationship between electrical engineering technician training and the skills required for electrical equipment servicing at manufacturing industries in Kenya. The findings indicate that skills necessary for diagnosing and repairing of faults in case of a machine failure was relevant and consistent with the needs of the industry. There is a significant positive relationship between the technical skills acquired by the electrical engineering technicians at TVET institutions and the technical skills required by the manufacturing industries for electrical equipment servicing ($r = 0.408$ and p value <0.01). The null hypothesis (Ho) was therefore rejected. This means that there is a significant positive relationship between electrical engineering training and the skills required for electrical equipment servicing at the manufacturing industries in Kenya.

5.3 Conclusions

The study concluded that the rating of the electrical engineering technician training acquired at TVET institutions is good and therefore relevant for electrical equipment servicing at manufacturing industries.

The training resources are available overall in terms of workshops and related infrastructure, while the equipment required for facilitating modern automation and control training was not readily available, therefore urgent measures have to be taken to ensure TVET institutions can acquire them with ease. Linkages and collaboration between the TVET institutions and manufacturing industries was rated fair therefore needing improvement if the training offered is to be relevant with the needs of the industry.

The manufacturing industry employers consider both engineering and manipulative skills as well as skills necessary to operate modern automation and control equipment as important.

There is a positive significant relationship between the electrical engineering technician acquired training at TVET institutions and the skills required for electrical equipment servicing at manufacturing industries in Kenya.

5.4 Recommendations

The Kenyan government through the ministry of education should ensure adequate training resources are allocated to achieve training relevant for the needs of the industry.

The TVET institutions need to strengthen linkages and collaboration with the industries to ensure the training offered is up-to date with the needs of the industry.

KICD in collaboration with CDACC and SSACs should develop a curriculum that addresses the competence requirements and occupational standard needs of the manufacturing industries.

5.5 Suggestions for further study

The following are suggestions for further research;

1. A study to establish how TVET institutions can actively collaborate with the industries through exchange programs
2. An evaluation of the engineering technician curriculum in relation to specialized competencies and occupational standards needed by the industries
3. A study to establish how engineering technician graduate tracer survey/skills mapping enhances determination of the needs of the industrial employers

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APPENDICES

APPENDIX I: ELECTRICAL ENGINEERING TECHNICIAN QUESTIONNAIRE

Introduction:

My name is ………………………… a researcher seeking to survey on the relevance of electrical engineering technician curriculum for the Kenyan industry. The study is intended to give insightful understanding of industrial relevance of the technician engineering technicians who completed their training in technical training institutions.

All information will be confidential and so feel free to answer. i truly appreciate the help you are giving me by taking part in this survey. This is not a test and therefore there are neither 'right' nor 'wrong' answers. Ask if there is anything that is not clear, and let me know if you need to stop for any reason.

Consent of respondent

Can we proceed?

Yes [ ]

No [ ]

If no, the researcher will thank the respondent and terminate the process

Section A: Personal informational

I would like to start by asking a bit about yourself and your training background.

1. Sex of respondent *(tick the appropriate answer)*

Male [ ]

Female [ ]

2. Age …………….. Years

3. Kindly complete the tables below by indicating the highest technical training you attained at technical training institutions.

Course	**Tick where Appropriate**			
	HND	**DIP**	**Craft Certificate**	**Artisan**
Electrical engineering (power)				
Electrical engineering (electronics)				
Electrical engineering (instrumentation & control)				

	Name of institution	examining body e.g. KNEC	Year of completion
HND			
Diploma			
Craft Certificate			
Artisan Certificate			

Section B: training process

I would kindly require you to rate the training process you experienced during your training by the time of completion. Please score each on the applicable options on a 5-point scale as per the items.

Score	Rating
1	Very Poor
2	Poor
3	Fair
4	Good
4	Very Good

For example if the training process was very poor you score '1' against the appropriate item and the others respectively as given in the table.

How would you rate the following training process?

Capacity Of Delivery	**VP**	**P**	**F**	**G**	**VG**
1. Ability Of Your Trainers To Deliver Practical Lessons	**1**	**2**	**3**	**4**	**5**
2. Ability Of Trainers To Use Teaching And Learning Resources (Such As Visual Aids, Real Objects)	**1**	**2**	**3**	**4**	**5**
3. Opportunity For Consulting Your Trainers	**1**	**2**	**3**	**4**	**5**
4. Trainers General Understanding Of The Subject Content	**1**	**2**	**3**	**4**	**5**
Relevance Of Skills Acquired	**VP**	**P**	**F**	**G**	**VG**

1. The Relevance Of The Engineering Skills To The Job Market	**1**	**2**	**3**	**4**	**5**
2. The Duration Of Training	**1**	**2**	**3**	**4**	**5**
3. The Depth Of The Content Taught	**1**	**2**	**3**	**4**	**5**
4. How Would You Rate Testing System In Final Examinations?	**1**	**2**	**3**	**4**	**5**
5. Programming And Application Of Circuit Boards, Processors, Chips And Electronic Equipment.	**1**	**2**	**3**	**4**	**5**
Availability Of Resources	**VP**	**P**	**F**	**G**	**VG**
1. The Availability Of Machines For Workshop Practice	**1**	**2**	**3**	**4**	**5**
2. The Availability Of Bench And Hand Tools For Workshop Practice And Experiments	**1**	**2**	**3**	**4**	**5**
3. Condition Of The Of Lecture Halls	**1**	**2**	**3**	**4**	**5**
4. Availability Of Engineering Text Books In The Institution	**1**	**2**	**3**	**4**	**5**
Linkages	**VP**	**P**	**F**	**G**	**VG**
1. Relationship Between Training Institution And The Industry	**1**	**2**	**3**	**4**	**5**
2. Ability Of The Training Institution To Place You For Industrial Attachment	**1**	**2**	**3**	**4**	**5**
3. Opportunity For Students To Access Internship Programs	**1**	**2**	**3**	**4**	**5**

4. Exposure Of The Trainers On New Technologies In Industries	**1**	**2**	**3**	**4**	**5**
5. Opportunity For Students Exchange Or Joint Programs With Institutions And Industries	**1**	**2**	**3**	**4**	**5**
Application of ICT	**VP**	**P**	**F**	**G**	**VG**
1. Internet Connectivity In The Institution	**1**	**2**	**3**	**4**	**5**
2. The Use Of Computers And Projectors In Teaching By The Trainers	**1**	**2**	**3**	**4**	**5**
3. Use Of A Computer To Undertake A Simulation, Auto-Cad Or Archi-Cad	**1**	**2**	**3**	**4**	**5**
4. Availability Of Computer Numerically Controlled Machines Or Models	**1**	**2**	**3**	**4**	**5**
5. Programming And Application Of Circuit Boards, Processors, Chips And Electronic Equipment.	**1**	**2**	**3**	**4**	**5**

6. Knowledge Of Design Techniques, And Production Of Technical Plans, Blueprints And Models.	**1**	**2**	**3**	**4**	**5**
7. Skills To Detect And Solve Problems In Case Of Any Machinery Failure (Simulation)	**1**	**2**	**3**	**4**	**5**
Technical Skills	**VP**	**P**	**F**	**G**	**VG**
1. Routine Maintenance And Planned Preventive Maintenance On Various Systems And Machines.	**1**	**2**	**3**	**4**	**5**

2. Skills To Undertake Engineering Projects And Research	**1**	**2**	**3**	**4**	**5**
3. Monitoring Skills Such As Watching Gauges, Dials, And Other Indicators To Make Sure A Machine Is Working Properly.	**1**	**2**	**3**	**4**	**5**

Section E: skills required at the industry.

I would like to ask you to please state whether you strongly agree, agree, disagree or strongly disagree with the following statements as regards the following skills required in the job market.

Response	**Score**
Strongly Disagree	1
Disagree	2
Undecided	3
Agree	4
Strongly Agree	5

Skills Required At The Job Market

Technical Skills	**SD**	**D**	**U**	**A**	**SA**
1. Knowledge On The Designs And Uses Of Various Machines, Equipments And Tools.	**1**	**2**	**3**	**4**	**5**
2. Ability To Operate Various Machines And Equipments	**1**	**2**	**3**	**4**	**5**
3. Use Of Computer Aided Drawing Skills/ Archi-Cad To Draw Engineering Drawing	**1**	**2**	**3**	**4**	**5**
4. Operation Of An Automated Machine/ Numerical Controlled Machine	**1**	**2**	**3**	**4**	**5**
5. Programming And Application Of Circuit Boards, Processors, Chips And Electronic Equipment.	**1**	**2**	**3**	**4**	**5**
6. Knowledge Of Design Techniques, Technical Plans, Blueprints, Drawings, And Models.	**1**	**2**	**3**	**4**	**5**
7. Skills To Detect And Solve Problems In Case Of Any Machinery Failure	**1**	**2**	**3**	**4**	**5**
8. Routine Maintenance And Planned Preventive	**1**	**2**	**3**	**4**	**5**

Maintenance On Various Systems And Machines.					
9. Skills To Undertake Engineering Projects And Research	**1**	**2**	**3**	**4**	**5**
10. Monitoring Skills Such As Watching Gauges, Dials, And Other Indicators To Make Sure A Machine Is Working Properly.	**1**	**2**	**3**	**4**	**5**

Section F: Skills and traits to be incorporated/ strengthened

1. How did you get to secure your first industrial attachment?

- By Help Of Our Institution [ ]
- Through Directorate Of Industrial Training (Dit) [ ]
- Friends [ ]
- Media Advertisement (Please Specify)……………….……………………………
- Door To Door (Job Hunting) …………………………………………………..
- Other (Please Specify) ………..……………………………………………..

2. What are the difficulties you encountered during job interviews when looking for a job? (tick only one i.e. the most appropriate answer)

- Lack Of Knowledge About Majority Of Relevant Modern Technology [ ]
- Employers Not Interested In My Level Of Qualification [ ]
- Employers Not Interested In My Area Of Specialization [ ]

- Lack Of Work Experience [ ]
- Limited Employment Opportunities In My Area [ ]
- Other (Please Specify) ……………………………………..

3. Considering the various activities in this organization, list down skills that you think Needs To Be Incorporated In School Curriculum And State The Activity That Requires Such Skills

Job Activities	**Skills That Need To Be Incorporated/ Strengthened**
1.	
2.	
3.	
4.	
5.	

4. In Your Opinion What Do You Think Needs To Be Done To Make The Technician Engineering Training More Relevant To The Current Labor Market?

……………………………………………………………………………………………

…………………………………………………………………………………………….

………………………………………………………………………………………………

That's The End of My Questions. Thank You Very Much For Spending Time To Answer Them.

APPENDIX II: EMPLOYERS' QUESTIONNAIRE

Introduction:

My name is …………………………. A researcher seeking to survey on the relevance of electrical engineering technician curriculum for the Kenyan industry. The study is intended to give insightful understanding of industrial relevance of the technician engineering technicians who completed their training in technical training institutions.

All information will be confidential and so feel free to answer. I truly appreciate the help you are giving me by taking part in this survey. This is not a test and therefore there are neither 'right' nor 'wrong' answers. Ask if there is anything that is not clear, and let me know if you need to stop for any reason.

Consent of respondent

Can we proceed?

Yes [ ]

No [ ]

If no, the researcher will thank the respondent and terminate the process.

Section A: Organizational Profile

1. In what sector would you classify the activities of this organization?

Construction [ ]

Manufacturing [ ]

Training Institution [ ]

Transport [ ]

Other (Please Specify)

……………………………………………..

2. What is the name of your organization? ....

3. What kind of procedures do the company / organization use to recruit technician Employees? (Multiple Reply Possible)

- Advertisement Of Vacancies In News Paper [ ]
- Internal Advertisement Of Vacancies [ ]
- Direct Application Of Technicians [ ]
- Placement Services Unit At The Training Institutions [ ]
- Personal Contacts To Technicians [ ]
- Private Employment Agencies [ ]
- Binding Students By Scholarships [ ]
- Others (Please Specify) ………………………………..

4. Do you prefer technicians from certain training institutions?

- Yes [ ] *(If Yes Answer Question 5 And 6)*
- No [ ] *(If No Skip To Section B)*

5. If yes, which training institutions do your prefer?

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

6. Why do you prefer the technicians from these institutions?

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

Section B: Skills Required, In The Industry By Employers.

I would like to ask you to rate how important are the following skills to the industry.

State not important, fairly important, important or very important to the following statements in regards the skills required by the industry.

Response	**Score**
Not Important	1
Fairly Important	2

Important	3
Very Important	4

For example if it is not important score “1”, in the table below.

Skills Required in Job Market

Professional Skills	**NI**	**FI**	**I**	**VI**
1. Knowledge On The Designs And Operation Of Various Machines, Equipments And Tools.	**1**	**2**	**3**	**4**
2. Knowledge Of Engineering Mathematics And Their Engineering Applications.	**1**	**2**	**3**	**4**
3. Knowledge Of Engineering Drawing, Blueprints And Models.	**1**	**2**	**3**	**4**
4. Skills To Detect And Solve Technicalities In Case Any Machine Failure.	**1**	**2**	**3**	**4**
5. Monitoring Skills That Is Watching Gauges, Dials, And Other Indicators To Make Sure A Machine Is Working Properly.	**1**	**2**	**3**	**4**
6. Routine Maintenance And Planned Preventive Maintenance On Various Systems And Machines.	**1**	**2**	**3**	**4**

ICT Skills	**NI**	**FI**	**I**	**VI**
1. Use Of Computer Aided Drawing Skills/ Archi-Cad To Draw Engineering Drawing	**1**	**2**	**3**	**4**
2. Operation Of An Automated Machine	**1**	**2**	**3**	**4**
3. Operation Of Computer Numerical Controlled Machine (Cnc Machines)	**1**	**2**	**3**	**4**
4. Knowledge Of Programmable Logic Controller (PLCS)	**1**	**2**	**3**	**4**
5. Knowledge Of Processors And Electronics Devices	**1**	**2**	**3**	**4**
6. General Computer Programming Techniques	**1**	**2**	**3**	**4**

7. Downtime

Equipment/ Process Performance	**(Hours)**
Mean Time To Repair	
Mean Time Between Failure	
Number Of Machine Failures Reported (Annually)	

9. Are there skills needed by this organization that are not readily available in this country?

Yes [ ]

No [ ]

10. If yes, what skills are needed by the organization but are not readily available in kenya? What has this organization done about it?

Type of skills lacking in the country	**action by the organization to address this**
•	
•	
•	

12. How best can TVET institutions and industry relationship strengthened?

………………………………………………………………………………………………

…………………………………………………………………………………………………… ………………………………………………………………………………

That’s the end of my questions. Thank you very much for spending time to answer them.

APPENDIX III: TRAINERS' QUESTIONNAIRE

Introduction:

My name is …………………………. a researcher seeking to survey on the relevance of electrical engineering technician curriculum for the Kenyan industry. The study is intended to give insightful understanding of industrial relevance of the technician engineering technicians who completed their training in technical training institutions.

All information will be confidential and so feel free to answer. I truly appreciate the help you are giving me by taking part in this survey. This is not a test and therefore there are neither 'right' nor 'wrong' answers.

Consent of respondent

Can we proceed?

Yes [ ]

No [ ]

If no, the researcher will thank the respondent and terminate the process.

Section A: introduction

I would like to start by asking a bit about yourself and your training background.

1. Sex of respondent

Male [ ]

Female [ ]

2. How long have you been teaching electrical engineering and related courses …………

3. Professional Qualifications, Dip Tech.Ed( ), Hnd ( ) Bsc ( ), Bedtech ( ), Bt ( ), Pgde( ), Msc ( ), , Meng( ) Mphil ( ), Med( ) Phd ( ), Others (Specify----------------------------)

Please rate each of the applicable items as per the 5-point scale.

Rating	Score
Very Poor	1
Poor	2
Fair	3
Good	4
Very Good	5

Score Appropriately Using The Scale Above, For Example "1" For Very Poor

How Would You Rate The Following Teacher Training Process?

Capacity Of Delivery	**VP**	**P**	**F**	**G**	**VG**
1. Ability To Deliver Practical Lessons	1	2	3	4	5

2. Ability To Use Teaching And Learning Resources (Such As Visual Aids, Real Objects)	1	2	3	4	5
3. Ability To Plan Lesson	1	2	3	4	5
4. Availability To Be Consulted By Students	1	2	3	4	5
5. General Understanding Of The Subject Content	1	2	3	4	5
Quality And Relevance Of Skills	**VP**	**P**	**F**	**G**	**VG**
1. The Relevance Of The Engineering Skills To The Job Market	1	2	3	4	5
2. The Duration Of Training	1	2	3	4	5
3. The Depth Of The Content Taught	1	2	3	4	5
4. How Would You Rate Testing System In Final Examinations?	1	2	3	4	5
Availability Of Resources	**VP**	**P**	**F**	**G**	**VG**
1. The Availability Of Machines For Workshop Practice	1	2	3	4	5
2. The Availability Of Bench And Hand Tools For Workshop Practice	1	2	3	4	5
3. Accessibility To Laboratory Apparatus For Conducting	1	2	3	4	5

Experiments In Your Training Institution					
4. Condition Of The Of Lecture Halls	1	2	3	4	5
5. Availability Of Engineering Text Books In The Library	1	2	3	4	5
Linkages	**VP**	**P**	**F**	**G**	**VG**
1. Relationship Between Training Institution And The Industry	1	2	3	4	5
2. Ability To Place Students For Industrial Attachment	1	2	3	4	5
3. Opportunity To Review The Curriculum At Kenya Institute Of Education And Other Bodies	1	2	3	4	5
4. Frequency Of Attending Industrial Attachment	1	2	3	4	5
5. Participation To Staff Exchange And Joint Programs	1	2	3	4	5
Application Of Ict	**VP**	**P**	**F**	**G**	**VG**
1. Internet Connectivity In The Institution	1	2	3	4	5
2. The Use Of Computers And Projectors In Teaching	1	2	3	4	5
3. The Availability Of Computers To The Student For Use During Any Computer Lesson, Auto-Cad Or Archi-Cad	1	2	3	4	5
4. Availability Of A Computer To The Student To Be Used	1	2	3	4	5

In Undertaking A Simulation.					
5. Availability Of Computer Numerically Controlled Machines Or Models To The Students	1	2	3	4	5

.

6. What suggestions do you have that can make electrical engineering technician training in kenya more relevant to the industry?

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

7. How best can tvet institutions and industry relationships get strengthened?

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

……………………………………………………………………………………

Section C: tick against the choice that best describe your opinion

1. What do you think about electrical technology taught at the TVET institution and the technology that is incorporated onto the modern Kenyan industry currently?

   a) There is no gap at all---------------- ( )

   b) There is little gap in some areas – -( )

   c) There is a gap in most areas -------- ( )

   d) There is a gap in all areas ----------- ( )

2. How do you think the gap between electrical technology taught at the institution and the technology in the industry can be bridged?

   a) Curriculum overhaul--- ( )

   b) Through curriculum evaluation an improvement-------- ( )

   c) Improvement of training facilities --------------------------- ( )

   d) Through training in collaboration in industry ------------ ( )

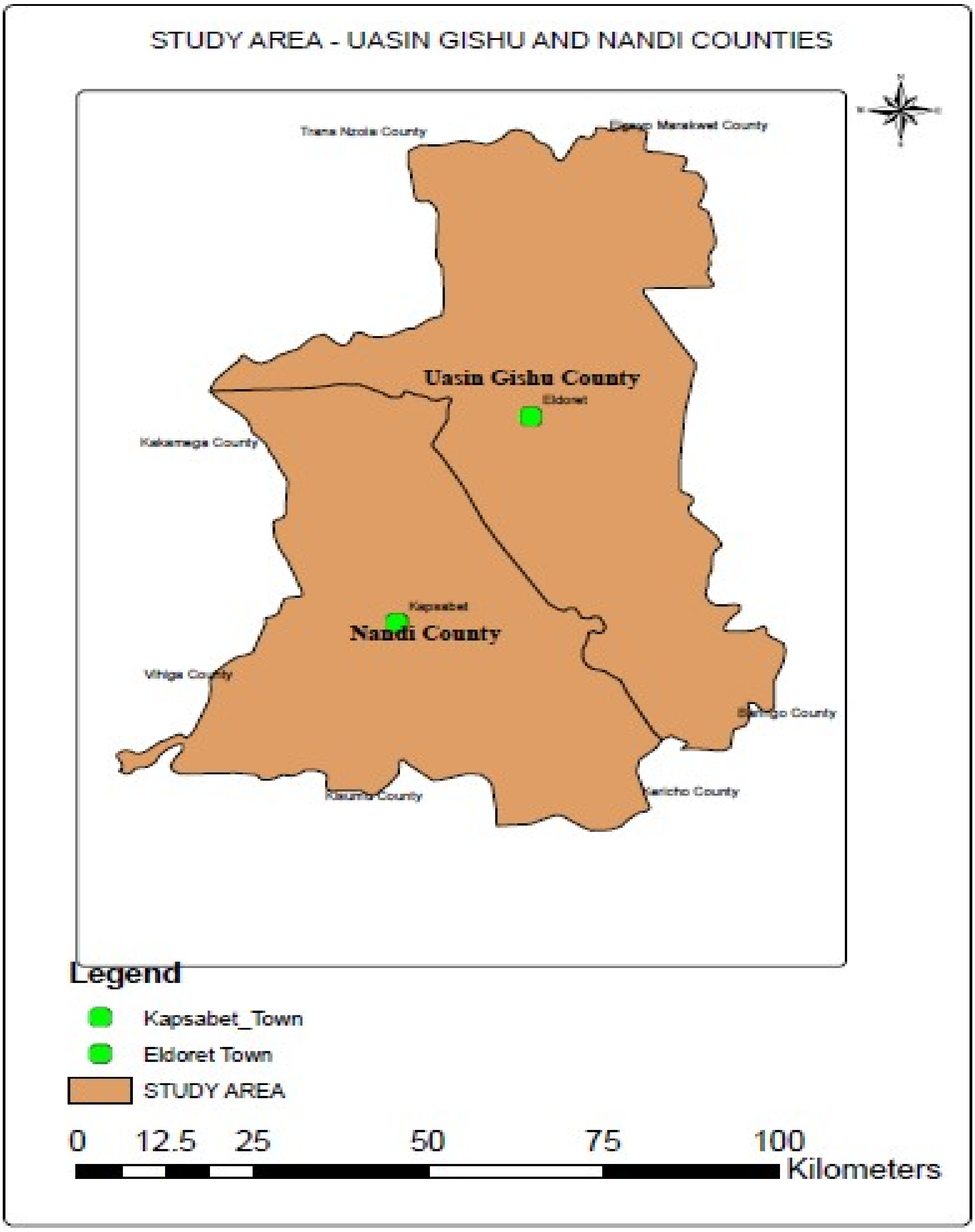
   e) Others (please specify)

____

____

That's the end of my questions. Thank you very much for spending time to answer.

APPENDIX IV: MAP OF STUDY AREA



(Source : Author, 2019)

APPENDIX V: RESEARCH PERMITS

THIS IS TO CERTIFY THAT:
MR. AMOS KIPRONO KETER
of UNIVERSITY OF ELDORET, 0-30301 NANDI HILLS,has been permitted to conduct research in *Nandi , Uasin-Gishu Counties*

Permit No : NACOSTI/P/18/90124/22998
Date Of Issue : 1st August,2018
Fee Recieved :Ksh 1000

on the topic: *THE RELEVANCE OF ELECTRICAL ENGINEERING TECHNICIAN CURRICULUM FOR THE INDUSTRY, A CASE OF SELECTED TVET INSTITUTIONS FROM THE NORTH RIFT REGION IN KENYA.*

for the period ending:
30th July,2019

....
Applicant's Signature

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

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When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref. No. **NACOSTI/P/18/90124/22998**

Date: **1st August, 2018**

Amos Kiprono Keter
University of Eldoret
P. O. Box 1125-30100
ELDORET.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"The relevance of electrical engineering technician curriculum for the industry, a case of selected TVET institutions from the North Rift Region in Kenya"*** I am pleased to inform you that you have been authorized to undertake research in **Nandi and Uasin Gishu Counties** for the period ending **30th July, 2019.**

You are advised to report to **the County Commissioners and the County Directors of Education, Nandi and Uasin Gishu Counties** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Nandi County.

The County Director of Education
Nandi County.

The County Commissioner
Uasin Gishu County.

The County Director of Education
Uasin Gishu County.

APPENDIX VI : SIMILARITY REPORT

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