CAPACITY BUILDING NEEDS OF WOODWORK TECHNOLOGY EDUCATION LECTURERS IN THE USE OF DIGITAL CIRCULAR SAW MACHINE IN NORTHWEST, NIGERIA

BY

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MTech/SSTE/2018/9038

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A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF TECHNOLOGY IN WOODWORK TECHNOLOGY EDUCATION

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ABSTRACT

This study was designed to determine the capacity building needs of woodwork technology education lecturers using Digital Circular Saw Machine (DCSM) in tertiary institutions offering NCE (Technical) Woodwork Technology Education in North-West States, Nigeria. Seven research questions guided the study while seven null hypotheses formulated were tested at 0.05 level of significance. The study made use of descriptive survey design. The population for the study was 84 subjects comprising of 40 Woodwork Technology Education Lecturers and 21 Woodwork Technology Education Administrators in seven tertiary educational institutions as well as 23 Woodwork Workshops Employers (Master Craftmens) in the seven North-West States. A 70 items questionnaire was used on instrument for data collection. The instrument was validated by five woodwork technology education experts. The reliability of the instrument was determined using cronbach alpha reliability method to find the internal consistency that yielded 0.86. The data collected were analyzed using mean and standard deviation to answer the seven research questions while Analysis of Variance (ANOVA) was employed to test the null hypotheses at 0.05 level of significance with help of SPSS version 23. The findings of the study revealed that Woodwork Technology Education Lecturers teaching NCE (Technical) Woodwork Technology Education Programme need capacity building in setting DCSM parameters such as: cutting speed and allowance tolerance with average mean value of 3.10 and also, finding on setting-up, programming, operation of computerized DCSM for ripping operation with average mean value 3.20. There was no significant difference in the mean response between woodwork technology education lecturers and woodwork administrators at the State Colleges of Education/State Polytechnics and Federal Colleges of Education/Federal Polytechnics on the capacity building needs of woodwork technology education lecturers on ripping operation with digital circular saw machine and also, There was no significant difference in the mean response between woodwork technology education lecturers and woodwork administrators at the State Colleges of Education/State Polytechnics and Federal Colleges of Education/Federal Polytechnics on the capacity building needs of woodwork technology education lecturers on grooving operation with digital circular saw machine. It was concluded that woodwork technology education lecturers need capacity building on setting of DCSM parameters, such as cutting speed, allowance tolerance, programming, operation with computerized DCSM for ripping operation. Based on the findings, it was recommended that: The National Commission for Colleges of Education (NCCE) and National Board for Technical Education (NBTE) should include ripping and other woodworking operations using Digital Circular Saw Machine (DCSM) in NCE (Technical) Woodwork Technology Education Programme Minimum Standard and also, Woodwork Technology Education Administrators should organize seminars and workshops for Woodwork Technology Education Lecturers on how to operate DCSM especially, on different woodworking operations.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Technology Education is an aspect of education use for training students to becomes teachers in technical colleges and higher institution specified in technology through imparting them with technology knowledge and practical skills. Technology Education is offered in universities, polytechnics, and colleges of education and other specialized institutions. Technology Education is the education of making an individual to become self-reliant. Technology Education is the aspect of education offered at various technical institutions of learning that leads the learners to acquisition of practical skills and basic scientific knowledge towards self-reliance (Okwori, 2019). Technology Education is the study of technology in which students learn about the processes and knowledge related to technology as a field of study. It covers the human ability to shape and change the physical world to meet the need of people by manipulating materials and tools with techniques (International Technology and Engineering Educators Association, ITEA, 2000). This technology education is offer in different professional field to include Automobile, Building, Electrical/Electronics, Metalwork and Woodwork Technology Education Programme.

Woodwork Technology Education (WTE) Programme in tertiary institutions that lead to the award of Nigeria Certificate in Education (NCE) (Technical) Programme cover wide range of areas of teaching/learning includes a machine woodworking, cabinet making, carpentry and joinery, furniture making and other wooden constructions with aim of producing woodwork trade teachers for technical colleges. Woodwork trade deals with production of woodwork cabinetmaking through design, application, constructions, operations and maintenance of woodwork tools and machines. Students who specialized in woodwork trade are expected to acquire knowledge, skills and attitudes to design, apply, construct, manufacture or make woodwork cabinets as well as to operate and maintain all kinds of woodwork tools and machines for his/her efficiency (Hornby, 2000). The National Commission for Colleges of Education designed the woodwork technology education curriculum for implementation at tertiary institutions offering Woodwork Technology Education Programme for the award of NCE (Technical) Woodwork Technology Education upon completion.

The Philosophy of NCE (Technical) in Woodwork Technology Education according to National Commission for Colleges of Education (NCCE, 2012) is to produce technical teachers with the intellectual and professional background adequate for teaching woodwork technology education courses and to make them adoptable to any changing situation in technological development not only in the country but also in the world at large (NCCE, 2012). Specifically, the objectives of Woodwork Technology Education Programme are:

- To provide qualified Woodwork Technology Education Teachers that will teach Basic Technology at upper basic education level;
- To provide Woodwork Technology Education Teachers who will be able to inculcate scientific and technological attitudes and values into the society;
- To provide qualified Woodwork Technology Education Teachers that are motivated to start the desired revolution of technological development in Nigerian Schools;

- To prepare Woodwork Technology Education Teachers for a post - NCE degree programme in Technical Education.

The minimum qualification for Woodwork Technology Education Lecturers in Woodwork Technology Education Programme at NCE (Technical) Woodwork level must be those obtained Bachelor of Education/Bachelor of Science in Industrial, Vocational and Technical Education with at least a Second Class Lower; Bachelor of Science, Engineering or Technology with at least Second Class Lower plus an evidence of teaching qualification such as Post-Graduate Diploma in Education (PGDE); Post-Graduate Diploma in Technical Education (PGDTE); Nigeria Certificate in Education (NCE) (NCCE, 2012).

A Woodwork Technology Education Lecturers are the academic staffs who teach the woodwork technology education programme courses. A Woodwork Technology Education Lecturers are the teachers in college or university that teaches students and carried-out research activities to solve identified problems in woodwork technology education programme. The Woodwork Technology Education lecturer is expected to use Digital Circular Saw Machine (DCSM) competently for teaching students ripping, cross-cutting, rebating, chamfering, mitre-cutting, grooving, trenching operations/processes and others. Despite that, the DCSM not included in the NCCE/NBTE minimum standard for the NCE (Technical) Programme.

To get the competence for the woodwork technology lecturers in the use of digital circular saw machine for teaching practical class that always produces number of graduates in NCE (Technical) in Woodwork Technology Education Programme is of paramount. The woodwork technology education lecturers' competence calls for compelling alternatives needs to help improve the level of knowledge and competence of NCE (Technical) students/graduates of woodwork technology education programme in the use of digital circular saw machine to operate effectively and efficiently. This could be improvement because the woodwork technology education lecturers must be competent in operating these kinds of new modern machines, but reverse is the case (Ugwu & Agbo, 2015). Competency is an essential ability obtained in a profession and those which the professional in the field must possess and be able to demonstrate at optimal level of functioning. Odewumi and Dekom (2020) referred to competency as knowledge, skill and attitude that are required for successful performing of the task. Competency as applied in this study is the knowledge, skills and attitude or training ability woodwork technology education lecturers must possess to operate Digital Circular Saw Machine (DCSM) for effective delivery of practical skills class without difficulties. Digital Circular Saw Machine (DCSM) also known as Computer Numerical Control (CNC) circular saw machine has revolutionized the world of highly precise woodworking.

The CNC circular saw machine can be defined as the computerized technology in which the functions and the motion of circular saw machine tools are controlled by means of a prepared programme (software) containing coded alphanumeric programme data (Samaila & Aminu, 2021). The CNC circular saw machining processes have been developed to meet extra required machining conditions. Circular Saw CNC Machine is electro-mechanical device that manipulate saw using computer programming inputs. It is the name given to a machine containing a spindle or router that receives its fabricating marching orders from a computer such as a laptop or desktop unit containing Computer Aided Design (CAD) software.

In a Circular Saw CNC machine depending on the models ability, software and accessories, these orders direct the spindle to cut wood (typically, up to ¾" deep) carve drill holes, and shape a work piece along various axes (from three to five) according to the invented design. It allows you to input the most specific commands that would be difficult for a human to do by hand and it is able to complete the woodworking design in just a matter of minutes (Samaila & Aminu, 2021).

Digital circular saw machine is a manufacturing technology in the 21st century which brought about changes from the old/manual traditional machining process to a new machining process which is more suitable for precision machining of hard and brittle materials (including wood) (Jan, 2010). That is, the use of digital technology in the world in many aspects of human endeavour comes with digital such as woodworking machinery including digital circular saw machine to save human labour, time, materials both in the process and products. CNC circular saw or DCSM offers many advantages over traditional machining processes such as: providing high accuracy and surface finish; prolong tool life; ability to machine very hard and fragile materials that are difficult for traditional machining, can also be carried-out by successful train students.

To enable woodwork students at NCE (Technical) level to acquire workplace skills with the aid of digital circular saw machine therefore depend on the ability level of woodwork technology education lecturers in getting knowledge on the how to operate Digital Circular Saw Machine (DCSM). In recent times, several countries of the world and some in African tertiary institutions are acquiring practical skills through the use of digital circular saw machine that is, using computer to direct or control the machines in order to boost learning outcome has become very difficult (Khan *et al.*, 2012). This is because of the different operation and application of the DCSM.

Application of DCSM in teaching and learning helps inculcating lifelong and workplace skills for future enterprise (Robert, 2014). Ogbuanya & Bakare (2017), introducing newly machining technology advancement into education improves teaching and learning but it cannot take the place of teacher in developing nations like Nigeria. Uwaifo and Uwaifo (2009) was the view that the current trend of globalization requires the woodwork technology education lecturers in NCE (Technical) programme are with the latest technology to produce NCE (Technical) graduates with skills and competencies to cope in a digital workplace. Education unlocks the door of modernization but is the teacher/lecturer who holds the key to the door. Woodwork Technology Education Lecturers are the hubs or pivots on which any successful NCE (Technical) Woodwork Technology Education Programme depend and if teachers/lecturers perform their tasks dutifully, there will certainly be a myriad of new technologies in the future of woodwork technology students. To perform successfully as woodwork teachers or lecturers of woodwork technology education will have to undergo constant training and capacity building programme continually to keep them abreast with changing dynamic in practical skills teaching and learning (Jürgen & Friedrich, 2017).

Capacity building is a measurable improvement in an organization’s ability to fulfill its mission through a blend of sound management, strong governance, and dedication to assessing and achieving results (Stavrons, 2018). Capacity building is the process of developing competencies and capabilities in individuals, groups, organization sectors or countries which leads to sustainable and self-generating performance improvement.

Stavrons further stated that the fundamental goal of capacity building is to enhance or improve the ability of individuals based on perceived needs. Corporation for National Community Service (CNCS, 2012) explained capacity building as a set of activities that expand the scale, reach, efficiency or effectiveness of an individual, organization or a programme. These activities may be expanding services or generate additional resources for the individual or organization. Capacity is the resources necessary to implement your strategy, pursue your mission, and achieve your vision.

Capacity building is as basic as continually improving some might consider it an obligation both for non-profits to undertake, and donors/grant makers to support. Capacity building is the ongoing process through which individuals, groups, organizations and society enhance their abilities to identify and meet development challenges. Therefore, in this study capacity building refers to the set of activities directed towards improving competencies and capabilities of woodwork lecturers in operating digital circular saw machines effectively during delivery of practical skills lessons in the NCE (Technical) programme and this could be achieved through assessment.

Assessment is a form of evaluation that uses collected data for estimating the work quality or effectiveness of a programme or project. Assessment involves use of empirical data on students learning (Baer *et al.*, 2016). Assessment is the wide variety of methods or tools that evaluators use to evaluate measure and document academic readiness, learning progress, skill acquisition, or educational needs of the students. Valid Assessment of people helps someone to pass judgment correctly. With reference to this study, assessment is the process of evaluating woodwork technology education lecturers in NCE (Technical) Woodwork Technology Education Programme through collection of data from them to determine the level of competencies they possess in operating DCSM for effective and efficient instructional delivery, despite the availability of DCSM in workshops in the tertiary institutions offering NCE (Technical) woodwork technology education programme. Hence, the need to determine the capacity building needs of woodwork technology education lecturers for NCE (Technical) programme in the use of digital circular saw machine in North-West States, Nigeria.

1.2 Statement of the Research Problem

The woodwork technology education lecturers implement the prepared curricula in various tertiary institutions offering NCE (Technical) woodwork technology education programme for the students' acquisition of skills. It was noted that woodwork technology education lecturers in North-West States, Nigeria still prefer to use manual circular saw machine for teaching practical skills courses despites the availability of the DCSM in the NCE (Technical) woodwork technology education programme offering institutions have this digital circular saw machine in the woodwork workshops, and also, the DCSM is easy to operate by anybody in carrying-out the ripping, cross-cutting, mitre-cutting, rebating, grooving, trenching, chamfering and other operations, all with this single digital circular saw machine. Again, woodwork workshops employers (master craftsmen) lack the competency knowledge of how to operate digital circular machine in day-today manufacturing wooden articles for selling to their customers, despite the availability of DCSM in their woodwork workshops. The inability of woodwork technology education lecturers to operate the DCSM in delivering practical class lesson could be attributed to inadequate experiences or competencies in using DCSM and woodwork workshops employers (master craftsmen) are also, have lack capability to operate digital circular saw machine in their private woodwork workshops for the production of wooden constructions in mass in order to sells to their customers to get more profits.

Bakare *et al.* (2018) was of the view that: effective delivery of technology courses using computer in tertiary institutions in South-Western, Nigeria" need capacity building in for effective delivery. This implies that for woodwork technology education lecturers to be able to utilize DCSM effectively and efficiently, they need capacity building on how to operate digital circular saw machine for effective and efficient delivery of practical class with students, as well as woodwork technology education administrators for managing the digital circular saw machine successfully and also, woodwork workshops employers (master craftsmen) for conducting their many woodworking constructions operations. It is therefore, pertinent to determine the capacity building needs of woodwork technology education lecturers in NCE (Technical) Woodwork Technology Education Programme in the use of Digital Circular Saw Machine (DCSM) for effective and efficient delivery of practical skills lessons with the students in North-West States Zone, Nigeria.

1.3 Aim and Objectives of the Study

The study was designed to determine the capacity building needs of woodwork technology education lecturers of NCE (Technical) Woodwork Technology Education Programme in the North-West States, Nigeria. Specifically, the study determined the:

1) Capacity building needs of woodwork technology education lecturers on ripping operation with digital circular saw machine.
2) Capacity building needs of woodwork technology education lecturers on cross-cutting operation with digital circular saw machine.

3) Capacity building needs of woodwork technology education lecturers on mitre-cutting operation with digital circular saw machine.
4) Capacity building needs of woodwork technology education lecturers on rebating operation with digital circular saw machine.
5) Capacity building needs of woodwork technology education lecturers on grooving operation with digital circular saw machine.
6) Capacity building needs of woodwork technology education lecturers on trenching operation with digital circular saw machine.
7) Capacity building needs of woodwork technology education lecturers on chamfering operation with digital circular saw machine.

1.4 Significance of the Study

The study would be of benefit to the following bodies' woodwork technology education lecturers, woodwork technology education workshops personnel, students, National Commission for Colleges of Education (NCCE), National Board for Technical Education (NBTE) and woodwork workshops employers (master craftsmen).

The findings for this study would benefit woodwork technology education lecturers, as it will reveal areas where they are deficient while operating digital circular saw machine and hence need capacity building in such areas and invariably improve their teaching skills using digital circular saw machine on basic operational skills such as: ripping, cross-cutting, rebating, chamfering, mitre-cutting, trenching and grooving operations.

The findings of this study would benefit woodwork technology education workshops personnel which includes: workshop attendant, workshop assistant, instructors, technologists, technicians and store keepers on the practical tasks using the digital circular saw machine so that when helping woodwork technology education lecturers in the practical instructions with students, it will reveal areas where they are deficient and hence needs capacity building in such areas are invariably improve their knowing how to carry-out chamfering, ripping, cross-cutting, trenching, grooving, rebating and mitre-cutting operations. Also, they are the personnel's have responsibility of carrying-out maintenance to the digital circular saw machine in the woodwork workshops.

The findings of this study would benefit students in their learning of how to carry-out the practical operations from the teaching of their woodwork technology education lecturers in NCE (Technical) programme as it reveals areas where they are deficient on how to operate digital circular saw machine and hence need capacity building in such areas and invariably improve their basic operational skills on how to perform ripping, chamfering, beveling, trenching, grooving, mitre-cutting and cross-cutting using digital circular saw machine. And also, benefits them on their practical projects as well as personal usage outside colleges/schools.

The findings of this study would benefit National Commission for Colleges of Education (NCCE) as it reveals areas where woodwork technology education lecturers in their Colleges of Education offering NCE (Technical) Woodwork Technology Education Programme not having the competencies/skills of using digital circular saw machine and help the NCCE in reviewing their minimum standard for woodwork technology education curriculum at NCE (Technical) Woodwork Technology Education Programme level to improve the students competencies and capabilities in this area and hence need capacity building in such areas and invariably improve their minimum standard at NCE (Technical) programme level.

The findings of this study would benefit National Board for Technical Education (NBTE) as it reveal areas where woodwork technology education lecturers in the Polytechnics offering NCE (Technical) Woodwork Technology Education Programme not having the competencies/skills of using digital circular saw machine and help the NBTE to include digital circular saw machine into syllabus or minimum standard for the students offering NCE (Technical) Woodwork Technology Education Programme and polytechnics and also, include DCSM in technical colleges syllabus.

The findings of this study would benefit woodwork workshops employers (master craftsmen) in their learning of how to carry-out the woodworking constructional processes as it reveals areas where they are deficient on how to operate digital circular saw machine and hence need capacity building in such areas and invariably improve their basic operational competencies/skills on how to perform ripping, chamfering, rebating, trenching, grooving, mitre-cutting and cross-cutting using digital circular saw machine for mass production of parts of wooden articles in a short time, in order to satisfy their customers' needs.

1.5 Scope of the Study

This study was delimited to determine the capacity building needs of woodwork technology education lecturers in the use of digital circular saw machine in North-West States. The basic skills for digital circular saw machine to be covered include: ripping, cross-cutting, rebating, trenching, mitre-cutting, grooving and chamfering operations in process of construction of wooden articles using respective digital circular saw machine and also, manually operated machine are not covered because is a well-known operational skill that is of no need for capacity building.

1.6 Research Questions

The following research questions were developed for the study:

(1) What are the capacity building needs of woodwork technology education lecturers on ripping operation with digital circular saw machine?

(2) What are the capacity building needs of woodwork technology education lecturers on cross-cutting operation with digital circular saw machine?

(3) What are the capacity building needs of woodwork technology education lecturers on mitre-cutting operation with digital circular saw machine?

(4) What are the capacity building needs of woodwork technology education lecturers on rebating operation with digital circular saw machine?

(5) What are the capacity building needs of woodwork technology education lecturers on grooving operation with digital circular saw machine?

(6) What are the capacity building needs of woodwork technology education lecturers on trenching operation with digital circular saw machine?

(7) What are the capacity building needs of woodwork technology education lecturers on chamfering operation with digital circular saw machine?

1.7 Hypotheses

The following null hypotheses were guide the study.

H_{O1}: There is no significant difference in the mean response between woodwork technology education lecturers and woodwork technology education administrators at the State Colleges of Education/State Polytechnics and Federal Colleges of Education/Federal Polytechnics on the capacity building needs of woodwork technology education lecturers on ripping operation with digital circular saw machine.

H_{O2}: There is no significant difference in the mean response between woodwork technology education lecturers and woodwork technology education administrators at the State Colleges of Education/State Polytechnics and Federal Colleges of Education/Federal Polytechnics on the capacity building needs of woodwork technology education lecturers on cross-cutting operation with digital circular saw machine.

H_{O3}: There is no significant difference in the mean response between woodwork technology education lecturers and woodwork technology education administrators at the State Colleges of Education/State Polytechnics and Federal Colleges of Education/Federal Polytechnics on the capacity building needs of woodwork technology education lecturers on mitre-cutting operation with digital circular saw machine.

H_{O4}: There is no significant difference in the mean response between woodwork technology education lecturers and woodwork technology education administrators at the State Colleges of Education/State Polytechnics and Federal Colleges of Education/Federal Polytechnics on the capacity building needs of woodwork technology education lecturers on rebating operation with digital circular saw machine.

H_{O5}: There is no significant difference in the mean response between woodwork technology education lecturers and woodwork technology education administrators at the State Colleges of Education/State Polytechnics and Federal Colleges of Education/Federal Polytechnics on the capacity building needs of woodwork technology lecturers on grooving operation with digital circular saw machine.

H_{O6}: There is no significant difference in the mean response between woodwork technology education lecturers and woodwork technology education administrators at the State Colleges of Education/State Polytechnics and Federal Colleges of Education/Federal Polytechnics on the capacity building needs of woodwork technology education lecturers on trenching operation with digital circular saw machine.

H_{O7}: There is no significant difference in the mean response between woodwork technology education lecturers and woodwork technology education administrators at the State Colleges of Education/State Polytechnics and Federal Colleges of Education/Federal Polytechnics on the capacity building needs of woodwork technology education lecturers on chamfering operation with digital circular saw.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Theoretical Framework of the Study

2.1.1 Fit theory

Edwards *et al.* (1998) developed the Person-Environment Fit Theory that focuses on the interaction between characteristics of the individual and the environment, whereby the individual not only influences his/her environment, but the environment also affects the individual. Person-Environment Fit is the degree of fit, or match, between you and your work environment. The theory behind person-environment fit is that everyone has a work environment with which they are most compatible. The idea of person-environment is grounded in Kurt Lewin's maxim, the behaviour is a function of person and environment.

The evidence that induced Fit Theory is closer to reality means that computer programs will have to be a little more sophisticated. This theory of induced fit extends the lock and key principle that Emil Fischer proposed exactly 400 years ago. 100 years "Schlussel-Schloss Prinzip": What made Emil Fischer use this analog. Edwards *et al.* (1998). Fits developed a Three-Phase Theory. This theory states that acquisition of complex skill necessitates the learner passing through three (3) overlapping phases. The three phases as follows:

(i) Cognitive phase – The learner analysis tasks and attempts to comprehend what expect and what has to be done. Procedures are described to him and frequently occurring errors are pointed out.

(ii) Associative phase – The correct patterns of response are established in the learner's repertoire as the result of practice. Inadequate movements and other errors are gradually eliminated.

(iii) Autonomous phase - Skilled acts are now performed automatically, errors have been largely eliminated, speed of performance is increased and resistance to the effects of stress is intensified.

Edwards *et al.* (1998), the fit developed a three-phase theory: the cognitive phase, the associative phase and autonomous phase in which all the three phases overlap each other in the process of acquisition of complex skills which necessitates the learner passing through them when learning the complex skills just like acquisition of basic skills such as: ripping, cross-cutting, mitre-cutting, grooving, trenching, rebating and chamfering using digital circular saw machine by the woodwork technology education lecturers. In the cognitive phase the woodwork technology education lecturers analyze tasks and attempts to comprehend the basic skills using digital circular saw machine, then move to associative phase in this phase he/she inadequate movement and other errors are gradually eliminated and moved to the last phase which is autonomous phase in which skilled acts are now performed automatically, errors have been largely eliminated, speed of performance is increased and resistance to the effects of stress is intensified.

Fits theory appears good for woodwork technology education lecturers' skills in using with Digital Circular Saw Machine (DCSM). However, the indicators of the autonomous phase such as number of errors and speed was noted in the use of Digital Circular Saw Machine (DCSM) in practical skills instruction delivery to their students in NCE (Technical) Woodwork Technology Education Programme.

2.1.1.2 Hierarchical structure theory

Hierarchy Theory was developed by Miller (1982) that focuses on levels of organization and issues of scale, with a specific focus on the role of the observer in the definition of the system. Hierarchy Theory refers to the analysis of the hierarchical levels, and the interactions between them. The most important founder of the hierarchy theory was a Herbert A. Simon, whose series of writings not only laid the foundation of hierarchy theory, but also have continued to influence its further development ever since (Smith & Sage, 1973).

A hierarchical organization is an organizational structure where every entity in the organization, except one, is subordinates to a single other entity. In an organization, the hierarchy usually consists of a singular/group of power at a top with subsequent levels of power beneath them. The hierarchical structure of the representations implies selective organization; some subsets of a figure. The results are discussed in terms of proposed theory of representation and also, distribution theory for hierarchical processes. Miller views the acquisition of skills as the progressive co-ordination of separate units of activity into a hierarchical structure. His theory is based on the concept of: Test, Operate, Test and Exit (TOTE).

The first phase of activity on which skill is based is a test. In the “Test” the learner assesses whether there is any difference between the actual state of the system and it is required state. Any observed difference requires “Operate” phase followed by a further “Test” again. The cycle of “Test, Operate and Test again” will continue until the desired state is achieved, after which activity ends (Exit Phase). The theory alienates the acquisition of skills as the integration and ordering of units of sensory motor activities. Hierarchical Structure Theory by Miller (1982): He views the acquisition of skills as the progressive co-ordination of separate units of activity in hierarchical order in which make it short as: TOTE that is, Test, Operate, Test and Exit. As in this study, the process of acquisition or building capacity needs on basic skills (ripping, cross-cutting, mitre-cutting, grooving, trenching, rebating and chamfering) using digital circular saw machine by woodwork technology education lecturers begins with testing the how to operate digital circular saw machine, then operate the digital circular machine while learning basic skills using these kind of machines, the next step is testing the operation with digital circular saw machine and lastly, exit from the acquiring this basic skills using digital circular saw machine. The theory was considered good for the instruction of skills acquisition as in this study that is, capacity building needs for woodwork technology education lecturers in the use of digital circular saw machine in North-West States, Nigeria.

2.2 Conceptual framework of the study

Capacity building is structured training activities that are intended to increase the skills and capabilities of woodwork lecturers in a defined way. Capacity building takes place after an individual begins works responsibly. Most typically, it is conducted during a break in the individual's work schedules. Thus, the trainees can draw from their work experience. Capacity building is increasingly being regarded as a strategy for effective change through education system (Aitken, 2002). It is closely linked to the introduction of new curricula. A concept can be defined as a broad principle affecting perception and behaviour; it is the most basic understanding of something, an idea that is usually technical but close to an event it represents (Ali, 2006). The word *concept* is a philosophical term that refers to "general idea".

Capacity building is related to tasks that need to be done at a given standard of performance. Capacity building is a short-term cost and long-term investment. The employer wants:

(i) Competent, confident, reliable staff.

(ii) To minimize the demand of supervision.

(iii) Expert staff that can produce quality goods and services.

(iv) Staff that can resolve job-related problems (Jarvis, 2003).

Capacity building emphasizes job skills and understandings and job specific development (Osuji, 2014). According to the model developed by Guskey and Sparks (Guskey, 2000), quality of capacity building programme depend on the content characteristics, process variables and context characteristics. Content is refers to what will be included in the in-service training programmes. In this respect, in-service training programme allow woodwork lecturers to increase their understanding of operational tasks skills and have unique construction styles. Thus, woodwork lecturers must understand how to reach or relate with such woodwork students from many different backgrounds different from their own. Woodwork lecturers may acquire assessment skills that will provide information to determine the effectiveness of their efforts (Payne & Wolfson, 2000).

Process is refers to how activities are planned, organized, carried, and followed up. In each step, following strategies should be considered: woodwork lecturers should be accepted as digital circular saw machine students while planning professional development (capacity building) activities (Ganser, 2000). The digital woodworking student is generally perceived to have characteristics that are unique. The unique qualities of the digital circular saw machine students must be recognized and special teaching and learning responses must be developed to meet their needs. According to Sander, (2001) posits that an in-service training activity for digital circular saw machine is a process which involves the whole persons as an intelligent agent in the process and that the following aspects would be regarded as "foundation stones" of digital circular machine learning theory:

(i) Woodwork technology education lecturers are motivated to learn as they experience needs and interests that learning will satisfy; therefore, there are appropriate starting points for organizing woodwork students learning activities.

(ii) Woodwork technology education lecturers' orientation to learning is life-centred; therefore, the appropriate units for organizing digital circular saw machine learning are operational tasks skills situation not subjects.

(iii) Experience is the richest resources for the digital circular saw machine learning; therefore, the core methodology of these machines is the analysis of experience.

(iv) Woodwork technology education lecturers have a deep need to be self-directing; therefore, the role of instructor or moderator in an in-service programme is to engage in a process of mutual inquiry with them rather than to transmit knowledge to them and then evaluate their conformity to it.

(v) Individual differences among people increase with age; therefore, digital circular machine must make optimal provision for differences in woodworking articles constructions styles, time, place and pace of learning, it must respect woodwork technology education lecturers' particular abilities and strengths, their subjective theories and their personal aspirations.

Professional development needs to be an ongoing process. Woodwork technology education lecturers should determine their needs and attend to new in-service training programmes related to such needs (McCarthy & Riley, 2000).

The context of capacity building activities, refers to organization, system, and culture in which the professional development, activities are implemented (Guskey & Sparks 2000). For effective professional development, woodwork technology education lecturers need to have environments where they can easily access digital machine and participate in operational tasks. Continuous support in individual, collegial, and organization level is important for achievement of optimal professional development in any context with collaborative work (Ganser, 2000). It is clear that professional development programmes can be effective, in it is implementation; there is support, not only from internal, but also from the external environment, such as: United Nations Educational Scientific and Cultural Organization (UNESCO), United Nations Development Programme (UNDP), and United Nations International Children Fund (UNICEF).

a. The context of professional development often extends beyond the digital circular saw machine. For example, state mandates, federal requirements, local policy and university programmes should facilitate woodwork technology education lecturers and woodwork technology education administrators of colleges of education professional development (Giron *et al*., 2014). Providing an environment for collaborative work between instructors, woodwork technology education lecturers and woodwork technology education administrators, is necessary for developing common goals and sharing ideas to increase the effectiveness of the professional development activities (National Staff Development Council NSDC, 2010). Context of professional development also includes collaboration between colleges of education/polytechnics and training institutions such as, universities and local education agencies (Ganser, 2000). Collaborative work among woodwork lecturers increases the woodwork technology education lecturers' and woodwork technology education administrators' as well as woodwork workshops employers (master craftsmen) ability to effectively handle digital circular machine problems and challenges (Gall & Borg, 2007).

The initial education and training workers bring to an organization are not enough to generate progress. Everybody must to be ready to adopt, apply learned information to new situations and be able to meet the changing demand of work; therefore, organization members need access to capacity building involving continuing educational and development opportunities. He subsequently, posits five essential conditions than the organization must fulfill in order to provide a culture of capacity building or continuous development; these are outlined below:

(i) The organization must have the operational plan in order to work effectively, and the implications of this plan should be well known to all employees. The aims, objectives and skills required should be clear if the organization is to be able to achieve the best possible outcome and reach it is maximum capacity.

(ii) Manager must to be able, eager, and ready to define and satisfy their employees' needs for learning that is integrated with, and support their work. Doing so, of course is not easy but in the initial efforts to establish a culture of continuous development, employees should be encouraged to suggest learning needs as they encounter them in their daily activities. In this way, the organization will be aware of it is staff's needs and can then try to meet them accordingly.

(iii) The impetus for continuous development must come from members of the top management team. They should regularly revise procedures, and consider the practical aspects of the introduction of this approach.

(iv) Learning and work must be integrated, since employees learn best from responding to the problems and challenges they face in their work. Moreover, contend that employees can multi-skill their workforce and workers can up-grade their qualification.

(v) The investment in continuous development must be regard as important as investment in research or new product development, and therefore the digital circular saw machine to support the process must be forthcoming. Whatever money spent on digital circular saw machine will not be wasted, since the goal of making such capital outlay is to help the organization and it is members (Barański & Pikała, 2017).

The policy of capacity building is intended to improve administrative skills and practices of woodworking technology education lecturers. Money spent in education, training and development, (Barrington & Woodman, 2004) should be regarded as an investment that will pay useful dividends in the future. The benefits are seen immediately, they are felt in the mind and long term. The major benefits are both the improvement of operational performance and simultaneous development of people and work.

Staff capacity building programmes, staff development programme have over the years been organized as in (Ogundele, 2001) in the form of conferences, correspondence courses, demonstration teaching, workshops, teacher orientation programmes, outreach programmes, radio or television programmes, sandwich programmes and others. The heads of woodwork technology education departments in the colleges of education/polytechnics are well positioned to encourage their woodwork technology education lecturers to take part in these programmes for self-improvement and for woodwork technology education effectiveness.

The main capacity building of instructors in Nigeria is the training they receive to up-grade their certificates just as to remain relevant as instructors in the nation's woodwork technology education scheme. According to, NBTE (2018) Ongoing staff (professional) development programme is essential for instructors to up-grade their skills and to improve instructor's quality in a rapidly changing world. (Guskey & Huberman, 2005) writing about professional development in the United States of America, emphasize the needs for reforms and the importance of instructors training to support changes. Never before, woodwork technology education has there been greater recognition of the needs for ongoing professional development of the digital circular saw machine with the mandate for to train woodwork technology education lecturers.

2.2.1 Woodwork technology education in the colleges of education/polytechnics

Woodwork Technology Education (WTE) at the NCE (Technical) programme level is the one of the programme or area of specialization under the School of Secondary Education (Technical) but, in some colleges of education the woodwork technology education programme were under School of Vocational and Technical Education. Also, NCE (Technical) Woodwork Programme under the Education (Technical) Department as currently happen in Kano State Polytechnic, but some is under woodwork technology education department as currently happen in Kaduna Polytechnic. The woodwork technology is the activity or skills of making objects from wood by woodwork craftsmen (Hornby, 2000). The objectives of the Technical Education Programme (including Woodwork) shall be:

(i) To provide Technical Teachers and Practitioners of technology capacity Basic Technology in Junior Secondary Schools;

(ii) To provide Technical NCE Teachers who will be able to inculcate Scientific and Technological attitudes and values into the society;

(iii) To provide qualified Technical Teachers motivated to start the so much desired revolution of Technological development right from the Nigerian Schools;

(iv) To prepare Technical Teachers so as to qualified them for a post-NCE degree programme in Technical Education (NCCE, 2012).

2.2.2 Ripping operation using digital circular saw machine

Rip-cut comes from rip: to split or saw timber in direction of the grain, and cut: to divide with a sharp-edged instrument. Wood may also be split along the grain (riven), but the split will follow the grain and usually not be flat. Knots also prevent riving thus the need for rip-cuts. A kerf is the opening in the wood made by the saw. The types of rip-cuts influence the quality of the timber. Plain sawn is the most common type of cut where a log is repeatedly run through a saw and much of the timber has wood grain nearly parallel to the width of the boards. As general rule, tools which work well for rip cutting do not work well for cross cutting (Lawal, 2019).

Most woodworkers thus have a table saw which is used for rip cutting, and a separate chop or mitre saw which is used for cross cutting. Cross-cut power saws should never be used for ripping a board because it is very dangerous circular saw blade designed for rip cutting have smaller number of larger teeth than smaller blades designed for cross-cutting. There are combination blades for table saws that can be used for ripping and cross-cutting but should be used for non through cuts such as: dados and rabbets. If you use a radial arm to rip you need a blade with a negative hook angle for the teeth to keep the saw from lifting the board off the saw and kicking back (Lawal, 2019).

In carrying out the ripping operation using Digital or CNC Circular saw, the characteristics of this machine are: technology circular, ripping, for extrusion lines, automatic planetary, round piece diameter minimum: 0 mm/maximum: 125 mm. The description of cutting unit of the machine

- Masfen planetary saw cuts the pipe at desired length, without any burr.
- Cutting speed during cutting is synchronous with the line speed by Programmable Logic Control (PLC), so accurate lengths are provided.
- Pipe length measures by encoder so desired length can cut Presley.

Ripping operation Standard procedure using digital or CNC circular saw:

(i) Keep all guards in place while CNC circular saw machine in operation;

(ii) While machine in operation, allow no one else to touch it;

(iii) Keep hands away from moving cutting tools;

(iv) Do not make measurements on wood while the CNC circular saw is powers;

(v) Do not allow large quantities of chips to accumulate around the work piece or machine table, use a brush or rag to remove all excess chips from the machine bed and wood;

(vi) Use a rag or Kevlar gloves to handle sharp cutting tools;

(vii) Cutting tools must be securely fastened in the machine spindle with the proper accessory. Never try to tighten cutting tools by hand;

(viii) Do not power the machine to tighten or loosen cutting tool;

(ix) Work piece and stock must be rigidly fastened to the machine bed with clamps, a vise, or special fixtures;

(x) Use appropriate speeds and feeds for the type and size of cutter being used and the wood being machined;

(xi) Make sure the cutting tool is clear of the work piece before starting the machine.

In nutshell,

- Clamp your timber on the CNC circular saw machine using fence after typing the sizes you want cut in the positiomat of the machine for cutting along the grain of wood (rip-cut);
- Then, switch ON the machine.
- The machine operates automatically by computer directive;

After the machine completed cutting it may switch OFF by the machine you switch OFF by you. And also, this standard procedure can be applied on any operations (Yang *et al.*, 2021). Some of the CNC circular saws have many cutting blades (that is, multiple saws) in which cut many timbers along the grain (rip-cut) the same time.

2.2.3 Cross-cutting operation using digital circular saw machine

A cross-cut is any cut that slices across the grain direction of the wood. So basically, making long boards shorter. The cross-cutting is the act of cutting across the grain of the wood. It is much harder to cut in this direction, than to rip cut. For this reason, cross-cutting is much slower than ripping. Cross-cut blades cuts perpendicular to the grains of the wood and requires clean cutoff without jagged edges. There are three (3) types of cross-cut saws: out of three (3) types of radial arm cross-cut saws are most common upstroke saws tend to be used in construction industry and pendulum saws are used for processing large timbers (Lawal, 2019).

When using CNC circular saw to cross-cut the circular saw/wood/with tilting blade/crosscut (Gama 65V). This machine has the characteristics of technology circular, treated wood, tilting blade, cross-cut, and table top.

The description of this machine was:

Equipment/scope of supply

- Cutting heights 90^0/245mm - 30^0/133mm;
- Machine table with lateral movement approximately 400mm with pneumatic brake system.

- Machine hood with lateral PVC protective curtains;
- Pneumatic clamping cylinder left – right;
- Pneumatic cross-cutting operation using two-hands control;
- Electrical saw blade inclination 90 - 30^0;
- Revolving table 0 – 270^0;
- Laser light for cross-cutting;
- Saw blade height adjustment via mechanical stop system with scale;
- TCT saw blade 650mm, dust extraction spigots 160/125mm;
- Drive motor 12KW
- Direct motor speed 1/minute – 3,000; and
- Saw blade speed 1/minute – 3,000.

Procedure for cross-cutting using CNC circular saw machine as:

- cutting lists are automatically optimized and can be programmed at the machine or remotely from an office;
- when straight cutting only like cross-cut is required an up stroke saw provides a very safe working system, two button operation is required to engage the cutting cycle ensuring both the operators hands are well away from the saw line;
- the wood is clamped from the above while the saw blade comes up through the wood from below the table;
- when medium to high volume cross-cutting is required an automatic saw provides key advantages;
- compared to traditional cutting methods an optimizing cross-cut saw will increase yield up to 15%, reduce labour by over 50%, reduce operator skill and

ultimately reduce costs and boost productivity while providing a 100% safe system of working (Nakajima & Hori, 2006).

2.2.4 Mitre-cutting operation using digital circular saw machine

Mitre is a joint made between pieces of wood or other materials at an angle of 90^0, such that the line of junction bisects the angle. It is called beveling when the angled cut is done on the side, although the resulting joint is still a mitre joint. For woodworking, a disadvantage of a mitre joint is, it is weakness, but it can be strengthened with a spline (a thin water of wood inserted into a slot, usually arranged with the long grain of the frame timber). A mitre joint is a joint made by cutting each of two parts to be joined, across the main surface, usually at a 45^0 angle, to form a corner, usually to form a 90^0 angle, though it can comprise any angle greater than 0^0 (Lawal, 2019).

A mitre-cutting using digital circular saw machine is almost the same procedure with rip-cut or cross-cut, only the different is the mitre-cut most tilt the mitre gauge on the CNC circular saw machine table at 45^0 to the table surface in order to cut the wood at 45^0, when you march the two mitre-cutted wood you can get 90^0. The mitre cutting is the simplest cutting operation using digital circular saw machine in which only adjust the fence at the 45^0 to the table of digital circular saw machine, then direct the computer using CAD software to control the functions and motion of digital circular saw blade to cut the wood, to produce in mass within short time.

2.2.5 Rebating operation using digital circular saw machine

Rebate or *Rabbet* is a groove or recess cut into the edge of a piece of wood. A rebate has two-sided and open to the edge or end of the surface into which it is cut. Rebate can be used to form a joint which another piece of wood (often containing dado). An example of the use of a rebate is in a glazing bar where it makes provision for the insertion of the pane of glass and putty. It may also accommodate the edge of the back panel of a cabinet. It is also used in door and casement window jambs, ship lap planking. The word *rabbet* is from old French *rabbet*, "a recess into a wall and *rabattre*" to beat down. In North-America the more usual form is rabbet; the form rebate is often pronounced the same way as "*rabbet*" (Lawal, 2019).

Rebating is mostly described as a circumferential exterior profiling of construction elements, such as: windows and doors. The term "rebating" can be historically explained as back then blind frame windows and doors with a frame thickness of 35 – 40mm were milled only with a simple rebate. Today, modern insulation glass windows and house doors are being milled by the thicknesses of 68mm (IV68) and more with at least a double rebate and seal grooves. The machine equipment can be recognized for the frame support and splinter protecting unit. The application areas for rebating were: rebating and profiling machines, angular plants for window productions and tool mills recommended with frame support.

Method of rebating operation:

- A rebate CNC router using a straight or rebate bit;
- Rabbetting or rebate plane or a shoulder plane;
- Circular saw with multiple passes (depending on width and depth);
- Dado set in a single pass;
- Spindle moulder;

- Hand saw and chisel; and
- Jointer equipped with a rabbet ledge.

But in this study, the rebating operation by using CNC or digital circular saw with passes machine is going to be considered. The same procedure as in ripping and cross-cutting operation, the only different is on the depth of cutting saw adjusted to the desired length of cutting rebate.

2.2.6 Grooving operation using digital circular saw machine

A groove is an indentation or rut in something like the grooves in an old record. Groove is rooted in an Old Dutch word for “Furrow” or “Dutch”. And that is just what a groove is a carved out like wheel ruts in a muddy road or the narrow opening that a sliding door moves in.

Grooving and rebating almost the same way of cutting the only different is that, grooving is the cutting recess along the grain direction of the wood as stated above like: recess of sliding window or door that is, the recess in which the glass of doors or windows moving left to right or right to left direction. While, rebating the process of cutting recess across the grain directions of the wood such as: joint of the window or door frames between stiles and rails. This indicate that, the method or process of cutting groove almost the same thing with rebating operation, that is when you follow the procedure of using digital circular saw machine of cutting rebate across the grain, then in the groove cutting along the grain direction of the wood (Lawal, 2019).

2.2.7 Trenching operation using digital circular saw machine

A trench is a type of excavation or depression in the ground that is generally deeper than it is wide (as opposed to a wider gully, or ditch), and narrow compared with it is length (as opposed to a simple hole or pit. In woodworking, a dado (US and Canada), housing (UK) or trench cut into the surface of a piece of machinable material, usually wood. Dados are often used to be often used to affix shelves to cabinetry bodies. When viewed in cross-section, a dado is cut across, or perpendicular to, the grain and is thus differentiated from a groove which is cut with, or parallel to the grain. Similar to the dado is *rabbet* (rebate) (Lawal, 2019).

There are two main forms of trench or dado as: A through dado, stopped dado and half dado. The through dado involves cuts which run between both edges of the surface, leaving both ends open. While, a stopped or blind dado ends before one or both of the cuts meets the edge of the surface. Then, last one is half dado which is formed with a narrow dado cut into one part, coupled with a rebate of another piece. This joint tends to be used because of it is ability to hide unattractive gaps due to varying material thicknesses (Charles, 2005).

Digital circular saw machine use when trenching or dado-cut which is the same procedure or process use with rebating procedure of operation, the only different with rebate, trench-cut is deeper than rebate cuts. The way of adjusting the CNC circular saw blade is the process of separating trenching and rebating operation.

2.2.8 Chamfering operation using digital circular saw machine

Chamfer is a transitional edge between two faces of a wood. Sometimes means a form of bevel, it is often created at a 45^0 angle between the adjoining right angled faces. Chamfers are frequently used in machining, carpentry, furniture, concrete framework, mirrors, printed circuit boards, and to facilitate assembly of many mechanical engineering designs. In machining the word “bevel” is not used to refer to a chamfer. Machinists use chamfers to “ease” otherwise sharp edges, both for safety and to prevent damage to the edges. A “chamfer” may sometimes be regarded as a type of “bevel”, and terms are interchangeably. Chamfer impacts a portion of the side of a piece of work specifically the edge of a part while, bevel is angle of the entire side of what was a squared-off part features (Lawal, 2019).

A chamfer mill can perform both operations (that is, chamfering and beveling). The two features are equivalent in both geometries, and how they are machined. A chamfer mill will create both part features in the exact same fashion; a bevel just may require multiple passes to create a large part feature. Chamfer mill, also known as a chamfer cutter which means a tool that can perform several machining operations including: chamfering, beveling, debugging, spotting and countersinking (Lawal, 2019).

In furniture-making, a lark’s tongue is a chamfer which ends short of a piece in a gradual upward curve, leaving the remainder of the edges as a right angle. Chamfers may be formed in either inside or outside adjoining faces of an object or room. By comparison, a “fillet” is the rounding-off of an interior corner, and a “round” (or “radius”) the rounding of an outside one. Chamfers are used in furniture such as: counters and table tops to ease their edges, when the edges are rounded instead, they are called bull nosed. Special tools such as: chamfer mills and chamfer planes are sometimes used (Charles, 2005).

In this study, the chamfering operation using CNC or digital circular saw going to be consider: The CNC wood circular saw uses CNC and is similar to a metal CNC mill with the following differences:

- The CNC wood circular saw typically spins faster with a range of 13,000 to 24,000 Revolutions per Minute (RPM).
- Professional quality machines frequently use a surface facing tools up to 3” in diameter or more, and spindle power from 5 to 15 horsepower. Machines capable of routing heavy wood at over a thousand inches per minutes are common.
- Some machines use smaller tool holders MK2 (morse-taper#2 – on older machines), ISO-30, HSK-63 or the tools just get held in a cullet tool holder affixed directly to the spindle nose. ISO-30 and HSK-63 are rapid-change tool holding systems. HSK-63 has begun to supplant the ISO-30 as a rapid change standard in recent years.
- A CNC wood circular saw is controlled in the same way as a metal mill, but there are Computer Aided Manufacturing (CAM) and Computer Aided Design (CAD) applications such as: ARTCAM, MASTETCAM, BOBCAD, and ALPHACAM, which are specifically designed for use with wood routers. Wood circular saw is frequently used to machine other soft materials such as: plastics.
- Three typical axis CNC wood circular saw machines are generally much bigger than their metal shop counterparts. 5’x5’, 4’x8’, and 5’x10’ are typical bed sizes for wood routers. They can be built to accommodate very large sizes up-to, but not limited to 12’x100’. The table can move, allowing for the true three axes

(XYZ) motion or the gantry can move, which requires the third axis to be controlled by two slaved servomotors.

The reasons for using digital circular saw machine in chamfering operations because for the following advantages: High degree of automation, consistent quality, high productivity, processing complex shape, and easy to implement CAD/CAM. But also, you can be using standard procedure stated under ripping operation for the cross-cutting, grooving, trenching, chamfering operation on CNC wood circular saw.

2.2.9 Digital circular saw machine/computer numerical control (C.N.C) circular saw machine

Digital is a Latin word *"digitus"*, finger and refer to one of the oldest tools for counting. When information is stored, transmitted and forwarded in digital formed. It is converted into numbers at the most basis machines level as zeros (0) and ones (1) Cambridge University Dictionary, (2020). The technology that relies on the use of microprocessors; hence computers and application that are dependent on computers. Digital technology is a base two process. Digitalized information is recorded in binary code of combinations of the digits 0 and 1, also called bits which represent words and images. Digital technology replaced analog technology. American engineer began developing digital technology in the mid-twentieth century. Their technologies were based on mathematical concepts suggested by the seventeenth century. German mathematician, Gottfried Wilhelm Leibniz, who proposed a binary computing system, his innovation inspired such numerical codes for American Standard Code for Information Interchange (ASCII) that described objects with digits (Compaine, 2011).

Digital Circular Saw Woodworking Machine is wood machine that are intended to process wood. This CNC Circular Saw machine is usually powered by electric motors and is extensively in woodworking. In relation with digital, is the circular machine using the computer to direct woodworking operations on the wood and also, well known as Computer Numerical Control (CNC) Circular Saw Machine.

CNC: Computerized Numerical Control (Computer + Numerical Control). Numerical Control is a programming automation in which process is controlled by Numbers, Letters, and Symbols. CNC Machining is a process used in the manufacturing sector that involves the use of computers to control machine tools like lathes, mills and grinders. To manufacture complex curved geometries in 2D or 3D was extremely expensive by mechanical means (which usually would require complex jigs to control the cutter motions). Machining components with high repeatability and precision. Unmanned machining operations. And also, to improve production planning and to increase productivity. To survive in global market CNC machines are must to achieve close tolerances. When it comes to digital woodworking, you can comfortably say that in 2016 we live in interesting times. There are always new options and methods being created for new ways to do things. The same is true when it comes to the machine we use. When you add digital circular saw, the evolution moves more quickly. In the last 18 months or so, we have seen several companies begin to offer CNCs that are well designed and sized right for woodworking tasks in small workshops. Since digital machines are still new to many woodworkers, we thought we did wrap up 2016 with a look at the state of digital woodworking hardware (Samaila & Aminu, 2021).

The new CNC circular saw machine designs for woodworkers have been introduced by Legacy Woodworking Machinery. They offer CNCs in interesting configurations that are well suited for woodworking tasks. From 24” x 60” to 32” x 72’ and more. These are great sizes for furniture making with a lot of thought put into woodworking friendly features such as over travel so you can clamp work on the end of the table, adjustable beds or a four axis for rotation for CNC turning. Digital Circular Saw is still something of a new idea for a lot of woodworkers. Through this blog for popular woodworking, possible future print articles and our own blog site at: woodworking digital, early in 2017 we will continue to introduce basic concepts, ideas, equipment and methods. But, once that foundation is laid it would not all be about introductions. Woodworkers want practical uses, projects, techniques and examples of ways to put these tools to regular work.

The differences between CNC Machines Tools and Conventional Machine Tools. In terms of constructional details basically, conventional machine have 2 axes, known as X and Y axis. There is also a Z axis long which only the bed moves vertically. The spindle along with the machine body does not move as it is fixed with the machine body. But in case of CNC machines, there minimum of 3 axes with spindle moving parallel to Z axis. CNC machine all look over proportioned when compared to the conventional machine. The structure of the CNC machine is therefore designed to cope with the tortionals forces and heavy duty cutting imposed on these machines (Seminar Report, 2015).

CNC Circular Saw Machinery is of various types. Solid timber machines include edge-profiling machines such as tenoners, moulding machines and CNC profiling machines such as “Point-to-Point” and “Routing” Machines. Profiling Machinery is generally used in the solid timber furniture, stair making, window, and joinery and door sector. In Australia the most used CNC profiling machine is the CNC "Point-to-Point" machine, or Processing Centre.

A circular saw is a power-saw using toothed or abrasive disc or blade to cut different materials especially wood using rotary motion spinning around an arbor. A whole saw and ring saw also use a rotary motion but are different from a circular saw. Circular saws may also be loosely used for the blade itself. Circular saws were invented in the late 18th century and were in common use in sawmills in the United States of America (USA) by the middle of the 19th century. A circular saw is a tool for cutting many materials such as: wood, metal, plastic and masonry and may be hand-held or mounted to a machine. In woodworking the term "Circular Saw" refers specifically to the hand-held type and the table saw and chop saw are other common forms of circular saws. "Skil" and "Skil saw" have become generic trade marks for conventional hand-held circular saws (Samaila & Aminu, 2021).

Circular saw blades are specially designed for each particular material they are intended to cut and in cutting wood are specifically designed for making rip-cuts, cross-cuts, mitre-cuts or a combination of both. Circular saws are commonly powered by electricity, but may be powered by a gasoline engine or a hydraulic motor which allows it to be fastened to heavy equipment, eliminating the need for a separate energy source. There are different types of circular saw blades as: abrasive saw, biscuit joiner, brush cutter, carbide saws, cold saw, concrete saw, and flip over saws (the combination of a compound mitre and table saw) (Samaila & Aminu, 2021).

Originally, circular saws in mills had smaller blades and were used to re-saw timber after it passed through an "up and down" (muley or sash) saw leaving both vertical and circular saw marks on different sides of the same piece. These saws made it more efficient to cut small pieces such as lath. After 1813 or 1822 saw mills use large circular saws, up to 3 metres (9.8 feet) in diameter. Large saws demand more power than up and down saws and did not become practical for sawing timbers until they were powered by steam engines. They are either left or right-handed, depending on which side of the blade the plank falls away from. But, due to the changing situation of technological rapid development brought the circular saw machine with digital technology or Computer Numerical Control (CNC) that is, using computer containing prepared instructions or programme (software) such as: Computer Aided Design (CAD)/Computer Aided Manufacturing (CAM) to control the functions and motions of the circular saw machine operations, such as: ripping, cross-cutting, mitre-cutting, rebating, grooving, trenching and chamfering of woodworking constructions processes.

The history of CNC Woodworking Machinery traced from the American Electronics Industries Association (AEIA) describes Numerical Control (NC) as "A system in which actions are controlled by the direct insertion of numerical data at some point. The system must automatically interpret at least some portion of this data". The McGraw-Hill Multimedia Encyclopedia describes CNC as "The method of controlling machines by the application of the digital electronic computers and circuitry". Put simply, NC and CNC are processes where machine functions are controlled by letters, numbers and symbols that the machine interprets mechanical actions.

NC control come about as a result of the American Military Aircraft Industry (AMAI). The Second World War the United States (US) embarked on the development of jet aircraft. It was soon apparent that the faster aircraft required more complex and demanding parts.

Conventional means of manufacturing were falling short of the required tolerances and a faster, more accurate method of parts manufacture was needed.

During the late 1940's John Parsons was working on a system where punched cards containing position data controlled a machine tool. The idea was to machine flat templates to check the contour of helicopter blades. Parsons submitted his idea to the U.S Air Force in 1948 and was awarded a development contract with the University of Massachusetts (MIT) servo mechanisms laboratory the following year. During the next three years, a conventional milling machine was fitted positioning, servomotors for three axes within the Cartesian co-ordinate system.

The machine demonstrated in 1952 looked very similar to modern-day single spindle CNC routers. Different were the banks of computer consoles needed to drive the servomotors, almost equal in area to the machine itself. All this was driven from a punched paper tape, and became known as Numerical Control (NC). Computer Numerical Control (CNC) circular saw was not to follow until IBM developed the personal computer.

Development in woodworking industries began in the mid 1960's with the first pressure beam saw, and a few years later there Ekstrom Carlson Company offered the first NC router in the U.S.A. The Japanese Heian Company developed it is first NC router in 1968 and in 1969 Shoda claimed the first "Circular-Cutting" NC router. Early machines of the NC type relied solely on a punched tape. No calculations or modifications were possible. Similarly, early pressure beam saws were set by a series of BCD (Binary Coded Decimal) switches. Every time a new program was needed the switches would be manually set for each cutting pattern. NC routers using punched paper tape would need a new program and hence new tapes if any modifications were needed.

The American Thermwood Company claims the first (Computer) CNC machine, based on the Intel 8080 chip. Unlike NC, a CNC machine is able to perform some calculations such as acceleration and deceleration of the axes, and offer modifications of programs at the machine control. These early CNC routers used G-Code as a programming language and this is still used today on all CNC circular saw machine where routing is performed. It is generally not available to the operator but it is still required to control the machine servomotors.

In the early 1980’s the first “Point-to-Point” machines appeared. These were primarily drilling machines and were developed from engineering machines of the same type where the work-head rapidly moved from “Point to Point” to insert pre-programmed drilling patterns. A saw blade was often added but there was no means of simultaneous interpolation of the three axes and therefore no possibility of a routing option. Unfortunately, the terminology has stuck and now all machines of similar appearance are (in correct) referred to as a “Point-to-Point” even though they have evolved from the original concept. These machines are now referred to as Machining Centres or Processing Centres.

CAM and other software that is needed for digital circular saw, several complete digital projects are already planned, including of all things, a new work bench designed for hand tool woodworking that is partially made with digital machines. These machines used a proprietary controller and software, and created a situation where program developed for one machine brand could not be used on another. This has changed and now windows-based software is used that allows the transfer of programs through generic AUTOCAD-Format Files. This is known as "Open-Architecture" and compliments the use of CAD-CAM software.

Some of the Advantages of CNC Processing or Digital Circular Saw Machine is:

(i) Reduced set-up times- this can be achieved with CNC Circular Machine. A Circular Saw Machine CNC programme (Software) can be recalled for use within a few seconds. Given that the tools and jigs can be quickly changed set-up time should be reduced to less than five minutes. An additional set-up advantage is that no checks are necessary after the program has been proved.

(ii) CNC Circular Saw Machine will eliminate pre-cutting of components. This also, will save on tool costs.

(iii) Because CNC Circular Saw tool can be set to operate at their optimum feed rate, tools will last longer. The fact that a CNC Circular Saw machine will not suffer from fatique will ensure that the tool will not burn due to reduced operator performance.

(iv) Cutting accuracy of one thousandth of a millimeter is an added bonus and the next time the job is run it will be exactly the same in specification and quality as the one processed today.

(v) Machining with digital circular saw mean that complex jigs need to be made and maintained. This requires skilled trades' persons not only to use the machinery, but also to construct the complex jigs (if at all) and these can be used even if the component dimensions are modified. There will also not be a requirement for an extensive jig storage area.

(vi) Because operators are not manually handling the jig and work-piece, there is less operator fatigue and the work-piece features cleaner working conditions.

(vii) There is usually less capital investment than for traditional machinery to do the same amount of work. A CNC Circular Saw Machine will do the work of five to eight static machines, and require considerably less floor space.

(viii) There will be a reduction in processing errors, and as a result increased customer confidence in the product. An advantage that is often over locked is the reduced handling of components made on CNC circular saw machinery. The results in less damage to parts, fewer stacks of components and a quicker production cycle.

(ix) A major function of CNC circular saw machinery is a reduced inventory.

(x) With CNC circular saw it is possible to practice the “tool-in-time” manufacturing principle. Make sell it and move on to the next job. What this means is that small production runs become more economical. Control over production is vital in knowing how much it is costing manufacturers to make the product. CNC circular saw repeatability and consistency of production can help achieve this.

(xi) CNC circular saw equipment can provide versatile manufacturing options while running smaller production lots. For instance, machining operations can be achieved into the one cycle.

(xii) Complex parts can be produced with CNC circular saw machining centres. There are numerous examples of parts that cannot be made with traditional woodworking machinery, but can be simply machined using CNC circular saw. Carved door panels are one example. Skilled wood carvers are rare in Australia, and while the CNC machine will not provide the "hand-made" look, a very classy carved finish can be achieved. The programming time may be expensive, but once the programme has been created, it is available forever.

CAD-CAM is a more recent development of the CNC circular saw technologies. Much of this development takes place due to the demands of the engineering industry but this progress is also relevant to the woodworking sector. CAD-CAM is the integration of the CAD (designing or drafting) process with the CAM (manufacture) of the component. A suitable CAD-CAM system should be considered essential when purchasing computerized machinery. In fact, CAD-CAM software is often considered an option and this sadly, limits the potential of CNC circular saw machine.

CAD (Computer Aided Design) has been used for many years with the AUTOCAD program using the market leaders. This program is used by 80% of draughts person's around the world. CAD systems are generally classified as either 2 or 3 dimensional. A 2D system draws lines on an X-Y with no height values. A 3D system allows the user to define elements in three-dimensional space, allowing the creation of 3D wire-frame models (two and a half dimension), with solid modeling (3 dimension) capabilities.

CAD programmes (softwares) are object-based graphics applications and interpret screen images as mathematical constructions that can be readily manipulated. For instance, a drawing entity (line or arc) is described as "a line from a start XY position in a certain colour and on a certain layer". This is different to painting and photographic software programmes such as the paintbrush program supplied with “Windows” software. These paintbrush programs generate bitmapped images that used coloured dots much like the pixels on a screen. Some bitmapped file types are bmp, pcx, tiff and jpg.

While, all CAD systems used object-oriented data type, the file format can differ. The file format is how the information is encoded, and for compatibility between different CAD programmes. This encoding is often provided in a neutral format, such as: HPGL (Hewlett Packard Graphics Language) and the most popular DXF (originated by AUTOCAD, stands for Data exchanges Format). A CAD-CAM programme which is unable to produce one of these files from another program, CAD drafts persons will not be able to send work to a customer who has a different CAD software programme.

The CAD programme is used mainly for drawings of geometric shapes based on lines and arcs possibly the most powerful is the “AUTOCAD” programme (or software) which in the full version costs much more than the computer itself, although a very good “light” version is available for less than a thousand dollars. Less expensive “off the shelf” AUTOCAD compatible CAD programmes such as INTELLICAD and TURBOCAD retail for a few hundred dollars. These programmes can produce drawings of the intended product three times quicker than with a drawing board. The drawing will be exact in every detail can be modified to incorporate design changes, and has the possibility of being applied to manufacture of the product. This is the CAM process. CAM (Computer Aided Machining or Manufacturing).

CAM is relatively new to woodworking industry or sector, but will become the most important manufacturing tool of future decades. CAD-CAM will become the basic technology for the factories of the future. CAM programmes take the CAM drawing to the final stage to plan, manage and control the operations of the factory through direct interface with CNC machinery.

CAD-CAM is today mainly applied through the individual machines controlled by task specific software, but the possibility is there to go beyond this narrow application and to control the whole manufacturing process. This is referred to as Computer Aided Manufacturing. And also, with this technology, the process is controlled from the part design stage through the machining of the pressure beam saw edge bander and CNC processing centre controlling parts through the entire production process is referred to as "CIM" (Computer Integrated Manufacturing).

In the CAM (Machining), process the product parts are processed into machine language that is transferred to CNC circular saw machinery as coded tool path information. These codes control the tools and movement of the equipment that is turn produces the components, usually to an accuracy of at least one hundredth of a millimetres. There is minimal operator input at the machine so semi-skilled persons can be used to load the parts on to the machine table and stack them when the process is complete. This process eliminates mistakes and speeds up the setting up of the equipment for a production run. This time is often reduced from hours to minutes, and in some cases even seconds.

Currently, the major function of CAD-CAM in Australia is in kitchen and cabinet manufacturing industry. Here CAD can be initially used as a sales tool, called as "Front-End" system. The sales person sits down with the customers and within the space of half an hour or so a new kitchen or bathroom has been designed full colour on the computer screen.

Views from any angle complete with light and shade, reflection, kitchen utensils and furniture, and even views through open windows are available to entice the customer into a purchase. Recent developments include a virtual-reality walk through. A front-end system will produce photo realistic pictures and cutting lists, but may be able to produce any NC machine codes.

A front-end system can be upgraded to a manufacturing aid with the function of an optimizing program. A good optimizer will be able to produce detailed cutting lists of all parts required for the job. In addition, a waste percentage, amount of edging required, time to complete and production costs may also be calculated. The optimized cutting patterns can be downloaded to the computer-controlled panel saw for immediate processing. Optimizing software needs to be purchased from an industry supplier, and is not usually available as a retail product. As an optimizer is an aid to manufacturing, it is in fact a CAM programme. There are some front-end CAD programmes that offer optimizer as an option, but they are usually very basic and do not provide many benefits.

The optimizer output can be set for maximum part recovery, which may require the sheet to be turned during cutting. The recovery can alternatively be set for the fastest possible cutting speedy where maximum recovery per sheet ignored. Either way, the costs are accurately established before the customer gives the go-ahead, and production begins. A good optimizer can cost over thirty thousand dollars, but time and material savings which can be recouped within a few months of purchase, offset this. After the part has been cut, the machining information can be applied through a CAD-CAM program supplied by the machine manufacturer.

The most common applications in Australia have been the REVERCAD and ASPAN programmes are also mainly focused on manufactured board. The parts are drawn on the computer and the machining processes applied. These processes such as drilling, routing and sawing processes and on recent machinery such as edge banding and sanding, the optimized machine codes are then sent to the machining centre, where modifications can be made usually however, the programs are ready to run and need little if any modification. For parts manufactured in solid wood, such as solid timber furniture, program such as "PATHTRACE" and "PROCAM" can be used to produce three dimensional drawings.

A tool path is then generated which is converted into machine code. This process is called "POST PROCESSING". A CAD drawing from this software can be post processed to run on any CNC circular saw machine. The most common linear and circular motion commands that are modified during the post process stage to suit the specific tooling requirements of the machine. Where skilled persons operate these programs, the output of the machine can be doubt!

Digitizing or scanning can develop machine code. A digitizer is an electronic tablet available in various standard paper sizes. The part drawing is placed on the tablet and a stylus or puck is used to identify key points on the drawing. Digitizing is a quick method of programming parts from a sample drawing or trace. A digitizer can be a handy tool and for around a thousand dollars can offer the manufacturer another programming alternative.

Scanning can be performed with the hand held or flatbed scanners, the resulting bitmap image converted into vector (CAD) image, then edited to smooth out crooked lines and eliminate unwanted ones. Scanning may require a fair amount of time-consuming editing to

“Clean-Up” the image. Scanners are used extensively in the sign-writing industry where the machine code is sent to flatbed routers that use drag-knives to cut lettering.

A further element of the CAD-CAM process is the ability to schedule the production. This can be done with a job scheduling program that may cost as little as a few thousand dollars. A calendar shows that schedule for each work centre (machine) in the factory and a summary of the hours required for each job. These programmes are difficult to get working properly as they do not allow for any programmes or unforeseen circumstances that do arise from time to time. Generally, the people who used them say that they give target to work towards and can be efficient production aid.

The European perception on furniture manufacturing varies depending on personal observation, acquaintances and what persons with vested interests want you to believe. The brief snapshot presented derived more from published literature, reports, and media, and what European involved in the furniture manufacturing industry itself has consistently reported. A 2002 Gottestein Fellowship Report “Improved high value-added furniture manufacturing in Australia using Computer Numerical Controlled (CNC) equipments by Philip Ashley has been used to provide some background.

A long and successful history can describe the European Furniture Industry. Museums throughout Europe house many fine pieces and these are now regarded as examples of fine art. Fine designers and craft persons such as Chippendale, Sheraton and Boulle are universally regarded. In the post second world war period the demand to re-build Europe drove the building and furniture industries, and mostly local crafts persons made furniture.

Many of the world's leading furniture makers and machinery manufacturers are located in the Continental Europe.

In the 1960's an economic boom saw the furniture industry successful primarily in replacing old products. Up until the 1970's Italians in particular continued to dispose of valuable furniture pieces, replacing them with the latest "fashion". Mass production furniture companies prospered, often at the expense of quality and taste. The 1970's saw a boom in kitchen, the latest electric appliances and a change in lifestyle from small workspaces to entertaining areas as the production of the "American style kitchen.

In the 1980's the cost of raw-materials increased, and many of the furniture companies of the 1960's had disappeared, replaced with enterprises that were able to adapt to changing market demands. Design, marketing and sponsoring were new tools that made all the difference companies specializing in one type of furniture production used improved technology to develop a flexible production based on smaller orders. The 1990's saw the introduction of regulations in product and machinery. New materials, fittings and manufacturing technology were the driving factors.

The European industries is similar to Australia in that a high percentage of machines are of the three-dimensional axis type and are used in industries employing less than twenty persons. Similar to Australia is the impact of imports from countries with low labour costs, able to supply low-cost product to a consumer market where cost, the latest design and shorter furniture "Lifespan" are current issues.

Woodworking machinery was developed mainly in Germany from the mid-1960s when the major suppliers were established. Italian companies followed some ten years later while, British Manufacturers have disappeared, and machinery is now made in Spain, Scandinavia and some Eastern Countries (Due to the low cost labour). The introduction of manufactured boards created a need for new machinery and processes and many of the early "Craft" skills have gone to artisans or companies fulfilling the needs of niche markets. CNC circular saw processing machinery is widely used in Europe to improve production of a range of wooden items in the furniture and related industries. CNC circular saw manufacturing provides opportunities to improve flexibility, quality, short delivery times, operator safety and control over the end product.

CNC circular saw machinery is used in most every type of solid wood manufacture. Furniture (Tables, Chairs, Bedroom and Lounge), stairs, entry and cabinet doors, joinery and window production are some of the examples. Companies using with CNC range from the largest companies employing one thousand people to small local enterprises with less than ten employees. Some of the largest factories can be found in Germany, Italy and Spain. Automated production lines produce furniture using CNC circular saw machinery and automated production and assembly systems, manufacturing up to a million (Australian) dollars of product per week (Susnjara, 2010).

Hands-free cutting, drilling, carving, and engraving at the push of button. Jim Harrold with Computer Numerical Control (CNC) circular saw consultant Steve Stevenson. Working with wood can take any number of directions and is often impacted by advances in technology. Most recently, the use of CNC circular saw and laser engraving machines has gained notice among those with a penchant for creative design using wood and other materials. The lowering prices in shop machines and hand tools, or serve as the primary machine in some small business venture. Here, the researcher will walk through the pros and cons of computer generated woodworking for the home shop and briefly explain how CNCs of circular saw and laser engravers works. It will introduce you to few entry level models and show off the kinds of wow factor projects you can create with a simple push of a button.

Prior to the 1870s, hand tools made up the arsenal used by woodworkers for cutting and shaping wood. Stationary line shaft operations were in existence then, relying on water wheels and windmills to power saws and boring machine via fly wheels and leather belts. These occupied the floors of wood and metal working production shops, not those belonging to small time cabinetmakers and woodworkers.

Enter the age of the foot-powered machines, (treadler, pedal, and sometimes hand driven) that allowed individual woodworkers or small production shops to purchase selected tools to save time while increasing production and precision. They could purchase a scroll saw, table saw, mortise and tenon machine, shaper, band saw, or lathe, and work with wood (while getting company excelled at making such machines for professionals and the burgeoning class of hobbyists).

In the 1920, with electricity at hand, electric motors took hold a real game changer which drove foot powered machines to the bone yard. Woodworkers witnessed the development of stationary power tools and the hand held (corded) electric drill, router, and sander. More freedom came in 1961 when Black and Decker first introduce handhold drills that basically cut the cord and ran off batteries, fast forward to the latest advances in woodworking.

Computer directed CNC circular saw machine and laser engravers. You start with a design idea one developed using Computer Aided Design (CAD) software, an imported photo or a design you purchased. The software converts the image to gray scale to determine the depth of cut. Then, you transfer it to the CNC circular saw and set up the machining parameters, with the CNC circular saw spindle axes established, you insert the work piece and push the "ON" button to activate the machining and a process akin to an easy brake oven. In short order, the project is complete.

2.2.10 Direction of axis cutting diagram for computer numerical control (CNC) machine

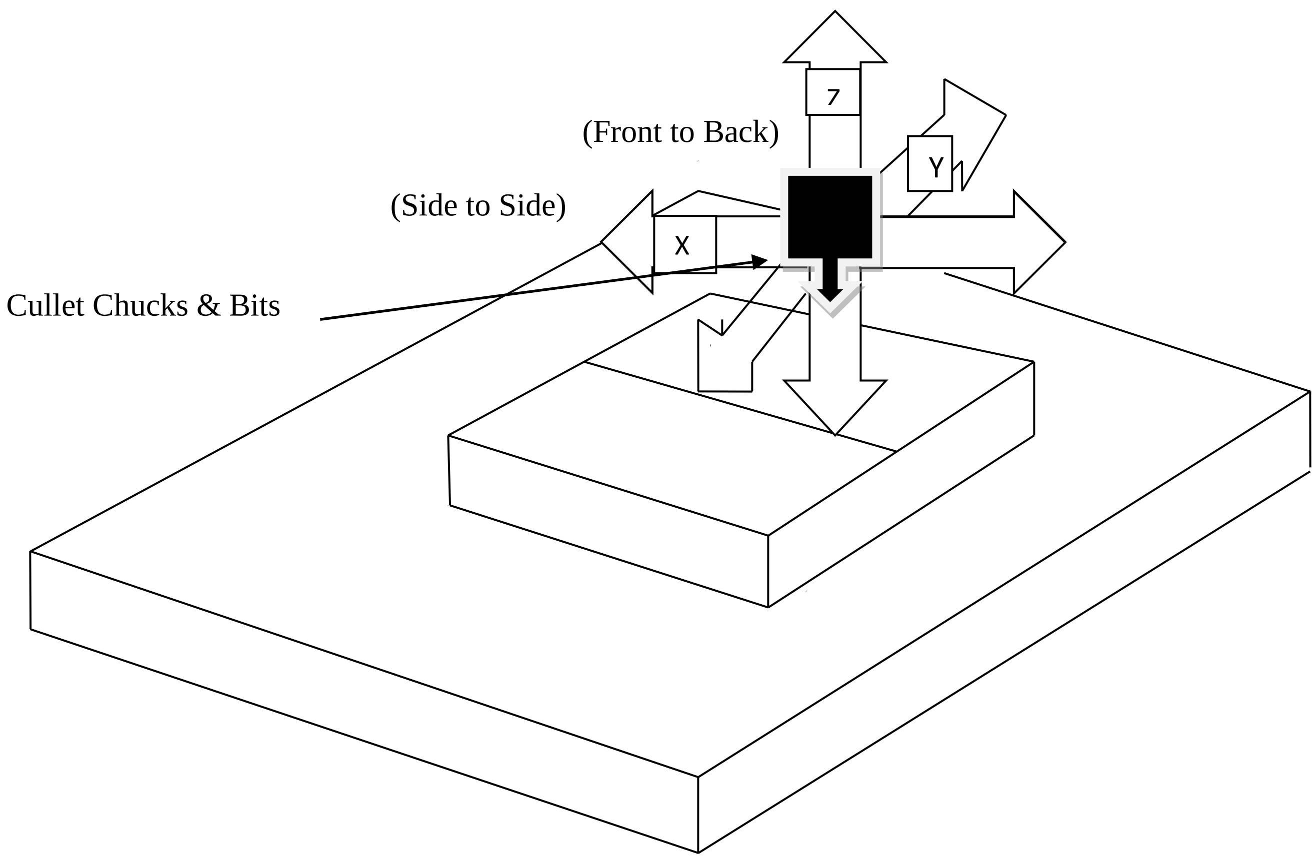

Figure 2.1: **Axis Cutting Direction**

CNC is an acronym for Computer Numerical Control. It is the name given to a machine containing a spindle or router that receives its fabricating marching orders from a computer such as a laptop or desktop unit containing CAD (Computer Aided Design) software. In a CNC Circular Saw Machine depending on the models ability, software, and accessories, these orders direct the spindle to cut (typically, up to ¾" deep), carve, drill holes, and shape a work piece along various axes (from three to five), according to the intended design.

The design can be originated from the woodworker using software such a design CAD, CorelDraw, TURBOCAD, or some proprietary programme developed for the CNC Company. You can also cut to the quick by importing a purchased project design may call for the CNC to cut all of the parts of a project, or having made the parts with conventional woodworking tools, may just want a single part in your project a feature a CNC circular saw embellishment or relief something like a box lid or front.

In any case, the woodworkers work with the CNC circular saw to establish the axes coordinates, which translates into the movement of the spindle and a selected bit, with entry-level 3-axes machine, as shown in the figure 1 above, the X-Coordinates represents the side movement, and Z, the Up and down movement or depth of cut. Higher priced step-up CNCs offer up to 5 axes meaning a move complex and capable machine, added is a circular axis that allows for the rotation of the work piece, such as a turning or other round item during machining.

The remaining axis tilts the work piece. Together, the 5 axes allow you to create something as sophisticated as a tapered table log with a rope twist from top to bottom. Anything from plaques to boxes to bowls and furniture, It helps you to make signs, create precise inlays, cut out perfectly fitting project parts and take on projects you avoided because you lacked the carving skills or tools. You should step up to a more expensive 4-axis or 5-axis machine (not shown here). You will increase your capacity even further.

Finally, because a CNC circular saw spindle so closely resembles a router (in fact, some low-end CNC circular saw, use a router), the materials you can machine and identical. They include wood, plywood, wood veneer, composite wood materials, plastic laminate, acrylic, and thin metal. CNC circular saw, it receives its marching orders from a computer's design software programme. Set-up is just like installing a printer, with the engraver's capacity limited by the size and parameters of the machine, wattage, and design constraints of the project, with lower powered entry level models cutting (or burning through) wood or sheet goods that measure 1/4" thick or less. The X, Y and Z coordinates still apply. One major difference lies in the extra ordinary detail in the outlines and engravings rendered by a laser engraver.

The cut or engraved edges, however, display a dark wood burned look. Unlike, CNC it is really a laser engraver can run even higher than a CNC machine, something to consider when looking at how and how often you intend to use the machine, whether for a hobby or for a cutting and engraving business.

To use the laser engraver, your computer, here, you establish the page size to match the size of the piece to be engraved. Then you either use a design, such as photo or illustration. At this point you send the image to the laser engraver and set-up the printing, engraving, or cutting parameters. Finally, you place your work piece in the engraver, select your file and hit "GO".

The basic set of CNC circular saw spindle bits. Essentially router bits allow creating different cuts and profiles. They include (from top) 1/8" and ¼" down spiral bits for through cutting 90” and 60” V-bits for 3-D carving, a 1/8” and mill bit for clearing, and a 1/13” conical V-bit for fine detail.

CNC circular saw offer a lot of advantages over traditional woodworking though some may not like the manufactured (versus the hand tooled) look of the end product. These include spot on precision, production speed, repeatability in making identical parts, safe hands-free machining, and the engagement to be more creative with project designs.

The down side includes machine and set-up costs, as well as the learning curve and time it takes to become proficient in CAD software. However, by using designs provided by the maker or a purchased design found online you can be machining in an hour or two. That is, likely the best way to go when first delving into CNC circular saw woodworking machine.

NOTE**:** that the manufacturers provide extensive educational service and technical support to help you achieve various tasks or designs. Be sure to inquire about such support and compare the services available from maker to maker.

CNC circular saw machine allows the application of decorative carvings, or 3-D design accents on the kind of projects typically cut with an entry-level laser may include architectural models, puzzle parts, or small items such as key chains and name plates. Materials, cork, acrylic, leather, cloth, matboard, melamine, paper, mylar, pressboard, rubber, fiber, glass, plastic, corian, and metal.

Laser engraving is where most of the action lies with this machine, design of all kinds and types can be applied to plaques and signs, pet urns, ornaments, picture frames, gunstocks, knife handles, plaques, and countless other items. In addition to the previously mentioned materials for cutting, a laser engraver can engrave a cyclic, glass, coated, painted and bare metals, tile, ceramics, marbles and rubber.

Materials you can cut and engrave with a laser engrave range from wood to metal to glass and cyclic. Some of the CNC Machines are: Numerical Control Technology as it is known today emerged in the mid-20th century. It can be traced the year of 1952, the US Air force and the names of John Parsons and Massachusetts institute of technology in Cambridge, MA, USA. The difference between Numerical Control (NC) circular saw machine and Computer Numerical Control (CNC) circular saw machine both perform the same functions, as manipulation of data for the purpose of machining a part. In both cases, the internal design of the control system contains logical instructions that process the data. At this main point the similarity ends.

NC circular saw machine system (opposed to the CNC circular saw machine system) uses fixed logical functions, those that are built-in and permanently wired within the control unit. These functions cannot be changed by the programmer or the machine operator. Because of the fixed writing of the control logic, the NC control system can interpret a part program, but it does not allow any changes must be made away from the control, typically in an office environment. Also, the NC circular saw system requires the compulsory used of punched tapes for input of the programme information.

The modern CNC circular saw machine system, but not old NC circular saw machine system, uses an internal micro-processor (that is, a Computer). This computer contains memory registers storing a variety of routines that are capable of manipulating logical functions. That means the part programmer or the machine operator can change the program of the control itself (at the machine) with instantaneous results. The flexibility is the greatest advantage of the CNC circular saw systems and probably the key element the contributed to such a wide used of technology in modern manufacturing.

The CNC circular saw programmes (software) and the logical functions are stored on special computer chips, as software instructions. Rather than used by the hardware connections, such as wires, that controls the logical functions. In contrast to the NC circular saw machine system, the CNC circular saw machine system is synonymous with the term 'softwared'.

If the CNC circular saw and the conventional machining processes are compared, a common general approach to machining a part will emerge the following:

(i) Obtain and study the drawing.

(ii) Select the most suitable machining methods.

(iii) Decide on the setup method (work holding).

(iv) Select the cutting tools.

(v) Establish speeds and feeds.

(vi) Machine the part.

Some of the major areas where CNC circular saw user expect improvement:

(a) Lead time reduction.

(b) Accuracy and repeatability.

(c) Set-up time reduction.

(d) Consistent cutting time.

(e) Contouring of complex shapes for instance using CNC wood lathes.

(f) Simplified tooling and work holding.

(g) General productivity increase.

The following are some of groups or classification or types of CNC circular saw machine tools are:

(a) Lathes and turning centres (horizontal and vertical types having X & Z axes).
(b) Drilling machines.
(c) Mills and machining centres (using X, Y & Z axes).
(d) Boring mills and profilers.
(e) Punch presses and shears.
(f) Electrical Discharge Machining (EDM) machines.
(g) Flame cutting machines.
(h) CNC routers.
(i) Laser profilers and water jet.
(j) Welding machines.
(k) Cylindrical grinders.
(l) Benders, winding and spinning machines and so on.

CNC circular saw machine programmer and CNC circular saw machine operator are the personnel for CNC circular saw machine tools also, may be carried out by one person. Wood routing machines electronics basic components as: stepper motor, limit switch and home switch, emergency bush button, opto couplers, L298 dual full H-bridge driver, L297 stepper motor controller IC and power supply. The major components related to CNC wood router machine tools are: part program, program input device, machine control unit, machine tool, feedback system and drive system. Power drives two (2) main types are: Electrical- AC, DC or stepper motors and Fluid- hydraulic or pneumatic. Generally, in CNC usually stepper and servo electric drives were used.

Stepper motor is a purse driven motor that changes angular position of the rotor in steps which is widely used in low cost, open loop position control systems. The stepper motor divided into two classes as: firstly, Permanent magnet- employs permanent magnet, low speed and relatively high tongue, secondly, Variable reluctance- does not have permanent magnet and low tongue.

Servo motors are special electromechanical devices that produce precise degrees of rotation. It may be DC or AC or brushes, DC motors combined with position sensing device. It is also called CONTROL MOTORS as they involved in controlling a mechanical system. It is used in close-loop servo system.

Linear motion drives are mechanical transmission systems which are used to convert rotary motion into linear motion. CNC machines generally employ ball screw for driving the work piece carriages. Hybrid Stepper Motion formula as: Step Angle is equal to 360^0 over number of poles. A group of commands given to the CNC for operating the machine is called the PROGRAM. The two (2) ways to program modern CNC machine tools are: conventional programming and CAM programming. The following are CNC codes: N-CODE, G-CODE, F-CODE, S-CODE, T-CODE, M-CODE, I, J & K-CODE and X, Y, & Z.

This study is about 3D wood CNC routing machine with 3 axes. It will have mechanical structure have the capability to move in the three axes which are X, Y, and Z axis. Driving the spindle in this axis will cause the working piece to be routed. There will be electronics attached to the structure to drive it. These electronics will handle the electrical signals came from the numerical controller (computer) to drive the structure.

CNC Wood Router Machine tool in which do some of the CNC Circular Saw Machine tool whose paths can be controlled via computer numerical control. It is a computer-controlled machine for cutting various hard materials in which wood included. It is one of the many kinds of tools that have CNC variants. A CNC wood router is very similar in concept to a CNC milling machine. CNC wood routers come in many configurations, from small home-style “DESKTOP” CNC wood routers to large “gantry”, it is used in boat-making facilities. Although there are many configurations, most these machines have a few specific parts a dedicated CNC controller, one or more spindle motors, AC inverters, and a table.

Generally, CNC routers are available in 3-axis and 5-axis CNC formats. It is run by a computer-coordinates are uploaded into the machine controller from a separate program. CNC wood router owners often have two software applications are: first program to make designs (CAD) and second program is to translate those designs into a program of instructions for the machine (CAM). As with CNC milling machines, CNC wood routers can be controlled directly by manual programming, but CAD/CAM opens up wider possibilities for contouring, speeding up the programming process and in some cases creating programs whose manual programming would be, if not truly impossible, certainly commercially impractical. These CNC wood routers can be very useful when carrying out identical, repetitive jobs.

It is typically producing consistent and high-quality work and improves factory productivity. Also, these kinds of machines reduce waste, frequency of errors, and the time the finished product takes to get to market. It gives more flexibility to the manufacturing process. It can be used in production many different items, such as interior and exterior decorations, door carvings, wood panels, wooden frames, sign boards, mouldings, furniture, musical instruments, and so on. In addition, the CNC wood router makes thermo-forming of plastics easier by automating the trimming process. It also helps to ensure part repeatability and sufficient factory output (Mo, 2001).

The structure of CNC wood router has the ability to move on the three directions X, Y, and Z axes. The element that will be responsible of routing the wooden piece is the spindle motor. This motor will be installed on the Z axis of the machine. Z-axis movement will do by a power screw attached to a stepper motor. That power screw will convert the rotational movement of the stepper motor into linear movement towards the (+) Z or (-) Z-axis depending on the direction of the stepper motor rotation. The Z-axis will be installed on the Y-axis of this machine, the whole structure of the axis will move along the Y-axis. The Z-axis structure screw will be attached to another stepper motor.

At the same way, the whole structure of the Y-axis will move along the X-axis. So, installed a power screw and attached a third stepper motion to it. At the end the mechanical structure is ready to be moved in the three (3) axes. The movement of the structure will be in responsible to the rotational movement of the stepper motors and screw attached to it. The displacement of each axis depends on the lead value of the screw we used. Lead value is simply the amount of axial travel that the nut will experience during one single rotation of the screw shaft.

Generally, electronics will be stepper motors to drive the structure, limit switches attached to each axis, and drive circuit to drive this machine. The drive circuit will contain an integrated circuit to the drive the stepper motors, opto-couplers to isolate the numerical controller (computer) from the drive circuit, and other components. Also, there will be a relay circuit to turn ON and OFF the spindle. In addition to the power supply which will provide the required electric power to run all the electronics in the protection manner.

The types of stepper motor used in this CNC wood router is bipolar stepper motor that have one winding per phase. A bi-polar driver must rapidly reverse the current through the windings to changes polarity. We decided to drive the stepper motor in dual coil full step mode. The method of stepping the motor energizes both phases constantly to achieve full rated torque at all positions of the motor.

Limit switches are used to prevent any linear axis from the moving too far and causing damage to the structure of this machine. You can run a machine without them, but the slightest mistakes in setting up or programming can cause a lot of expensive damage. An axis may have a home switch. Mach3 can be recommended to move one (or all) axes to the Home position. This needs to be done whenever the system is switched on so that it knows where the axes are currently positioned. If you do not provide Home switches, then you will have to dog the axes by eye to a reference position. The Home switch for an axis can be at any coordinate position, and you define this location. Thus, the Home switches do not have to be at machine zero. The repeatability of the operating point, particularly with mechanical switches, is very dependent on the quality of the switch and the rigidity of it is mounting and actuating lever.

2.2.11 Two switches operated by frame with over travel protected by mechanical stops diagram

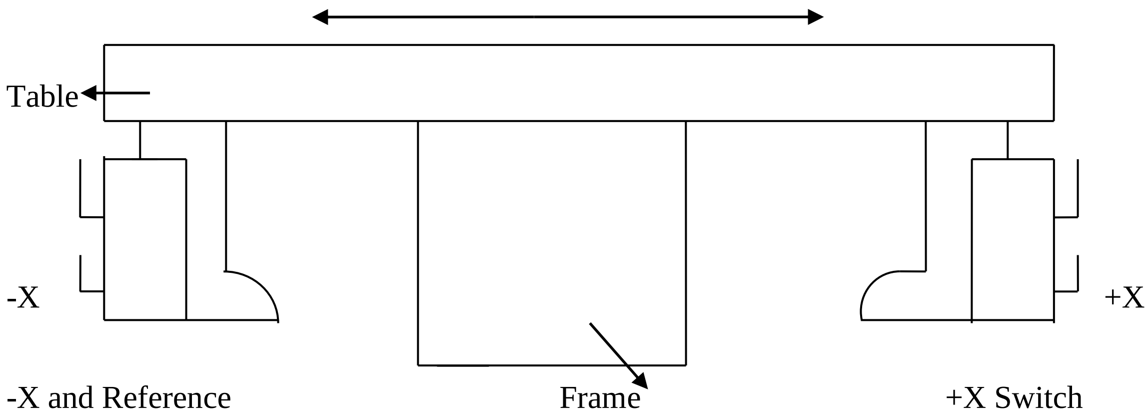

Figure 2.2: Two Switches Operated by Frame with Over Travel Protected by Mechanical Stops.

Emergency button were installed with an E-stop button to send Error signal to the computer which connected to the control panel to stop this machine, in this case an Error occurred on this machine. Opto couplers are small optical switches that isolate circuits to prevent an electrical short from the drive circuit affecting the computer. These opto-couplers will be installed between the signals coming from the computer and the integrated circuits that will handle these signals. Also, to isolate the computer from the feedback signals coming from the limit switches and the emergency stop button (Samaneh and Masoud, 2013).

L298 Dual Full H-Bridge Driver is an integrated monolithic circuit in a 15-lead watt package. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic levels and drive inductive leads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input signals. The emitters of the lower transistors of each bridge are connected together and the corresponding external terminal can be used for the connection of an external terminal can be used for the connection of the external sensing resistor. An additional supply input is provided so that the logic works at a lower voltage.

L297 stepper motor controller Integrated Circuit (IC) generates four phase drive signals for two phases bi-polar and four phases un-polar step motors in microcomputer computer-controlled applications. The motor can be driven in half step, normal and wave drive modes and on chip PWM chipper circuits permit switch-modes control of the current in the windings. A feature of this device is that it requires only clock, direction and mode input signals. Since the phase is generated internally the burden on the microprocessor and the programmer is greatly reduced. Mounted in DIP20 and SO20 packages, the L297 can be used with monolithic bridge driver such as the L298N or L293E, or with discrete transistors and Darlington.

In the case of power supply, we installed a readymade power supply to the control panel. This power supply will provide two levels of voltages to the control panel. Positive 5 volt for the integrated circuits installed in the drive circuit and positive 12 volt to provide enough power to drive the stepper motors.

One of the main functions of drive circuit is to drive the stepper motors attached to each axis. Drive circuit will take movement instructions from the numerical controller (computer) through the parallel port. These instructions are two signals, one for number of steps and remaining one for direction of rotation. Signals coming from the parallel port will be optically isolated from the drive circuit. Another function that the drive circuit should do is pass feedback signals coming from the limit switches and the E-stop button to the computer through the parallel port. Also, the feedback signals will be optically isolated to protect the computer hardware. This leads us to design the drive circuit to meet the requirement of driving the machine. By using Eagle software, we designed the schematic of the drive circuit. Next step was to design the PCB layout of the drive which is ready for implementation.

Relay circuit is a simple circuit containing a relay to turn ON and OFF the spindle on this machine. Relay coil will be energized by a normal NPN transistor (2N2222). Enable signal coming to the transistor from the parallel port of the computer which is optically isolated for protection reasons.

Finally, all the components are placed inside plastic container to protect all the elements from mechanical shocks and dust. In the process of selecting kernel speed, the Mach3 driver can run at frequencies from 25,000Hz (pulses per seconds) up to 100,000Hz, depending on the speed of your processor and other loads placed on it when running Mach3. The frequency we need depends on the maximum pulse rate to drive any axis at its top speed. 25,000Hz will probably suitable for stepper motor systems. With a 10 micro-step driver such as a Gecko 201, we will get around 750RPM from a standard 1.8-degree stepper motor with a 25,000Hz pulse rate. Higher pulse rates are needed to achieve desired motor RPM for servo drives that have high resolution shaft encoders on the motor, determining axis drive requirements.

Computers with a 1GHz clock speed will almost certainly be able to run at 35,000Hz, so we can select this if we need a high step rate. The demonstration version of Mach3 will run at 25,000Hz only. In addition, if Mach3 is forcibly closed, then on re-start it will automatically revert to 25,000Hz operation. The actual frequency of the running system is displayed on the standard diagnostics screen click the box next to the desired kernel speed.

The Digital Wood Carver also, carried-out some of the Digital or CNC Circular Saw Machine was introduced by Engineer, Burl Tichener to the woodworking and engineering industry using CNC Technology, the Digital Wood Carver can produce a variety of details including 3D shapes, V-carving and pocketing text or figures.

Geared to woodworkers, custom engravers, craftsman and sign designers, this digital wood carver includes the carving head and tables. It has board software to program art work, text or free style designs. The computerized carver moves to the exact location on the wood to make the desired design. Digital Wood Carver Cutting Head Specification:

* 2hp full size router with soft start and variable speed,

* Z axis (height) uses acm thread that can produce up to 90 inches per minutes in rapid movement.

* Spindle cam lock for bit changes.

* Optional dust collection system for keeping work area clean.

Digital Wood Carver Table Specifications:

* A large 40” multiply by 24” cutting area (x and y) with 41/4” Z –Axis.

* Harden polished chrome rods with heavy duty linear bearings. X is 1” rods, Y and Z rods ¾”.

* Precise gear tooth timing belt to drive X and Y axis.

* Up to 275 inches per minutes in rapid movement.

Digital Wood Carver Control System Specifications:

* 4 axis steppers more driver.

* Diagnostic indicator for trouble shooting.

* Fan cooled.

* Relay system which controls ON/OFF functions of the spindle and vacuum controlled by software.

* 36 bolt power supply.

Customers of the digital wood carver have experienced success within their carving creations. John Malinowski from Michigan says: “it is so satisfying designing and making stuff for this machine that I have a hard time going to sleep because thinking of interesting way to use the machine. I was working in the CNC last night till midnight”.

According to Burl Tichenor, owner and engineers: “you are only limited by your imagination and the digital wood carver creates woodworking details like near before”

The digital wood carver is available for immediate purchase through the company website: http//www.digitalwoodcarver.com

About the digital wood carver, Burl Tichenor has been a woodworker for 25 years and enjoys making individual items for those close to him. The Digital Wood Carver (DWC) was designed in order to, add unique touches and personalize projects to make them special. The Digital Wood Carver is quickly earning a reputation for allowing woodworkers and other craftsmen to create their own master pieces (Susnjara, 2012).

2.3 Review of Related Empirical Studies

Bakare *et al.* (2018a) undertook a study title: “Capacity Building Needs of Lecturers in E-Learning for Effective Delivery of Computer and Electrical/Electronics Technology Courses in Tertiary Institutions in South-Western, Nigeria”. The population for the study was all 544 lecturers, 190 electrical/electronic lecturers and 354 computer science lecturers. There were no sampling techniques due to the manageable size of the study.

The statistical tools use in analyzing data, the mean and standard deviation were used to answer research questions. Weighted Mean (WM) and Improvement Need Index (INI) were used to answer the research questions. And also, for testing hypotheses, Analysis of Variance (ANOVA) was employed for testing three null hypotheses at .05, but it was less than .05. The researcher did the analysis with the help of Statistical Package of Social Sciences (SPSS, Version 23). Lastly, the researchers found out possible barriers of effective utilization of e-teaching approach in instructional delivery by lecturers in various institutions. The mean, standard deviation and ANOVA results on possible barriers to effective utilization of e-learning approach in instructional delivery by various institutions out of 15 barriers items presented, 13 items had their means above the cut-off to effective utilization of e-learning by lecturers in tertiary institutions in South-western, Nigeria, while 2 items had their means below the cut-off point of 2.50, thus indicating that the respondents disagreed on these items as not barriers to utilization of e-teaching in instructional ranged from .59 to .78 indicating that the respondents were close to one another in their opinion. In the conclusion, the electrical/electronics lecturers have interest and ready to be using e-teaching because they perceived it as a vital tool for instructional delivery in tertiary institutions.

However, electrical/electronics lecturers possessed low or lack competencies in utilizing e-teaching platform for educational purposes. In the recommendations: The identified competency item be packaged on retraining programme and use it to organize seminars or workshops for electrical/electronics lecturers in tertiary institutions in Nigeria and other developing nations. Secondly, governments at all levels, religious institutions and individuals with enabling abilities should donate facilities or equipment that could help implementing e-teaching in colleges and schools and also, the management of each tertiary institutions should embark regular capacity building programmes in ICT-related areas to enable lecturers acquire necessary knowledge, skills, attitudes for effective utilization of e-teaching for educational purposes.

The above-mentioned study was relevant to this study because, is talking about: capacity building needs for woodwork technology education lecturers in the use of digital circular saw machine in North-West, Nigeria because, is talking about capacity building for the electrical/electronics lecturers on e-teaching approach in tertiary institutions South-Western, Nigeria. Therefore, is similar with this study because is on capacity building needs and also, on use with computer as this study is on the use digital technology. The difference with this study, is talking about electrical technology education and computer science lecturers on e-learning in tertiary institutions in southwestern, Nigeria but, this study is on woodwork technology education lecturers in tertiary institutions offering NCE (Technical) Woodwork Technology Education Programme in North-West States, Nigeria. And also, the instrument they use for their study was the statistical tools used in analyzing data; mean and standard deviation were used to answer research questions. Weighted Mean (WM) and Improvement Need Index (INI) were used to answer research question two, three and four. and also, Analysis of Variance (ANOVA) used for testing hypotheses while, this study will use with mean and standard deviation for testing instrument and also, the same with their own that is, will use with Analysis of Variance (ANOVA) will employ for testing hypotheses with help of Statistical Package of Social Science (SPSS, version 23).

Bakare *et al.* (2018b). Conducted a study on development of electro-mechanical contents in woodwork machine maintenance for capacity building of technologists in Nigerian Universities. Government of Nigeria has made a significant effort to make sure every Nigerian graduate acquires relevant skills for paid or self employment. Effort made by government recently includes provision of modern machines and equipment for improving skill acquisition among students in technical education programmes. However, effort is less in the area of capacity building of technologists to effectively utilize the machines provided for promoting skills acquisition. Based on this reason, the researchers now carried out the study to develop electro-mechanical contents for capacity building of technologists in woodwork machine maintenance in Nigerian universities. Three research questions guided the study and three null hypotheses formulated were tested at 0.05 level of significance. The study adopted descriptive research design. The area of the study was Enugu State of Nigeria. The population for the study was 203 lecturers of technical education in tertiary institutions and supervisors in relevant industries. There was no sample because of the manageable sizes of the population of subjects. A structured questionnaire titled: Electro-Mechanical Contents in Woodwork Machine Maintenance Questionnaire was used as the instrument for data collection. The instrument was validated by three experts and Cronbach alpha reliability method was adopted to determine the internal consistency of the questionnaire items while 0.84 was obtained. Out of two hundred and three copies of the questionnaire administered on respondents by the researchers, only 187 copies were duly retrieved which represents 93.03 percent return rate. The data collected were analyzed using factor analysis and mean while t-test was used to test the null hypotheses. The findings revealed that 33 contents in form of competencies were determined for capacity building of technologists, 44 instructional strategies for implementing the contents for capacity building of electromechanical technologists in Nigerian universities while 33 training facilities and procedures that could be utilized by trainers for building the capacity of technologists in maintaining woodwork machines and equipment were also determined. Recommendations include that technologists should be re-trained using the developed electro-mechanical contents in woodwork machines and equipment.

The study was relevant/similar with this study because is concerned with woodwork machine maintenance for capacity building and it has differences because the reviewed study is on development of electro-mechanical contents in woodwork machine maintenance for capacity building of technologists in Nigerian Universities while, this study is on capacity building needs for woodwork technology education lecturers in the use of digital circular saw machine in North-West States, Nigeria but differs in terms of population, study area and method of data analysis.

Odawn (2016) undertook a study title: "Capacity Building Needs of State Agency Directors in Human Resources Management in Adult Education in North-Central Zone of Nigeria". The population of the study consist all directors and deputy directors in agency of adult and non-formal education in six states in north-central, Nigeria and Abuja. There is one director from Abuja and three directors in each of the six states making 28 directors subjects. The sample for this study was 28 subjects, 7 directors and 21 deputy directors from the six states and Abuja. The entire population was used for the study due to the manageable size of the study. The data collected using descriptive and inferential statistical analysis. Mean and standard deviation were used for answering research questions, while the t-test statistics was used for testing hypotheses formulated for the study. The in-service training if carefully implemented, are hoped to improve the human resources management of the adult education agencies. The in-service needs are: skills in staff recruitment and selection, skills in orientation and induction of staff, skills in deployment to duties, skills in staff appraisal, and skills in development/in-service training of staff.

Findings of this study revealed that all the in-service needs of directors on the recruitment and selection of the staff in Adult Education are accepted as appropriate. This is because; the mean responses of the respondents in all the items range are from 2.50 and above. Moreover, the responses of the directors and deputy directors on in-service needs on recruitment and selection are accepted as appropriate because there is no significant difference in the mean responses as indicated on the hypotheses with P-Value greater than the level of significance ($P>0.05$). This finding is in line with Jarvis (2003) that in-service needs of managers is based on identifying appropriate range of experience of applicants, determining the required level of comportment, constituting the right type of interviewing panel, making reference to religion and determining the right and of discipline required for a job vacancy. Therefore, those in-service, needs of directors in recruitment and selection of staff should be included in the in-service training programme.

In this context, the study was relevant/similar with this study because, the study is on capacity building needs and there were difference because the study is on state agency directors in human resources management in adult education in North-Central, Nigeria while, this study is on capacity building needs for woodwork technology education lecturers in the use of digital woodworking machines in North-West, Nigeria and also, mean and standard deviation used for testing their questionnaire and hypotheses tested at 0.05 the level of significance, they used Very High Extent (VHE) = 4, High Extent (HE) = 3, Low Extent (LE) = 2 and Very Low Extent (VLE) = 1. While, in this study also will use with mean and standard deviation to test the questionnaire and will used 0.05 to test hypotheses as similarities to the mentioned reviewed study and also, this study will use with Strongly Agree (SA) = 4, Agree (A) = 3, Strongly Disagree (SD) = 2 and Disagree (D) = 1 as difference with stated reviewed study.

Hashim (2011) undertook empirical study title: “Building Capacity of Teachers and Trainers in Technical and Vocational Education and Training (TVET) in Sudan” (Case of Khartoum State). Ten research questions and null hypotheses were formulated to guide the study. A closed-ended questionnaire is designed to get information from teachers and trainers who are working in VTCs and ITSs during the study year 2007 to 2008. Only one open-ended question is left for the response of the phrase: (other specify) for writing any additional information the respondents wanted to add. These forms are: Technical Education, Vocational Education and Technological Education. The responsibility of the three types of distributed into three ministries. Ministry of General Education, Ministry of Labour Public Service and Human Resources, and finally Ministry of Higher Education and Scientific Research respectively. No doubt, such intersection of responsibilities is lead to contradiction of policies and consequently weakens the TVET generally.

The study was relevant/similar with this study because is concerned with building capacity and is have differences because on teachers and trainers in Technical and Vocational Education and Training (TVET) in Sudan (Case of Khartoum State) while, this study is on needs for woodwork technology education lecturers in the use of digital circular saw machine in North-West States, Nigeria and also, a closed end questionnaire designed to collect data from teachers similar to this study designed questionnaire on closed end form and test hypotheses at 0.05 level of significance also similar to this study.

Ibukun (2019). Conducted a study on Skills required for woodwork technology capacity building as perceived by technical educators in Nigeria South-West Colleges of Education. The teacher holds the key to nation building; this is because the aspiration of any nation to transform into a great economy can only be possible if there are competent and dedicated lecturers to impart the appropriate knowledge. This, prompts the researchers to examines kills required for woodwork technology capacity building as perceived by technical educators in Nigeria South-West Colleges of Education. Two research questions guided the study. The study employed descriptive survey research design. The population for this study consisted of 91 woodwork technology educators in South-West Colleges of Education and University. Census study was adopted because of the population is small and manageable. The instrument used for data collection was 20 items structured questionnaire which was designed on a modified 4-point Likert scale titled: 'Required Woodwork Technology Skills for Capacity Building Questionnaire (RWTSCBQ). The instrument was validated by three research experts from Department of Technical Education, Emmanuel Alayande College of Education, Oyo. Reliability co-efficient (r) value of 0.89 was obtained through Cronbach alpha method. 91 copies of the questionnaire were retrieved by the researchers with the help of two research assistants and analysed using weighted mean and Improvement Need Index. It was found out that woodwork lecturers in the university perceived that trade skills in woodwork technology are required for proper capacity building in woodwork technology. However, it was recommended that college management should ensure that lecturers are expose to the right saleable skills needed in the woodwork industries to enable them swim with the tide.

The study was relevant/similar with this study because is concerned with woodwork technology capacity building and it has differences because the reviewed study is on skills required for woodwork technology capacity building as perceived by technical educators in Nigeria South-West Colleges of Education while, this study is on capacity building needs for woodwork technology education lecturers in the use of digital circular saw machine in North-West States, Nigeria and also similar in terms of research design and instrument for data collection but differs in terms of population, study area and method of data analysis.

Samuel *et al.* (2018) conducted a study on capacity building needs of technical college woodwork teachers on medium density fiberboard for construction of modern furniture. Medium Density Fiberboard (MDF) requires expert handling for construction of modern furniture and thus requires Technical College Woodwork teachers to be acquainted with the latest processes of construction with reference to the use of tools and machines through capacity building. This study determined capacity building needs of Technical College woodwork teachers on medium density fiberboard for construction of modern furniture. Three research questions were developed. Capacity Building Needs of Woodwork Teachers Questionnaire (CBNWTQ) containing 18 items was the instrument developed and used for data collection while 3 experts were engaged to validate the instrument. The reliability coefficient of the instrument was established at 0.76 using Cronbach Alpha Coefficient. The instrument was used for collecting data from 44 Technical College woodwork teachers in Ogun State. The data collected were analyzed using descriptive statistics of mean and standard deviation. Results indicated that Technical College woodwork teachers lack skills and information on the use of MDF for modern furniture through capacity building. Therefore, the study recommended that capacity building of Technical College woodwork teachers should be initiated, embraced and sponsored, and that training and re-training of Technical College woodwork teachers should be handled with utmost seriousness by Technical College stakeholders.

The study was relevant/similar with this study because is concerned with capacity building needs of technical college woodwork teachers and it has differences because the reviewed study is on capacity building needs of technical college woodwork teachers on medium density fiberboard for construction of modern furniture while, this study is on capacity building needs for woodwork technology education lecturers in the use of digital circular saw machine in North-West States, Nigeria but differs in terms of population, study area and method of data analysis.

Nwokedi (2018) examined the capacity building needs of education lecturers in information and communication technology in universities. The study adopted a Theory of Human Capital Development propounded by Schultz in 1967. The literature was reviewed on the concept of ICT, Human Capacity building needs of education lecturers, ICT devices required for the enhancement of capacity building needs of education lecturers, Ways ICT Devices can Enhance Capacity Building of Education Lecturers, Factors Militating Against the Enhancement of ICT Capacity Building Needs of Education Lecturers, and Strategies for enhancing the ICT capacity building needs of education lecturers in universities. The study showed that capacity building needs of education lecturers in universities include: knowledge of operating the ICT devices, good knowledge of handling the devices in teaching, clear skills of manipulating the devices for research developments, using the devices to store and present academic data, using the devices for record keeping, assisting staff with ICT devices to be involved in human capacity building programmes, and regular involvement of staff in knowledge updates through appropriate use of new technological devices. The study finally concluded that, capacity building needs of education lecturers in universities help them to acquire new knowledge and skills to carry out their duties effectively, skills on research and development, ideas needed for knowledge creation and team spirits to deliver lectures appropriately.

The study was relevant/similar with this study because is concerned with capacity building needs of education lecturers and it has differences because the reviewed study is on capacity building needs of education lecturers in information and communication technology in universities while, this study is on capacity building needs for woodwork technology education lecturers in the use of digital circular saw machine in North-West States, Nigeria but differs in terms of research design, population, study area and method of data analysis.

Thokozani *et al.* (2020). Conducted a study on the usage of digital resources in Civil Technology: A case of teaching Tools and Equipment. The digital world is increasingly penetrating the education space, with digital technology gradually being used as a vehicle to deliver educational knowledge and skills in new and innovative ways. The need for technical teacher's development in using digital resources as means to bridge the knowledge gap in teaching the topic Tools and Equipment is to be emphasized in these modern times. Most importantly, in Civil Technology issues of overcrowding, rare exposure to practical activities as well as lack of practical skilled-competent teachers are still pressing challenges. The purpose of this study was to investigate the extent to which digital resources are used in Civil Technology when teaching about Tools and Equipment. Non-probability sampling was used to select a total of 9 teachers and 145 learners to participate in this study. This study employed Roger's 'Diffusion of innovativeness'. Observation, semi-structured interviews and questionnaire instruments were used as data-collection methods. The study found that Civil Technology teachers prefer to use prescribed textbooks and previous exam question papers to teach the concepts in the topic Tools and Equipment whilst there are video clips and posters that can help to expand learners' practical skill knowledge. Teachers did not see those digital technology resources as helpful in comparison to their own knowledge base when it comes to exposing learners to the wider context of Tools and Equipment. This study recommends that in order to bridge practical skill knowledge gap, teachers should integrate digital technology into their lessons as they are helpful in outlining concepts that might have been omitted by teachers during lessons.

The study was relevant/similar with this study because is concerned with digital resources and it has differences because the reviewed study is on usage of digital resources in civil technology: a case of teaching tools and equipment while, this study is on capacity building needs for woodwork technology education lecturers in the use of digital circular saw machine in North-West States, Nigeria but differs in terms of research design, population, study area and method of data analysis.

Besmart-digbori (2017) examines the adequacy of Technical Education Teachers and machinery for the teaching and learning of woodworking trades in technical colleges with a focus on Sapele Technical College, Sapele, Nigeria. To guide the study, two research questions were raised and answered. A 21-item structured questionnaire was used for data collection. The instrument was validated by three lecturers in the department of technical and Business Education, Delta State University, Abraka, Nigeria. The reliability of the questionnaire was ascertained by the test-retest method with a coefficient of 0.78. Data collected were analysed using mean and standard Deviation. The results revealed that qualified teachers to teach safety and technical drawing are adequate. NCE and B.Sc. (ed) teachers are adequate. Teachers to teach woodworking trades are inadequate, while teachers who are ICT literate are inadequate. Holders of B. Tech (ed) certificates are inadequate. Based on the findings, it was recommended that (a) teachers in technical colleges should be computer (ICT) literate (b) ICT facilities should be made available in all technical colleges in Nigeria (c) Government and the private sector should provide equipment in existing technical colleges in Nigeria to improve instruction.

The study was relevant/similar with this study because is concerned with machinery for the teaching and learning of woodworking trades and it has differences because the reviewed study is on adequacy of Technical Education Teachers and machinery for the teaching and learning of woodworking trades in technical colleges with a focus on Sapele Technical College, Sapele, Nigeria while, this study is on capacity building needs for woodwork technology education lecturers in the use of digital circular saw machine in North-West States, Nigeria but differs in terms of population, study area and method of data analysis.

Opara *et al.* (2019) investigated the Competency improvement needs of woodwork technology lecturers in Utilizing various Teaching Methods for effective Teaching of woodwork machinery skills in Colleges of Education (Tech). One research question and null hypothesis guided the study. Instrumental Research design was adopted for the study. The sample population comprised 70 experienced lecturers and 72 less experienced lecturers making a total of 142 respondents. The instrument (the observation check list) was subjected to face validation by experts in woodwork technology department and one from measurement and evaluation in the faculty of education. The instrument was also tested for reliability which yielded a reliability coefficient of 0.80. Mean and Standard Deviation was used to answer the research question while the hypothesis was tested using t-test at 0.05 level of significance. Competency improvement needs of utilizing various teaching methods for effective teaching of woodwork machinery skills were identified as required and relevant for successful teaching. It is recommended that a woodwork technology lecturer should attend seminars, conferences and workshops towards equipping their competencies.

The study was relevant/similar with this study because is concerned with woodwork technology lecturers and it has differences because the reviewed study is on competency improvement needs of woodwork technology lecturers in Utilizing various Teaching Methods for effective Teaching of woodwork machinery skills in Colleges of Education (Tech) while, this study is on capacity building needs for woodwork technology education lecturers in the use of digital circular saw machine in North-West States, Nigeria but differs in terms of population, study area and method of data analysis.

Okwori *et al.* (2013) identified practical skills possessed by woodwork graduates of Niger state technical colleges in using woodworking machines, hand tools and consumables. Three research questions were answered and two hypotheses tested at 0.05 level of significance. A survey research design was adopted for the study. A structured questionnaire was used to gather data from one hundred and two respondents. Simple random sampling was applied to identify the study sample. Mean rating was used to answer research questions, t- test statistics was used to test the hypotheses. Cronbach Alpa Formula was used to determine reliability coefficient of the instrument. The reliability coefficient of the instrument was found to 0.81. The findings of the study showed that Woodwork graduates of technical colleges in Niger State used all the woodworking machines listed except band saw machine, tenoning machine, mortiser and thicknesser. They used all the hand tools such as hammer, screw driver, hand plane, electric jig saw, scraper, pincer, plier, try square and spanner. It was recommended that State Government should provide modern machines for improving practical skills of woodwork students and Woodwork teachers should teach students how to apply formica on wood surfaces.

The study was relevant/similar with this study because is concerned with woodwork technology and it has differences because the reviewed study is on evaluation of Practical Skills Possessed by Woodwork Graduates of Technical Colleges in Niger State, Nigeria while, this study is on capacity building needs for woodwork technology education lecturers in the use of digital circular saw machine in North-West States, Nigeria but differs in terms of population, study area and method of data analysis.

Akpan (1998) undertook a study titled: "In-Service Competency Needs of Supervisors of Vocational and Technical Education Programmes in Akwa-Ibom State of Nigeria". Three research questions and two null hypotheses were formulated to guide the study. Two sets of questionnaires, Vocational and Technical Education Supervisory Competencies Questionnaire (VTESCQ) and Vocational and Technical Education Supervisors Performance Rating Inventory (VTESPRI) were developed in the study. The questionnaires were administered to 24 administrators and 68 supervisors of Vocational and Technical Education Programme in Akwa-Ibom State. Data obtained from the study were analyzed using the mean and t-test statistics. The findings of the study indicated that, the important task area of Vocational and Technical Education Supervisory in Akwa-Ibom State are:

coordination of curriculum development in Vocational and Technical Education Programme, organization of public relations activities, provision of guidance to teachers on the application of curriculum theory with respect to local situation.

This study has some relationship or similar to this study in identifying areas of in-service competency needs which is almost the same thing as capacity building, and their differences with this study were, on supervisors of vocational and technical education programmes in Akwa-Ibom State of Nigeria while in this study, of capacity building needs for woodwork technology education lecturers in using with digital circular saw machine in North-West States, Nigeria. Data obtained from the reviewed study were analyzed using the mean and t-test statistics as another different with this study were will use the mean and standard deviation.

Apagu (1997) undertook a study of titled: "Technical In-Service Competency Needs of Post-Primary School Building Technology Teachers of Adamawa State". Three research questions and three two-tailed null hypotheses were formulated and tested at .05 level of a prior probability. The design of the study employed survey design. A questionnaire was developed and administered to 287 Building Technology Teachers in Adamawa State Public Post-Primary Schools. Mean ratings, percentages, correlated t-test; one-way ANOVA and Scheffe test were employed for data analysis. The result of the study revealed that the teachers perceived themselves as performing the competencies at a moderate level. It was also further observed that their educational qualifications had significant effect on their perceived level of performance of the building technology competencies. Also, Apagu observed that the teachers capacity building is (96%) of the 24 building drawing competences and in all of block lying and carpentry and joinery respectively.

The research has relevant or similar with the present study because, is on the technical in-service competency needs but, having differences because is on primary school building technology teachers of Adamawa State, with respect to this study on capacity building needs for woodwork technology education lecturers in the using with digital circular saw machine in North-West States, Nigeria and also, mean and standard deviation will use to test questionnaire and .05 will use to test the level of significance in this study while, for the reviewed study three research questions and two-tailed null hypotheses were formulated and tested at .05 level of a prior probability and also, mean ratings, percentages, corrected t-test; one way ANOVA and scheffe test were employed for data analyses as another different with this study.

Ezegworie (2002) undertook a descriptive survey research titled: “In-Service Needs of Principals in Critical Skills of Instructional Supervisory Behavior with Special Focus on the Technical, Interpersonal Conceptual and Diagnostic Aspects of Supervisory Behaviour”. Seven research questions and three null hypotheses guided the study. A questionnaire was developed and administered. The sample for the study comprised all the two hundred and sixty-two (262) secondary school principals within the six education zones of Enugu State. Data for the study were collected using a Critical Supervisory Skill In-Service Training Needs Assessment Scale (CSSITNAS). Mean as standard deviation were used to analyze the data while the hypotheses revealed that Secondary School Principals Needs In-Service Training In all aspects of Critical Skills of Instructional Supervisory Behaviour. Also, in-service training needs decreases with the year of experience on the job; principals with first degree in education. The study also revealed that males need more of conceptual and diagnostic skills of instructional supervisory behavior than their female counterpart.

The study has a relevant or similar with this present study is on in-service needs and have differences because; this in-service needs on principals in critical skills of instructional supervisory behavior with special focus on the technical, interpersonal conceptual and diagnostic aspects of supervisory behavior; but in this study is on the capacity building needs in the use of digital circular saw machine, for woodwork technology education lecturers in North-West States, Nigeria. The mean and standard deviation will use for testing instrument in this study while, for the reviewed study mean and t-test statistics analyzed to obtained data.

Ogeleka (2019) undertook as study. His topic is: “Adequacy of Technical Education Teachers and Machinery for the Teaching and Learning of Woodwork: A Case Study of a South-Southern Nigerians’ Technical Colleges”. His research examines the adequacy of technical education teachers and machinery for the teaching and learning of woodworking trades in technical colleges with a focus on Sapele Technical College, Sapele, Nigeria. To guide the study, two research questions were raised and answered. A 21-items structured questionnaire was used for data collection. The instrument was validated by three lecturers in the Department of Technical and Business Education, Delta State University, Abraka, Nigeria. The reliability of the questionnaire was ascertained by the test-retest method with a coefficient of 0.78. Data collected were analyzed using mean and standard deviation. The results revealed that qualified teachers to teach safety and technical drawing are adequate. Nigeria Certificate in Education (NCE) and Bachelor of Science (Education) teachers who are ICT literate are in adequate. Holders of Bachelor of Technology (Education) Certificate are inadequate. Based on the findings, it was recommended that:

(a) Teachers in technical colleges should be computer (ICT) literate.

(b) ICT facilities should be made available in all technical colleges in Nigeria.

(c) Government and private sector should provide equipment in existing technical colleges in Nigeria.

The study is relevant or similar with this study because, is on adequacy of technical education teachers and machinery for the teaching and learning of woodwork which almost the same thing as capacity building and also, on machinery of technical education teachers while, the only differences on in form of the machinery for the teaching and learning of woodwork of technical education teachers and in the South-Southern Nigerians' technical colleges. While this study is concerning of the digital circular saw machine capacity building for woodwork technology education lecturers in North-West States, Nigeria. Data collected were analyzed using mean and standard deviation similar to this study was will use mean and standard deviation for testing instrument. A 50- items structured questionnaire will use for the collection of data in this study while, in the reviewed study a 20-items structured questionnaire used to collect the data as another different. The mean and standard deviation will use for the testing instrument in this study as another similarity with reviewed study were also, mean and standard deviation used to test instrument.

2.4 Summary of Literature Review

The fit developed a three-phase theory: the cognitive phase, the associative phase and autonomous phase in which all the three phases overlap each other in the process of acquisition of complex skills which necessitates the learner passing through them when learning the complex skills just like acquisition of basic skills such as: ripping, crosscutting, mitre-cutting, rebating, grooving, trenching and chamfering using digital circular saw machine by the woodwork technology education lecturers. Miller views the acquisition of skills as the progressive co-ordination of separate units of activity in hierarchical order in which make it short as: TOTE that is, Test, Operate, Test and Exit.

A concept means general idea but in this study deals capacity building which also means structured training activities that is intended to increase the skills and capabilities of woodwork technology education lecturers in the use of digital circular saw machine. The digital circular saw machine also known as Computer Numerical Control (CNC) circular saw machine that are, using computer programme or instruction (software) to control or direct the circular saw machine to carry-out operations on wood automatically without human efforts.

The study reviewed some of the related empirical studies titled: "Capacity Building Needs of Lecturers in E-Learning for Effective Delivery of Computer and Electrical/Electronics Technology Courses in Tertiary Institutions in South-Western, Nigeria", "Capacity Building Needs of State Agency Directors in Human Resources Management in Adult Education in North-Central Zone of Nigeria", "Building Capacity of Teachers and Trainers in Technical and Vocational Education and Training (TVET) in Sudan" (Case of Khartoum State), "In-Service Competency Needs of Supervisors of Vocational and Technical Education Programme in Akwa-Ibom State of Nigeria", "Technical In-Service Competency Needs of Post-Primary School Building Technology Teachers of Adamawa State", "In-Service Needs of Principals in Critical Skills of Instructional Supervisory Behaviour with Special Focus on the Technical, Interpersonal Conceptual and Diagnostic Aspects of Supervisory Behaviour" and "Adequacy of Technical Education Teachers and Machinery for the Teaching and Learning of Woodwork: A Case Study of a South-Southern Nigerians' Technical Colleges.

The aim for this study was designed to determine the capacity building needs for woodwork technology education lecturers in the use of digital circular saw machine in North-West States Zone, Nigeria due to the lack of competencies of operating the DCSM by the woodwork technology education lecturers to teach students practical skills lesson effectively and efficiently with new technology, due to the availability of DCSM in their institutions woodwork technology education workshops and also, based on the literature reviewed, no work done in the above topic or area of research, this creates a gap which needs to be filled for effectively and efficiently delivery of practical skills class to students at NCE (Technical) Woodwork Technology Education Programme.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Research Design

Descriptive survey research design was considered suitable for this study. This research design is mostly applied to real life situation in education where need to determine the capacity building needs. Olaitan and Mama (2001) stated that the descriptive survey research design is the plan, structure and strategy that the investigator/researcher wants to adopt in order to obtain solution to research problems using questionnaire in collecting, analyzing and interpreting the data. Questionnaires was used to collect data from woodwork technology education lecturers from tertiary institutions offering NCE (Technical) woodwork technology education programme in order to determine their capacity building needs in using Digital Circular Saw Machine (DCSM) in delivering their practical instruction with the students.

3.2 Area of the Study

The study was carried-out in North-West States of Nigeria. Both Federal and State tertiary educational institutions offering N.C.E. (Technical) Woodwork Technology Education Programme in the geographical zone were inclusive. The North-West Geographical Zone of Nigeria comprises seven states of the country's 36 states. These are Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara States (See Appendix F). The zone covers an area of 216,065 square kilometres or 25.75% of the Nigeria's total land marks (Premium Times Nigeria, 2017).

The reasons of choosing North-West States Zones tertiary educational institutions offering Woodwork Technology Education Programme on capacity building needs for the woodwork technology education lecturers in the use of digital circular saw machine for the study is because: These institutions has Digital Circular Saw Machine (DCSM) in their woodwork technology education workshops, but not judiciously utilize in training the students by the woodwork technology education lecturers.

3.3 Population of the Study

The population of the study was 84 respondents, this include: 40 Woodwork Technology Education Lecturers and 21 Woodwork Technology Education Administrators at N.C.E. (Technical) Woodwork Technology Education Programme and 23 Woodwork Workshops Employers (Master Craftsmen) all of them from the seven states in the North-West Zone, Nigeria (See Appendix C) showing the three groups of respondents.

3.4 Sample and Sampling Techniques

There was no sampling due to the size of the population for the two groups of respondents, that is, Woodwork Technology Education Lecturers and Woodwork Technology Education Administrators. But, the one group of respondents that is, woodwork workshops employers (master craftsmen) purposive sampling were used for them in the seven states in North-West Zone, Nigeria in which woodwork workshops employers from each state were used as a respondents for the instrument for the study. The whole population of the study in the five Colleges of Education offering N.C.E. (Technical) Woodwork Technology Education Programme and two Polytechnics offering N.C.E. (Technical) Woodwork Technology Education Programme and woodwork workshops employers (master craftsmen) from seven states to answer the instrument of the study in the North-West States Zone of Nigeria was used.

3.5 Instrument for Data Collection

A 70 - items questionnaire titled: Digital Circular Saw Machine Capacity Building Needs of Woodwork Technology Education Lecturers Questionnaire (DCSMCBNWTELQ) was developed by the researcher based on literature reviewed. The instrument of the study contains two sections: the section one is the personal data of woodwork technology education administrators, woodwork technology education lecturers, and woodwork workshops employers (master craftsmen) while, section two contains the capacity building needs of woodwork technology education lecturers on ripping, cross-cutting, mitre-cutting, rebating, grooving, trenching and chamfering operations with digital circular saw machine in NCE (Technical) woodwork technology education programme and also, each item of the questionnaire was assigned a four point scale response of: Highly Needed (HN) = 4, Needed (N) = 3, Slightly Needed (SN) = 2, Not Needed (NN) = 1. (See Appendix A).

3.6 Validation of the Instrument

The instrument was subjected to face for construct and content validity by five woodwork technology education experts, one from Department of Industrial and Technology Education, School of Science and Technology Education, Federal University of Technology, Minna, one woodwork technology education expert from Department of Woodwork Technology Education, College of Technical and Vocational Education of Kaduna Polytechnic. three woodwork technology education experts from Department of Woodwork Technology Education, School of Secondary Education (Technical) of Federal

College of Education (Technical) Bichi, Kano State. They were requested to use their woodwork technology education expertise in determining the suitability of the instrument items for data collection (See Appendix B). Their observations, corrections and suggestions were used to develop the final copy of the instrument.

3.7 Reliability of the Instrument

The pilot test was conducted at Federal College of Education (Technical) Gombe, Gombe State which is outside of the area of study. The respondents comprised of 13 subjects, three woodwork technology education administrators and 10 woodwork technology education lecturers. The internal consistency of the questionnaire items was established using Cronbach Alpha Reliability Method. The closer the Cronbach Alpha is to 1, the higher the internal consistency (Olelewa & Agomuo, 2016). The data was collected from woodwork technology education lecturers and woodwork technology education administrators and were analyzed for internal consistency using Cronbach Alpha Reliability Method. The reliability of the instrument was found to be 0.86 (See Appendix D). The Statistical Product and Service Solutions formerly, Statistical Packages for Social Sciences/Statistical Product and Service Solutions (SPSS version 23) was employed to analyze data collected from the respondents.

3.8 Administration of the Instrument

Eighty four copies of the questionnaire was administered to Woodwork Technology Education Lecturers and Woodwork Technology Education Administrators offering NCE (Technical) Woodwork Technology Education Programme and woodwork workshops employers (using purposive sampling) from each state in the North-West Zone States, Nigeria with helps of thirteen Research Assistants (RAs) from tertiary educational institutions, including the researcher which serve as a research assistant for one tertiary institution and one research assistant from each seven states of North-West Zone of Nigeria, for separation of instruments to respondents and collecting the instruments when it is filled by the respondents in North-West States, Nigeria.

3.9 Method of Data Analysis

Mean and Standard Deviation was used to answer research questions one to seven. Any item with a mean value of 2.50 or above was regarded as Needed (N) while any item with a mean value of less than 2.50 was regarded as Not Needed (NN). The analysis was done by the researcher with the help of Statistical Package of Social Science/Statistical Product and Service Solutions (SPSS, version 23) while, Analysis of Variance (ANOVA) statistics was used for testing the hypotheses using P-Value to determine the level of significance at 0.05 for the study, if the level of significant is below or less than ($p<0.05$) therefore the result shows that: there is significant in the testing hypothesis while, if the level of significant is above or greater than ($p>0.05$) therefore the result shows that: there is no significant in the hypothesis testing (See Appendix G).

CHAPTER FOUR

4.0 PRESENTATION OF DATA AND DISCUSSION

4.1 Research Question 1

What are the capacity building needs of woodwork technology education lecturers on ripping operation with digital circular saw machine?

Table 4.1

Mean and Standard Deviation on the Capacity Building Needs of Woodwork Technology Education Lecturers on Ripping Operation with Digital Circular Saw Machine

S/NO.	ITEMS	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_A$	SD	REM
1.	Switch ON/OFF the Digital Circular Saw Machine (DCSM) computer and machine.	3.19	3.33	3.38	3.40	.74	N
2.	Ability to Interpret drawing and data of ripping dimension using DCSM.	3.21	3.24	2.75	3.00	.69	N
3.	Programme the code for the (DCSM) from the data or set-up the automated software to generate the code for ripping operation.	2.77	2.80	3.20	2.40	.77	NN
4.	Sequencing the ripping operation in the correct order using DCSM.	3.15	3.00	3.20	2.90	.75	N
5.	Select and check appropriate DCSM for ripping operation.	3.16	3.09	3.20	2.70	.67	N
6.	Set DCSM parameters such as: cutting speed and allowance tolerance.	3.09	3.43	3.22	3.10	.69	N
7.	Operate the DCSM computer and machine while ripping.	3.13	3.29	3.18	3.20	.70	N
8.	Inspect the quality of the finished product against industry standards.	3.16	3.05	3.33	3.40	.85	N
9.	Rectify any faults with the end product after ripping operation with DCSM.	3.09	3.24	3.03	3.20	.83	N
10.	Set-up, programme, operate computerized DCSM or CNC circular saw machine for ripping operation.	3.10	3.23	3.00	3.20	.74	N

Source: Field Work

KEYS: $\bar{X}_1$ = Mean Responses of Woodwork Technology Education Administrators, $\bar{X}_2$ = Mean Responses of Woodwork Technology Education Lecturers, $\bar{X}_3$ = Mean Responses of Woodwork Workshops Employers, $\bar{X}_A$ = Average Mean Responses of all the three Respondents, SD = Standard Deviation, REM = Remark, N = Needed & NN = Not Needed.

The results in Table 4.1 revealed that the respondents needed items (1, 2, 4, 5, 6, 7, 8, 9 & 10) on the extent of need of capacity building on ripping operation of woodwork technology education lecturers using Digital Circular Saw Machine (DCSM) in North-West, Nigeria average mean ranging from 2.40 to 3.40. However, respondents did not need item 3 of capacity building on ripping operation woodwork technology education lecturers using Digital Circular Saw Machine (DCSM) in North-West, Nigeria with mean of 2.40 less than mean value 2.50. Table 4.1 also showed that the standard deviation of items ranges from 0.63 to 0.83 showing the respondents were close to another.

4.2 Research Question 2

What are the capacity building needs of woodwork technology education lecturers on cross-cutting operation with digital circular machine?

Table 4.2:

Mean and Standard Deviation on the Capacity Building Needs of Woodwork Technology Education Lecturers on Cross-Cutting Operation with Digital Circular Saw Machine

S/NO.	ITEMS	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_A$	SD	REM
11.	Switch ON/OFF DCSM computer and machine.	2.99	3.10	3.50	3.10	.79	N
12.	Programme cutting list on the DCSM automatically.	3.12	3.40	3.20	3.30	.79	N
13.	Set the DCSM on up stroke for the cross-cutting operation.	3.21	3.30	3.20	2.90	.75	N
14.	Regulate the volume of stroke to either high or low mode as desired.	3.13	3.40	3.20	3.00	.62	N
15.	Use the DCSM ultimately for safe and high productivity.	3.24	2.80	3.00	3.40	.76	N
16.	Start the DCSM, adjust controls and make trial cuts to ensure that is operating smoothly.	3.27	3.40	3.20	3.40	.76	N
17.	Examine finish work piece for conformance to specifications and verify dimensions while using DCSM.	3.11	3.20	2.60	3.10	.68	N
18.	Set-up, programme or operate or tend computerized DCSM or CNC circular saw machine for cross-cutting operation.	3.00	3.00	3.40	3.10	.66	N
19.	Monitor the DCSM cross-cutting operation and make adjustments to correct problems and ensure conformity with the specifications.	3.11	3.40	3.20	3.00	.74	N
20.	Examine wood stock for defects and to ensure conformity with the size and other specification standards.	3.12	3.40	3.50	3.10	.73	N

Source: Field Work

KEYS: $\bar{X}_1$ = Mean Responses of Woodwork Technology Education Administrators, $\bar{X}_2$ = Mean Responses of Woodwork Technology Education Lecturers, $\bar{X}_3$ = Mean Responses of Woodwork Workshops Employers, $\bar{X}_A$ = Average Mean Responses of all the three Respondents, SD = Standard Deviation, REM = Remark, N = Needed & NN = Not Needed.

The results in Table 4.2 revealed that the respondents needed the ten items (11, 12, 13, 14, 15, 16, 17, 18, 19 & 20) on the extent of need of capacity building on cross-cutting operation of woodwork technology education lecturers using Digital Circular Saw Machine (DCSM) in North-West, Nigeria average mean ranging from 2.90 to 3.40. Table 4.2 also showed that the standard deviation of items ranges from 0.62 to 0.73 showing the respondents were close to another.

4.3 Research Question 3

What are the capacity building needs of woodwork technology education lecturers on mitre-cutting operation with digital circular machine?

Table 4.3:

Mean and Standard Deviation on the Capacity Building Needs of Woodwork Technology Education Lecturers on Mitre-Cutting Operation with Digital Circular Saw Machine

S/NO	ITEMS	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_A$	SD	REM
21.	Switch ON/OFF DCSM computer and machine.	3.23	3.20	3.60	3.30	.79	N
22.	Set the DCSM on up stroke for the mitre-cutting operation.	3.19	2.70	3.20	3.00	.65	N
23.	Use simple Computer Aided Design (CAD)/Computer Aided Manufacturing (CAM) for mitre-cutting operation.	3.21	3.50	3.60	3.10	.66	N
24.	Programme cutting list on the DCSM automatically.	3.27	3.10	3.10	2.10	.78	NN
25.	Regulate the volume of stroke to either high or low mode as desired.	3.20	3.70	3.00	2.90	.74	N
26.	Examine finished mitre-cut work piece for conformity with specifications and verify dimensions when using DCSM.	3.21	3.30	3.10	3.00	.68	N
27.	Set-up, programme or operate or tend computerized DCSM or CNC circular saw machine for mitre-cutting operation.	3.23	3.30	3.40	3.40	.73	N
28.	Ability to use a digital circular saw table to accommodate the large piece.	2.25	3.40	2.70	3.00	.56	N
29.	Learn how to start DCSM, adjust controls and make trial and ensure that the machine is properly mitre-cutted.	3.37	3.20	3.10	3.00	.71	N
30.	Ability to monitor mitre-cutting operation of DCSM and make adjustments to correct position and ensure conformity with specifications.	3.48	3.30	3.00	3.60	.55	N

Source: Field Work

KEYS: $\bar{X}_1$ = Mean Responses of Woodwork Technology Education Administrators, $\bar{X}_2$ = Mean Responses of Woodwork Technology Education Lecturers, $\bar{X}_3$ = Mean Responses of Woodwork Workshops Employers, $\bar{X}_A$ = Average Mean Responses of all the three Respondents, SD = Standard Deviation, REM = Remark, N = Needed & NN = Not Needed.

The results in Table 4.3 revealed that the respondents needed the items (21, 22, 23, 25, 26, 27, 28, 29 & 30) only item 24, not needed on the extent of need of capacity building on mitre-cutting operation of woodwork technology education lecturers using Digital Circular Saw Machine (DCSM) in North-West, Nigeria average mean ranging from 2.10 to 3.60. However, respondents did not need item 24 of capacity building on mitre-cutting operation of NCE (Technical) programme woodwork technology education lecturers using Digital Circular Saw Machine (DCSM) in North-West, Nigeria with mean of 2.10 less than mean value 2.50. Table 4.3 also showed that the standard deviation of items ranges from 0.55 to 0.79 showing the respondents were close to another.

.4.4 Research Question 4

What are the capacity building needs of woodwork technology education lecturers on rebating operation with digital circular machine?

Table 4.4:

Mean and Standard Deviation on the Capacity Building Needs of Woodwork Technology Education Lecturers on Rebating Operation with Digital Circular Saw Machine

S/NO.	ITEMS	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_A$	SD	REM
31.	Switch ON/OFF DCSM computer and machine.	3.20	3.30	3.10	3.10	.78	N
32.	Ability to Interpret drawing and data of rebating using DCSM.	3.24	2.70	2.90	2.80	.71	N
33.	Ability to operate digital circular saw equipped with a rabbet ledge during rebating operation and also used to plane or finish rebates directed by CAD software.	3.34	3.30	2.60	2.60	.65	N
34.	Ability to create circumferential exterior profiling on windows and doors.	3.12	3.40	2.90	3.30	.71	N
35.	Rebate with digital circular saw using a straight or rebate bit.	3.19	3.30	3.10	3.00	.72	N
36.	Have the skills of operating digital circular saw with multiple passes during rebating operation.	3.18	3.10	2.90	3.20	.58	N
37.	Ability to mount dado set in a single pass which is directed by CAM.	3.12	2.70	3.30	3.10	.77	N
38.	Ability to carry-out rebating operation using digital circular saw machine.	3.25	3.10	3.20	3.30	.69	N
39.	To operate digital circular saw equipped with a rabbet ledge when rebating.	3.24	2.90	3.40	3.00	.69	N
40.	To adjust cutting depth of the saw to the desired length of cut.	3.49	3.40	3.20	3.40	.65	N

Source: Field Work

KEYS: $\bar{X}_1$ **=** Mean Responses of Woodwork Technology Education Administrators, $\bar{X}_2$ = Mean Responses of Woodwork Technology Education Lecturers, $\bar{X}_3$ = Mean Responses of Woodwork Workshops Employers, $\bar{X}_A$ **=** Average Mean Responses of all the three Respondents, SD = Standard Deviation, REM = Remark, N = Needed & NN = Not Needed.

The results in Table 4.4 revealed that the respondents needed all the ten items (31, 32, 33, 34, 35, 36, 37, 38, 39 & 40) on the extent of need of capacity building on rebating operation of woodwork technology education lecturers using Digital Circular Saw Machine (DCSM) in North-West, Nigeria average mean ranging from 2.80 to 3.40. Table 4.4 also showed that the standard deviation of items ranges from 0.58 to 0.78 showing the respondents were close to another.

4.5 Research Question 5

What are the capacity building needs of woodwork technology education lecturers on grooving operation with digital circular machine?

Table 4.5:

Mean and Standard Deviation on the Capacity Building Needs of Woodwork Technology Education Lecturers on Grooving Operation with Digital Circular Saw Machine

S/NO.	ITEMS	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_A$	SD	REM
41.	Switch ON/OFF DCSM computer and machine.	3.23	3.50	3.10	3.30	.61	N
42.	Ability to create circumferential exterior profiling on sliding windows and doors.	3.44	3.60	3.50	2.90	.59	N
43.	Groove with digital circular saw using a straight or groove bit.	3.39	3.40	3.30	3.00	.56	N
44.	Ability to operate digital circular saw equipped with a groove ledge during grooving operation and also used to plane or finish grooves directed by CAD software.	3.28	3.40	3.20	3.20	.48	N
45.	To adjust cutting depth of the saw to the desired length of cut.	3.29	3.20	3.00	3.44	.69	N
46.	Ability to Interpret drawing and data of grooving using DCSM.	3.43	3.30	3.50	3.50	.63	N
47.	Ability to carry-out grooving operation using digital circular saw machine.	3.18	2.80	3.30	3.40	.56	N
48.	Ability to mount dado set in a single pass which is directed by CAM.	3.29	3.20	3.00	3.30	.64	N
49.	Have the skills of operating digital circular saw with multiple passes during grooving operation.	3.24	3.00	3.60	3.40	.72	N
50.	To operate digital circular saw equipped with a groove ledge when grooving.	3.35	3.50	3.50	3.10	.57	N

Source: Field Work

KEYS: $\bar{X}_1$ **=** Mean Responses of Woodwork Technology Education Administrators, $\bar{X}_2$ = Mean Responses of Woodwork Technology Education Lecturers, $\bar{X}_3$ = Mean Responses of Woodwork Workshops Employers, $\bar{X}_A$ **=** Average Mean Responses of all the three Respondents, SD = Standard Deviation, REM = Remark, N = Needed & NN = Not Needed.

The results in Table 4.5 revealed that the respondents needed all the ten items (41, 42, 43, 44, 45, 46, 47, 48, 49 & 50) on the extent of need of capacity building on grooving operation of woodwork technology education lecturers using Digital Circular Saw Machine (DCSM) in North-West, Nigeria average mean ranging from 2.80 to 3.40. Table 4.5 also showed that the standard deviation of items ranges from 0.58 to 0.78 showing the respondents were close to another.

4.6 Research Question 6

What are the capacity building needs of woodwork technology education lecturers on trenching operation with digital circular machine?

Table 4.6:

Mean and Standard Deviation on the Capacity Building Needs of Woodwork Technology Education Lecturers on Trenching Operation with Digital Circular Saw Machine

S/NO.	ITEMS	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_A$	SD	REM
51.	Switch ON/OFF DCSM computer and machine.	3.33	3.20	3.20	3.10	.78	N
52.	Ability to mount dado set in a single pass which is directed by CAM.	3.29	3.50	3.20	3.40	.74	N
53.	To operate digital circular saw equipped with a trench ledge when trenching.	3.29	3.60	3.70	3.00	.64	N
54.	Have the skills of operating digital circular saw with multiple passes during trenching operation.	3.23	3.80	3.20	3.40	.59	N
55.	Ability to carry-out trenching operation using digital circular saw machine.	3.21	3.20	3.40	3.50	.52	N
56.	Ability to Interpret drawing and data of trenching using DCSM.	3.35	3.00	3.22	3.10	.65	N
57.	Programme the code for the DCSM from the data or setting up the automated software to generate the code for trenching operation.	3.24	3.20	3.30	3.40	.59	N
58.	Ability to use CAM/CAD applications such as: ARTCAM, MASTETCAM, BOBCAD & ALPHACAM, with digital circular saw blade.	3.29	3.10	3.40	3.20	.79	N
59.	Sequence the trenching operation in the correct order using DCSM	3.20	2.90	2.90	3.30	.71	N
60.	Ability to operate digital circular machine which is capable of trenching heavy wood.	3.48	3.30	3.30	3.30	.63	N

Source: Field Work

KEYS: $\bar{X}_1$ **=** Mean Responses of Woodwork Administrators, $\bar{X}_2$ = Mean Responses of Woodwork Lecturers, $\bar{X}_3$ = Mean Responses of Woodwork Workshops Employers, $\bar{X}_A$ **=** Average Mean Responses of all the three Respondents, SD = Standard Deviation, REM = Remark, N = Needed & NN = Not Needed.

The results in Table 4.6 revealed that the respondents needed all the ten items (51, 52, 53, 54, 55, 56, 57, 58, 59 & 60) on the extent of need of capacity building on trenching operation of woodwork technology education lecturers using Digital Circular Saw Machine (DCSM) in North-West, Nigeria average mean ranging from 3.10 to 3.50. Table 4.6 also showed that the standard deviation of items ranges from 0.58 to 0.78 showing the respondents were close to another.

4.7 Research Question 7

What are the capacity building needs of woodwork technology education lecturers on chamfering operation with digital circular machine?

Table 4.7:

Mean and Standard Deviation on the Capacity Building Needs of Woodwork Technology Education Lecturers on Chamfering Operation with Digital Circular Saw Machine

S/NO.	ITEMS	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_3$	$\bar{X}_A$	SD	REM
61.	Switch ON/OFF DCSM computer and machine.	3.15	3.10	3.10	2.40	.50	NN
62.	Ability to Interpret drawing and data of chamfering dimension using DCSM.	3.19	2.80	3.30	3.10	.50	N
63.	Ability to operate the DCSM computer and machine for chamfering operation.	3.33	3.30	3.50	3.40	.65	N
64.	Sequence the chamfering operation in the correct order using DCSM.	3.18	2.80	3.00	3.10	.69	N
65.	Ability to operate digital circular machine which is capable of chamfering heavy wood.	3.38	3.20	3.30	3.00	.59	N
66.	Programme the code for the DCSM from the data or setting up the automated software to generate the code for chamfering operation.	3.29	2.90	3.20	3.20	.59	N
67.	Ability to use CAM/CAD applications such as: ARTCAM, MASTETCAM, BOBCAD & ALPHACAM, with digital circular saw blade.	3.10	3.00	3.30	3.10	.69	N
68.	Set DCSM parameters such as: cutting speed and allowance tolerance.	3.05	3.10	3.33	3.40	.88	N
69.	Select and checking appropriate DCSM digital circular saw machine.	2.55	3.50	3.33	3.40	.79	N
70.	Ability to chamfer at a 45^0angle between the adjoining right angled faces.	2.39	2.80	3.50	3.10	.84	N

Source: Field Work

KEYS: $\bar{X}_1$ **=** Mean Responses of Woodwork Technology Education Administrators, $\bar{X}_2$ = Mean Responses of Woodwork Technology Education Lecturers, $\bar{X}_3$ = Mean Responses of Woodwork Workshops Employers, $\bar{X}_A$ **=** Average Mean Responses of all the three Respondents, SD = Standard Deviation, REM = Remark, N = Needed & NN = Not Needed.

The results in Table 4.7 revealed that the respondents needed all the ten items (62, 63, 64, 65, 66, 67, 68, 69 & 70) only item 61 not needed on the extent of need of capacity building on chamfering operation of woodwork technology education lecturers using Digital Circular Saw Machine (DCSM) in North-West, Nigeria average mean ranging from 2.40 to 3.40. However, respondents did not need item 23 of capacity building on ripping operation of woodwork technology education lecturers using Digital Circular Saw Machine (DCSM) in North-West, Nigeria with mean of 2.10 less than mean value 2.50. Table 4.7 also showed that the standard deviation of items ranges from 0.50 to 0.88 showing the respondents were close to another.

4.8 Testing Hypotheses

Table 4.8

One-Way ANOVA of Mean Scores of Respondents on the Capacity Building Needs of Woodwork Technology Education Lecturers on Ripping Operation with Digital Circular Saw Machine

Source	Sum of Squares	df	Mean Square	F	Sig. (P-Value)
Between Groups	0.928	2	0.464	6.221	0.003
Within Groups	6.044	81	0.075		
Total	6.972	83			

Source: Field Work

The result of analysis as presented in Table 4.8 showed that there is significant difference ($P<0.05$) in the mean scores of the respondents. The hypothesis one was therefore upheld (Needed). The data supported the one, (2, 81) = 6.221, P (Sig.) = 0.003. (See Appendix G data is for the result from the analysis).

Table 4.9

One-Way ANOVA of Mean Scores of Respondents on the Capacity Building Needs of Woodwork Technology Education Lecturers on Cross-Cutting Operation with Digital Circular Saw Machine

Source	Sum of Squares	df	Mean Square	F	Sig. (P-Value)
Between Groups	0.104	2	0.052	0.705	0.497
Within Groups	5.962	81	0.074		
Total	6.066	83			

Source: Field Work

The result of analysis as presented in Table 4.9 showed that there is no significant difference (P<0.05) in the mean scores of the respondents. The hypothesis one was therefore upheld (Needed). The data supported the one, (2, 81) = 0.705, P (Sig.) = 0.497. (See Appendix G data is for the result from the analysis).

Table 4.10

One-Way ANOVA of Mean Scores of Respondents on the Capacity Building Needs of Woodwork Technology Education Lecturers on Mitre-Cutting Operation with Digital Circular Saw Machine

Source	Sum of Squares	df	Mean Square	F	Sig. (P-Value)
Between Groups	0.361	2	0.181	2.489	0.089
Within Groups	5.881	81	0.073		
Total	6.242	83			

Source: Field Work

The result of analysis as presented in Table 4.10 showed that there is no significant difference (P<0.05) in the mean scores of the respondents. The hypothesis one was therefore upheld (Needed). The data supported the one, (2, 81) = 0.703, P (Sig.) = 2.489 (See Appendix G data is for the result from the analysis).

Table 4.11

One-Way ANOVA of Mean Scores of Respondents on the Capacity Building Needs of Woodwork Technology Education Lecturers on Rebating Operation with Digital Circular Saw Machine

Source	Sum of Squares	df	Mean Square	F	Sig. (P-Value)
Between Groups	0.951	2	0.476	7.321	0.001
Within Groups	5.264	81	0.065		
Total	6.215	83			

Source: Field Work

The result of analysis as presented in Table 4.11 showed that there is significant difference ($P>0.05$) in the mean scores of the respondents. The hypothesis one was therefore upheld (Needed). The data supported the one, (2, 81) = 0.476, P (Sig.) =0.001 (See Appendix G data is for the result from the analysis).

Table 4.12

One-Way ANOVA of Mean Scores of Respondents on the Capacity Building Needs of Woodwork Technology Education Lecturers on Grooving Operation with Digital Circular Saw Machine

Source	Sum of Squares	df	Mean Square	F	Sig. (P-Value)
Between Groups	0.012	2	0.006	0.177	0.838
Within Groups	2.664	81	0.033		
Total	2.676	83			

Source: Field Work

The result of analysis as presented in Table 4.12 showed that there is no significant difference ($P<0.05$) in the mean scores of the respondents. The hypothesis one was therefore upheld (Needed). The data supported the one, (2, 81) = 0.177, P (Sig.) = 0.838 (See Appendix G data is for the result from the analysis).

Table 4.13

One-Way ANOVA of Mean Scores of Respondents on the Capacity Building Needs of Woodwork Technology Education Lecturers on Trenching Operation with Digital Circular Saw Machine

Source	Sum of Squares	df	Mean Square	F	Sig. (P-Value)
Between Groups	0.215	2	0.107	2.132	0.125
Within Groups	4.075	81	0.050		
Total	4.289	83			

Source: Field Work

The result of analysis as presented in Table 4.13 showed that there is no significant difference ($P<0.05$) in the mean scores of the respondents. The hypothesis one was therefore upheld (Needed). The data supported the one, (2, 81) = 2.132, P (Sig.) = 0.125 (See Appendix G data is for the result from the analysis).

Table 4.14

One-Way ANOVA of Mean Scores of Respondents on the Capacity Building Needs of Woodwork Technology Education Lecturers on Chamfering Operation with Digital Circular Saw Machine

Source	Sum of Squares	df	Mean Square	F	Sig. (P-Value)
Between Groups	0.379	2	0.190	3.431	0.037
Within Groups	4.478	81	0.055		
Total	4.857	83			

Source: Field Work

The result of analysis as presented in Table 4.14 showed that there is no significant difference ($P<0.05$) in the mean scores of the respondents. The hypothesis one was therefore upheld (Needed). The data supported the one, (2, 81) = 3.431, P (Sig.) = 0.037 (See Appendix G data is for the result from the analysis).

4.9 Findings of the Study

The results of the findings revealed that:

1. Ripping operation with Digital Circular Saw Machine (DCSM) capacity building needs for the woodwork technology education lecturers has significant because, when hypothesis was tested obtained the level of significance below .05 and also, only one item not needed by the woodwork technology education lecturers.
2. Cross-Cutting operation with Digital Circular Saw Machine (DCSM) capacity building needs for the woodwork technology education lecturers has no significant because, when hypothesis was tested obtained the level of significance above .05 and also, all the items needed by the woodwork technology education lecturers.
3. Mitre-Cutting operation with Digital Circular Saw Machine (DCSM) capacity building needs for the woodwork technology education lecturers has no significant because, when hypothesis was tested obtained the level of significance above .05 and also, all the items needed by the woodwork technology education lecturers.
4. Rebating operation with Digital Circular Saw Machine (DCSM) capacity building needs for the woodwork technology education lecturers has significant because, when hypothesis was tested obtained the level of significance below .05 and also, all the items only one item not needed by the woodwork technology education lecturers.

5. Grooving operation with Digital Circular Saw Machine (DCSM) capacity building needs for the woodwork technology education lecturers has no significant because, when hypothesis was tested obtained the level of significance above .05 and also, all the items needed by the woodwork technology education lecturers.
6. Trenching operation with Digital Circular Saw Machine (DCSM) capacity building needs for the woodwork technology education lecturers has no significant because, when hypothesis was tested obtained the level of significance above .05 and also, all the items needed by the woodwork technology education lecturers.
7. Chamfering operation with Digital Circular Saw Machine (DCSM) capacity building needs for the woodwork technology education lecturers has no significant because, when hypothesis was tested obtained the level of significance above .05 and also, all the items needed by the woodwork technology education lecturers.
8. There was significant in the research question one indicating the level of significant at 0.003 ($P<0.05$) on hypothesis testing on the capacity building needs of woodwork technology education lecturers on ripping operation with digital circular saw machine.
9. There was no significant in the research question two indicating the level of significant at 0.497 ($P>0.05$) on hypothesis testing on the capacity building needs of woodwork technology education lecturers on cross-cutting operation with digital circular saw machine.
10. There was no significant in the research question three indicating the level of significant at 0.089 ($P>0.05$) on hypothesis testing on the capacity building needs of woodwork technology education lecturers on mitre-cutting operation with digital circular saw machine.

11. There was significant in the research question four indicating the level of significant at 0.001 (P<0.05) on hypothesis testing on the capacity building needs of woodwork technology education lecturers on rebating operation with digital circular saw machine.
12. There was no significant in the research question five indicating the level of significant at 0.083 (P>0.05) on hypothesis testing on the capacity building needs of woodwork technology education lecturers on grooving operation with digital circular saw machine.
13. There was no significant in the research question six indicating the level of significant at 0.125 (P>0.05) on hypothesis testing on the capacity building needs of woodwork technology education lecturers on trenching operation with digital circular saw machine.
14. There was no significant in the research question seven indicating the level of significant at 0.089 (P>0.05) on hypothesis testing on the capacity building needs of woodwork technology education lecturers on chamfering operation with digital circular saw machine.

4.10 Discussion of Findings

The results of the study revealed that woodwork technology education lecturers capacity building needs on ripping operation using digital circular saw machine (DCSM) for delivery of practical class together with their students. Mean responses of the respondents are needed as appropriate because in all the items ranges are from 2.50 and above only item number three not needed for the respondents at 2.40 on average mean responses of all the three groups of respondents, less than 2.50. Moreover, the responses of woodwork technology education administrators as well as woodwork workshops employers (master craftsmen) needs of capacity building are needed as appropriate because there was significant difference in the mean responses as indicated on the hypotheses with p-value less than the level of significance ($p<0.05$), the significant level at 0.003 ($p<0.05$).

The results of the study revealed that woodwork technology education lecturers needs capacity building on cross-cutting operation using digital circular saw machine (DCSM) for delivery of practical class together with their students. Mean responses of the respondents are needed as appropriate because in all the items ranges are from 2.50, except item number 24 average mean response value at 2.10 less than 2.50 and above. Moreover, the responses of woodwork technology education administrators as well as woodwork workshops employers (master craftsmen) needs of capacity building are needed as appropriate because there was no significant difference in the mean responses as indicated on the hypotheses with p-value greater than the level of significance ($p>0.05$), the significant level at 0.497.

The results of the study revealed that woodwork technology education lecturers needs capacity building on mitre-cutting operation using digital circular saw machine (DCSM) for delivery of practical class together with their students. Mean responses of the respondents are needed as appropriate because in all the items ranges are from 2.50 and above. Moreover, the responses of woodwork technology education administrators as well as woodwork workshops employers (master craftsmen) needs of capacity building needed as appropriate because there was no significant difference in the mean responses as indicated on the hypotheses with p-value greater than the level of significance ($p>0.05$), the significant level at 0.089.

The results of the study revealed that woodwork technology education lecturers needs capacity building on rebating operation using digital circular saw machine (DCSM) for delivery of practical class together with their students. Mean responses of the respondents are needed as appropriate because in all the items ranges are from 2.50 and above. Moreover, the responses of woodwork technology education administrators as well as woodwork workshops employers (master craftsmen) needs of capacity building needed as appropriate because there was significant difference in the mean responses as indicated on the hypotheses with p-value less than the level of significance ($p>0.05$), the significant level at 0.001.

The results of the study revealed that woodwork technology education lecturers needs capacity building on grooving operation using digital circular saw machine (DCSM) for delivery of practical class together with their students. Mean responses of the respondents are needed as appropriate because in all the items ranges are from 2.50 and above. Moreover, the responses of woodwork technology education administrators as well as woodwork workshops employers (master craftsmen) capacity building needs as appropriate because there was no significant difference in the mean responses as indicated on the hypotheses with p-value greater than the level of significance ($p>0.05$), the significant level at 0.083.

The results of the study revealed that woodwork technology education lecturers needs capacity building on trenching operation using digital circular saw machine (DCSM) for delivery of practical class together with their students. Mean responses of the respondents are needed as appropriate because in all the items ranges are from 2.50 and above. Moreover, the responses of woodwork technology education administrators as well as woodwork workshops employers (master craftsmen) needs of capacity building needs as appropriate because there was no significant difference in the mean responses as indicated on the hypotheses with p-value greater than the level of significance ($p>0.05$), the significant level at 0.125.

The results of the study revealed that woodwork technology education lecturers needs capacity building on chamfering operation using digital circular saw machine (DCSM) for delivery of practical class together with their students. Mean responses of the respondents are needed as appropriate because in all the items ranges are from 2.50 and above. Moreover, the responses of woodwork technology education administrators as well as woodwork workshops employers (master craftsmen) needs of capacity building are needed as appropriate because there is no significant difference in the mean responses as indicated on the hypotheses with p-value greater than the level of significance ($p>0.05$), the significant level at 0.039.

These findings are in line with Jarvis (2003) that capacity building needs of managers is based on identifying appropriate range of experience of 79 applicants, determining the required level of comportment, constituting the right kind of interviewing panel, making reference to religion and determining the right and discipline required for a job vacancy. These findings agreed with findings of Olelewa and Okwor (2017) that using ICT supported strategies for teaching improves learning outcomes of students and make the delivery of practical class easier for teachers. The implication of this finding is that, woodwork technology education lecturers were deficient in using DCSM approach and relevant facilities that could support DCSM of woodwork technology education courses to students in all tertiary institutions offering NCE (Technical) programme.

These findings of this study could be attributed to the fact that woodwork technology education lecturers not regularly have capacity building in using ICTs such as: laptops, desktops, ipads, smart phones, internet, electronics interactive boards, Email and digital projectors for teaching purposes. The low level of ICT skills possessed by woodwork technology education lecturers could be attributed to the perceived inadequate ICT capacity building and orientation given to woodwork technology department members on ICT related equipment (Ertmer 1999; Jegede 2009).

Furthermore, the findings support Ogwo and Oranu (2006) who stated that teachers of vocational education must be continuous learners through improvement programmes. This will improve the efficient and effectiveness of lecturers in performing specific teaching activities. These findings of Adirika and Alike (2008) disclosed that technologies such as: computer, Email, cell phones, e-teaching facilities, ipads among others are yet to be used for teaching of school subjects due to the inadequate skills possessed by the lecturers.

The findings of this study again, also in agreement with the findings of Olaitan *et al.* (2009) that lecturers required performance competencies in using computer for teaching, operating computer and applying computer to agriculture through the internet, e-mail and Microsoft power point.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The purpose of the study was to determine the capacity building needs of woodwork technology education lecturers using Digital Circular Saw Machine (DCSM). The seven research questions were designed for study on skills of how to operate DCSM as: ripping, cross-cutting, mitre-cutting, rebating, grooving, trenching and chamfering operations for effective and efficient in the practical skills class. Based on the findings of the study, the mean responses of the three groups of respondents shows the need capacity building on (that is, for all the seven research questions) only three items for the whole instrument at level of not needed for the whole respondents.

On the other hand, there is significant in the research question one indicating the level of significant at 0.003 ($P<0.05$) on hypothesis testing on the capacity building needs of woodwork technology education lecturers on ripping operation with digital circular saw machine. There was no significant in the research question two indicating the level of significant at 0.497 ($P>0.05$) on hypothesis testing on the capacity building needs of woodwork technology education lecturers on cross-cutting operation with digital circular saw machine. There was no significant in the research question three indicating the level of significant at 0.089 ($P>0.05$) on hypothesis testing on the capacity building needs of woodwork lecturers on mitre-cutting operation with digital circular saw machine. There was significant in the research question four indicating the level of significant at 0.001 ($P<0.05$) on hypothesis testing on the capacity building needs of woodwork technology education lecturers on rebating operation with digital circular saw machine.

Also, there was no significant in the research question five indicating the level of significant at 0.083 (P>0.05) on hypothesis testing on the capacity building needs of woodwork technology education lecturers on grooving operation with digital circular saw machine. There was no significant in the research question six indicating the level of significant at 0.125 (P>0.05) on hypothesis testing on the capacity building needs of woodwork technology education lecturers on trenching operation with digital circular saw machine and lastly, there was no significant in the research question seven indicating the level of significant at 0.089 (P>0.05) on hypothesis testing on the capacity building needs of woodwork technology education lecturers on chamfering operation with digital circular saw machine. The study will contribute to the knowledge on the how to operate computer by woodwork technology education lecturers in the process of conducting woodworking operations as: ripping, crosscutting, mitre-cutting, rebating, grooving, trenching and chamfering operations using Digital Circular Saw Machine (DCSM). Secondly, the study will contribute to the study on how get accurate and minimize demand of supervision from the woodwork technology education lecturers. Thirdly, the study will contribute on producing quality goods and services. Fourthly, the study will contribute produce confident, competent and reliable woodwork technology education lecturers and fifthly, the study will contribute to the woodwork technology education lecturers that can resolve job-related problems.

5.2 Recommendations

The study recommended the following based on the findings of the study:

1. The National Commission for Colleges of Education (NCCE) and National Board for Technical Education (NBTE) should include ripping and other woodworking

operations using Digital Circular Saw Machine (DCSM) in NCE (Technical) Woodwork Technology Education Programme Minimum Standard.

2. Woodwork Technology Education Administrators should organize seminars and workshops for Woodwork Technology Education Lecturers on how to use Digital Circular Saw Machine (DCSM) especially, on different woodworking operations (including cross-cutting operation).
3. Woodwork Technology Education Lecturers should adopt to use with available Digital Circular Saw Machine for NCE (Technical) Woodwork Technology Education Programme on mitre-cutting operation since all items needed by the respondents for practical skills lesson with the students.
4. Woodwork Technology Education Lecturers should adopt to training and retraining on rebating operation using Digital Circular Saw Machine (DCSM) capacity building since the findings of the study indicated that there was significant.
5. Woodwork Technology Education Administrators should adopt to take care of the maintenance of Digital Circular Saw Machines (DCSMs) especially, when teaching students on grooving operation by woodwork technology education lecturers.
6. Woodwork Technology Education Administrators should also, make provision of standby generator incase of failure from National Power Holding Company for operating Digital Circular Saw Machine (DCSM) especially, when teaching students trenching operation by woodwork technology education lecturers.
7. Woodwork Technology Education Programme Administrators should organized capacity building training for woodwork workshops employers (master craftsmen) on how to operate Digital Circular Saw Machine (DCSM) for carrying-out woodworking operations especially on chamfering operation.

5.3 Suggestions for Further Research

The following suggestions were made for further research:

1. Capacity Building Needs of Technical Colleges Carpentry and Joinery Teachers in the use of Digital Circular Saw Machine in Kano State, Nigeria
2. Capacity Building Needs of Technical Colleges Carpentry and Joinery Teachers in the use of Digital Wood Carver Machine in Kano State, Nigeria
3. Similar study can be carried out in all the Geo-Political Zones of Nigeria.
4. Similar study can be carried out in other disciplines of technology education programme.

5.4 Contribution to Knowledge

The study established the capacity building needs of woodwork technology education lecturers in using digital circular saw machine (DCSM), during practical classes of NCE (Technical) woodwork technology education. These areas of capacity building of woodwork technology education lecturers includes ripping, cross-cutting, rebating, grooving, trenching and chamfering operations, with mean values 3.05, 3.11, 3.04, 3.08. 3.25, 3.27 and 3.46 respectively.

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Appendix A

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
INDUSTRIAL AND TECHNOLOGY EDUCATION DEPARTMENT

QUESTIONAIRE ON**: CAPACITY BUILDING NEEDS OF WOODWORK TECHNOLOGY EDUCATION LECTURERS IN THE USE OF DIGITAL CIRCULAR SAW MACHINE IN NORTHWEST, NIGERIA**

SECTION "A"

PERSONAL DATA

WOODWORK ADMINISTRATORS ( )	WOODWORK LECTURERS ( )	WOODWORK WORKSHOPS EMPLOYERS ( )

SECTION "B"

Please tick (√) against the response that best represents your opinion on each of the item below:

Highly Needed (HN) = 4
Needed (N) = 3
Slightly Needed (SN) = 2
Not Needed (NN) = 1

RESEARCH QUESTION 1:
What are the capacity building needs of woodwork technology education lecturers on ripping operation with digital circular saw machine?

S/NO.	ITEMS	HN	N	SN	NN
1.	Switch ON/OFF the Digital Circular Saw Machine (DCSM) computer and machine.				
2.	Ability to Interpret drawing and data of ripping dimension using DCSM.				
3.	Programme the code for the (DCSM) from the data or set-up the automated software to generate the code for ripping operation.				
4.	Sequencing the ripping operation in the correct order using DCSM.				
5.	Select and check appropriate DCSM for ripping operation.				
6.	Set DCSM parameters such as: cutting speed and allowance tolerance.				
7.	Operate the DCSM computer and machine while ripping.				
8.	Inspect the quality of the finished product against industry standards.				

9.	Rectify any faults with the end product after ripping operation with DCSM.				
10.	Set-up, programme, operate computerized DCSM or CNC circular saw machine for ripping operation.				

RESEARCH QUESTION 2:
What are the capacity building needs of woodwork technology education lecturers on cross-cutting operation with digital circular saw machine?

S/NO.	ITEMS	HN	N	SN	NN
11.	Switch ON/OFF DCSM computer and machine.				
12.	Programme cutting list on the DCSM automatically.				
13.	Set the DCSM on up stroke for the cross-cutting operation.				
14.	Regulate the volume of stroke to either high or low mode as desired.				
15.	Use the DCSM ultimately for safe and high productivity.				
16.	Start the DCSM, adjust controls and make trial cuts to ensure that is operating smoothly.				
17.	Examine finish work piece for conformance to specifications and verify dimensions while using DCSM.				
18.	Set-up, programme or operate or tend computerized DCSM or CNC circular saw machine for cross-cutting operation.				
19.	Monitor the DCSM cross-cutting operation and make adjustments to correct problems and ensure conformity with the specifications.				
20.	Examine wood stock for defects and to ensure conformity with the size and other specification standards.				

RESEARCH QUESTION 3:
What are the capacity building needs of woodwork technology education lecturers on mitre-cutting operation with digital circular saw machine?

S/NO.	ITEMS	HN	N	SN	NN
21.	Switch ON/OFF DCSM computer and machine.				
22.	Set the DCSM on up stroke for the mitre-cutting operation.				

23.	Use simple Computer Aided Design (CAD)/Computer Aided Manufacturing (CAM) for mitre-cutting operation.				
24.	Programme cutting list on the DCSM automatically.				
25.	Regulate the volume of stroke to either high or low mode as desired.				
26.	Examine finished mitre-cut work piece for conformity with specifications and verify dimensions when using DCSM.				
27.	Set-up, programme or operate or tend computerized DCSM or CNC circular saw machine for mitre-cutting operation.				
28.	Ability to use a digital circular saw table to accommodate the large piece.				
29.	Learn how to start DCSM, adjust controls and make trial and ensure that the machine is properly mitre-cutted.				
30.	Ability to monitor mitre-cutting operation of DCSM and make adjustments to correct position and ensure conformity with specifications.				

RESEARCH QUESTION 4:
What are the capacity building needs of woodwork technology education lecturers on rebating operation with digital circular saw machine?

S/NO.	ITEMS	HN	N	SN	NN
31.	Switch ON/OFF DCSM computer and machine.				
32.	Ability to Interpret drawing and data of rebating using DCSM.				
33.	Ability to operate digital circular saw equipped with a rabbet ledge during rebating operation and also used to plane or finish rebates directed by CAD software.				
34.	Ability to create circumferential exterior profiling on windows and doors.				
35.	Rebate with digital circular saw using a straight or rebate bit.				
36.	Have the skills of operating digital circular saw with multiple passes during rebating operation.				
37.	Ability to mount dado set in a single pass which is directed by CAM.				
38.	Ability to carry-out rebating operation using				

	digital circular saw machine.				
39.	To operate digital circular saw equipped with a rabbet ledge when rebating.				
40.	To adjust cutting depth of the saw to the desired length of cut.				

RESEARCH QUESTION 5:
What are the capacity building needs of woodwork technology education lecturers on grooving operation with digital circular saw machine?

S/NO.	ITEMS	HN	N	SN	NN
41.	Switch ON/OFF DCSM computer and machine.				
42.	Ability to create circumferential exterior profiling on sliding windows and doors.				
43.	Groove with digital circular saw using a straight or groove bit.				
44.	Ability to operate digital circular saw equipped with a groove ledge during grooving operation and also used to plane or finish grooves directed by CAD software.				
45.	To adjust cutting depth of the saw to the desired length of cut.				
46	Ability to Interpret drawing and data of grooving using DCSM.				
47.	Ability to carry-out grooving operation using digital circular saw machine.				
48.	Ability to mount dado set in a single pass which is directed by CAM.				
49.	Have the skills of operating digital circular saw with multiple passes during grooving operation.				
50.	To operate digital circular saw equipped with a groove ledge when grooving.				

RESEARCH QUESTION 6:
What are the capacity building needs of woodwork technology education lecturers on trenching operation with digital circular saw machine?

S/NO.	ITEMS	HN	N	SN	NN
51.	Switch ON/OFF DCSM computer and machine.				
52.	Ability to mount dado set in a single pass which is directed by CAM.				
53.	To operate digital circular saw equipped with a trench ledge when trenching.				

54.	Have the skills of operating digital circular saw with multiple passes during trenching operation.				
55.	Ability to carry-out trenching operation using digital circular saw machine.				
56.	Ability to Interpret drawing and data of trenching using DCSM.				
57.	Programme the code for the DCSM from the data or setting up the automated software to generate the code for trenching operation.				
58.	Ability to use CAM/CAD applications such as: ARTCAM, MASTETCAM, BOBCAD & ALPHACAM, with digital circular saw blade.				
59.	Sequence the trenching operation in the correct order using DCSM.				
60.	Ability to operate digital circular machine which is capable of trenching heavy wood.				

RESEARCH QUESTION 7:
What are the capacity building needs of woodwork technology education lecturers on chamfering operation with digital circular saw machine?

S/NO.	ITEMS	HN	N	SN	NN
61.	Switch ON/OFF DCSM computer and machine.				
62.	Ability to Interpret drawing and data of chamfering dimension using DCSM.				
63.	Ability to operate the DCSM computer and machine for chamfering operation.				
64.	Sequence the chamfering operation in the correct order using DCSM.				
65.	Ability to operate digital circular machine which is capable of chamfering heavy wood.				
66.	Programme the code for the DCSM from the data or setting up the automated software to generate the code for chamfering operation.				
67.	Ability to use CAM/CAD applications such as: ARTCAM, MASTETCAM, BOBCAD & ALPHACAM, with digital circular saw blade.				
68.	Set DCSM parameters such as: cutting speed and allowance tolerance.				
69.	Select and checking appropriate DCSM digital circular saw machine.				
70.	Ability to chamfer at a 45^0angle between the adjoining right angled faces.				

Appendix B

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

RESEARCH INSTRUMENTS VALIDATION CERTIFICATE

Student's Name: **NASIRU, Musa Zarewa**

Registration Number: **M. Tech./SSTE/2018/9038**

Programme: **M. Tech. Woodwork Technology Education**

Topic: **Capacity Building Needs of Nigeria Certificate in Education (Technical) Woodwork Lecturers' in the use of Digital Woodworking Machines in North-West, Nigeria**

WOODWORK TECHNOLOGY EDUCATION EXPERT

General Overview of the Instrument

I have no access to the research objectives ~~and questions as such~~ but the instrument is adequate for the research questions stated.

Name of Validator: Dr Mohammed, B.M.

Area of Specialization: WOODWORK **Rank:** L1

Name of Institution: FCET Minna

Signature: [signature] **Date:** 22/04/2021

WOODWORK TECHNOLOGY EDUCATION EXPERT

General Overview of the Instrument

Effect the observations before administering the instrument.

Name of Validator: Umar Bala

Area of Specialization: WOODWORK TECHNOLOGY

Name of Institution: KADUNA POLYTECHNIC

Signature: [signature] **Date:** 18-4-2021

WOODWORK TECHNOLOGY EDUCATION EXPERT

General Overview of the Instrument

The questionnaire items are relevant to the research questions with just a minor corrections

Name of Validator: Umar Lawal

Area of Specialization: Woodwork Tech **Rank:** Principal Lecturer

Name of Institution: Fed. Col. of Education (Tech) Bichi, Kano State

Signature: [signature] **Date:** 29/04/21

WOODWORK TECHNOLOGY EDUCATION EXPERT

General Overview of the Instrument

WELL STRUCTURED AND SATISFACTORY

Name of Validator: BAFFA GARBA INDABO

Area of Specialization: WOODWORK **Rank:** SENIOR LECTU.

Name of Institution: F C E (T) BICHI

Signature: [signature] **Date:** 21/4/2021

WOODWORK TECHNOLOGY EDUCATION EXPERT

General Overview of the Instrument

THE INSTRUMENT IS COMPREHENSIVE AND SATISFACTORY.

Name of Validator: MUHAMMAD SANI CHADO

Area of Specialization: WOODWORK TECH. **Rank:** SENIOR LECTURER

Name of Institution: FEDERAL COLLEGE OF EDUCATION (TECH).

Signature: [signature] **Date:** 27/04/2021

Appendix C

Population Distribution Tables

Woodwork Technology Education Lecturers, Woodwork Technology Education Administrators and Woodwork Workshops Employers Population Distribution Table

S/No.	Name of Institutions	States	No. of Woodwork Administrators	No. of Woodwork Lecturers	No. of Woodwork Workshops Employers
1.	Federal College of Education (Technical) Bichi	Kano	3	7	5
2.	Federal College of Education (Technical) Gusau	Zamfara	3	7	2
3.	Sa'adatu Rimi College of Education Kumbotso	Kano	3	3	-
4.	Isah Kaita College of Education Dutsin-Ma	Katsina	3	3	4
5.	Shehu Shagari College of Education	Sokoto	3	3	4
6.	Kaduna Polytechnic	Kaduna	3	11	4
7.	Kano State Polytechnic	Kano	3	5	-
8.	-	Jigawa	-	-	2
9.	-	Kebbi	-	-	3
Total			**21**	**40**	**23**

Source: Office of the Registrars of the Colleges of Education/Polytechnics, (2020)/Offices of Chairmen of North-West States Woodwork Workshops Employers (2021).

Appendix D

Reliability Test Result

Digital Circular Saw Machine Capacity Building Needs Woodwork Technology Education Lecturers Questionnaire (DCSMCBWTELQ)

Cronbach Alpha Reliability Method

Scale: All Variables Overall Score.

Case Processing Summary

	No.	**%**
Cases Valid	10	100.00
Excluded	0	0
Total	10	100.00

a. List wise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	**No. of Item**
0.86	70

Appendix E

Introduction Letter to Field

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA.
SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION
DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

Vice Chancellor:
PROF. ABDULLAHI BALA, FSSSN
B. Agric (ABU), M. Sc (Reading), Ph.D (London)
Head of Department:
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Your Ref:

Our Ref:

Date: 21 – 06 – 2021

NCE (TECHNICAL) WOODWORK
LECTURERS IN NORTHWEST
STATES, NIGERIA

Sir/Ma.

TO WHOM IT MAY CONCERN

The bearer NASIRU, MUSA ZAREWA with Registration Number M.Tech/SSTE/2018/9038 is A Master student of Industrial and Technology Education Department.

He is carrying out a research titled: CAPACITY BUILDING NEEDS OF NIGERIA CERTIFICATE IN EDUCATION (TECHNICAL) WOODWORK LECTURERS IN THE USE OF DIGITAL CIRCULAR SAW MACHINE IN NORTH-WEST, NIGERIA

He needs your assistance to enable him carry out his field work.

We will appreciate your anticipated co-operation.

Thank you.

21/06/2021
Dr. E. Raymond
Postgraduate Coordinator, ITE.

Appendix F

Northwest States Geographical Zone of Nigeria

Plate 1.

Six Geo-Political Zones of Nigeria showing the North-West States covered with yellow colours in this study.

Appendix G

Research Questions Analysis Answers and Hypotheses testing using One-Way ANOVA

Research Question1: Analysis Evidence using SPSS Version 23

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
A	84	1.00	4.00	3.19	.73593
B	84	1.00	4.00	3.21	.69545
C	84	1.00	4.00	2.77	.76601
D	84	1.00	4.00	3.15	.75241
E	84	1.00	4.00	3.16	.67366
F	84	1.00	4.00	3.09	.68757
G	84	1.00	4.00	3.13	.70761
H	84	1.00	5.00	3.16	.84787
I	84	1.00	4.00	3.09	.83043
J	84	1.00	4.00	3.10	.74475
VAR00012	0				
VAR00013	21	2.00	4.00	3.3333	.57735
VAR00014	21	2.00	4.00	3.2381	.70034
VAR00015	21	2.00	4.00	2.8095	.60159
VAR00016	21	1.00	4.00	3.0000	.89443
VAR00017	21	1.00	4.00	3.0952	.70034
VAR00018	21	2.00	4.00	3.0952	.53896
VAR00019	21	2.00	4.00	3.4286	.59761
VAR00020	21	2.00	4.00	3.2857	.84515
VAR00021	21	1.00	4.00	3.0476	.74001
VAR00022	21	2.00	4.00	3.2381	.62488
VAR00023	0				
VAR00024	40	1.00	4.00	3.2250	.73336
VAR00025	40	2.00	4.00	3.3750	.58562
VAR00026	40	1.00	4.00	2.7500	.86972
VAR00027	40	1.00	4.00	3.2000	.72324
VAR00028	40	2.00	4.00	3.2000	.64847
VAR00029	40	2.00	4.00	3.2250	.61966
VAR00030	40	2.00	4.00	3.1750	.59431
VAR00031	40	1.00	5.00	3.3250	.79703
VAR00032	40	1.00	4.00	3.3250	.82858
VAR00033	40	1.00	4.00	3.0250	.80024
VAR00034	0				
VAR00035	23	1.00	4.00	3.0000	.85280
VAR00036	23	1.00	4.00	2.9130	.79275
VAR00037	23	1.00	4.00	2.7826	.73587
VAR00038	23	2.00	4.00	3.2174	.67126
VAR00039	23	2.00	4.00	3.1739	.71682
VAR00040	23	1.00	4.00	2.8696	.86887
VAR00041	23	1.00	4.00	2.7826	.85048
VAR00042	23	1.00	4.00	2.7826	.85048
VAR00043	23	1.00	4.00	2.7391	.81002
VAR00044	23	1.00	4.00	3.1304	.75705
Valid N (listwise)	0				

Research Question 2: Analysis Evidence using SPSS Version 23

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
A	84	1.00	4.00	2.9881	.79901
B	84	1.00	4.00	3.1071	.79179
C	84	1.00	4.00	3.2143	.74561
D	84	1.00	4.00	3.1310	.77272
E	84	1.00	4.00	3.2619	.62323
F	83	1.00	4.00	3.1325	.76143
G	84	2.00	4.00	3.2381	.63282
H	84	1.00	4.00	3.2738	.68286
I	84	1.00	4.00	3.1071	.65891
J	84	1.00	4.00	3.1190	.73476
Valid N (listwise)	83				

Research Question 3: Analysis Evidence using SPSS Version 23

Descriptive Statistics

MEAN	N	Minimum	Maximum	Mean	Std. Deviation
A	84	1	5	3.23	.797
B	84	2	4	3.19	.649
C	84	1	4	3.21	.660
D	84	1	4	3.27	.782
E	84	1	4	3.20	.741
F	84	1	4	3.21	.678
G	84	1	4	3.23	.734
H	84	2	4	3.25	.557
I	84	1	4	3.37	.708
J	83	2	4	3.48	.549
Valid N (listwise)	83				

Research Question 4: Analysis Evidence using SPSS Version 23

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
A	83	1.00	4.00	3.2048	.77710
B	84	1.00	4.00	3.2381	.70487
C	83	2.00	4.00	3.3373	.64915
D	84	1.00	4.00	3.1071	.71166
E	84	1.00	4.00	3.1905	.71937
F	84	2.00	4.00	3.1786	.58414
G	84	1.00	4.00	3.1190	.76685
H	84	1.00	4.00	3.2500	.69204
I	84	2.00	4.00	3.2381	.68757
J	84	2.00	4.00	3.4881	.64926
Valid N (listwise)	82				

Research Question 5: Analysis Evidence using SPSS Version 23

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
A	83	2.00	4.00	3.2289	.61138
B	84	2.00	4.00	3.4405	.58806
C	84	2.00	4.00	3.3929	.56007
D	83	2.00	4.00	3.2771	.47661
E	84	1.00	4.00	3.2976	.69038
F	84	2.00	4.00	3.4286	.62644
G	84	1.00	4.00	3.1786	.56314
H	83	1.00	4.00	3.2892	.63496
I	84	1.00	4.00	3.2381	.72176
J	84	2.00	4.00	3.3452	.57023
Valid N (listwise)	81				

Research Question 6: Analysis Evidence using SPSS Version 23

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
A	83	1.00	4.00	3.3253	.78256
B	84	1.00	4.00	3.2857	.73749
C	83	2.00	4.00	3.2892	.63496
D	84	1.00	4.00	3.2262	.58806
E	84	2.00	4.00	3.2143	.51651
F	84	2.00	4.00	3.3452	.64926
G	84	2.00	4.00	3.2381	.59352
H	84	1.00	4.00	3.2857	.78497
I	84	1.00	4.00	3.3690	.70761
J	84	1.00	4.00	3.4762	.63009
Valid N (listwise)	82				

Research Question 7: Analysis Evidence using SPSS Version 23

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
A	84	2	4	3.15	.503
B	84	2	4	3.19	.502
C	84	1	4	3.33	.646
D	84	1	4	3.18	.697
E	84	1	4	3.38	.599
F	83	1	4	3.29	.595
G	84	1	5	3.10	.688
H	84	1	4	3.05	.877
I	84	1	4	2.55	.798
J	84	1	4	2.39	.836
Valid N (listwise)	83				

Hypotheses Testing Evidence Tables for 7 Research Questions

One-Way ANOVA Testing Result for Research Question 1 using SPSS Version 23

MEAN	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.928	2	.464	6.221	.003
Within Groups	6.044	81	.075		
Total	6.972	83			

One-Way ANOVA Testing Result for Research Question 2 using SPSS Version 23

MEAN	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.104	2	.052	.705	.497
Within Groups	5.962	81	.074		
Total	6.066	83			

One-Way ANOVA Testing Result Evidence for Research Question 3 using SPSS Version 23

MEAN	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.361	2	.181	2.489	.089
Within Groups	5.881	81	.073		
Total	6.242	83			

One-Way ANOVA Testing Result Evidence for Research Question 4 using SPSS Version 23

MEAN	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.951	2	.476	7.321	.001
Within Groups	5.264	81	.065		
Total	6.215	83			

One-Way ANOVA Testing Result Evidence for Research Question 5 using SPSS Version 23

MEAN	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.012	2	.006	.177	.838
Within Groups	2.664	81	.033		
Total	2.676	83			

One-Way ANOVA Testing Result Evidence for Research Question 6 using SPSS Version 23

MEAN	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.215	2	.107	2.132	.125
Within Groups	4.075	81	.050		
Total	4.289	83			

One-Way ANOVA Testing Result Evidence for Research Question 7 using SPSS Version 23

MEAN	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.379	2	.190	3.431	.037
Within Groups	4.478	81	.055		
Total	4.857	83			