Chapter One

Introduction

Background of the Study

Early 1970's many industrialized nations, recognizing the benefits of computer aided design and manufacturing to their economies, have promote its adoption by both state and private enterprises. The automated factory, made possible by advances in microchip technology, has become more available at increasingly less cost to a greater number and wider variety of business. Millions of dollars have been spent in Europe, the United Kingdom, Japan and the United States to encourage the development and adoption of this technology by industry. Creating a coincident increased in the demand for technical expertise. The development of required training and education for this technology has been left to the CAD vendors, universities, technical institutes, and trade schools with little or no assistance from government. As a result, education and training for CAD have become a priority in their countries.

The Canadian government, recognizing the need for expertise in those areas, has encourage provincial educational institutions to develop appropriate training programs through its skills Growth fund and other program. In Nigeria, there are some institutions presently offering a variety of high technology oriented courses. In most cases, this training is offered as a part of drafting technology,

engineering, or similar program. Although there is considerable demand for offerings of computer aided drafting as an upgrade course for engineers, architects, designers, draftsmen and other professional.

There, appears to be little distinction between computer aided design and computer aided drafting and it should be noted that most institutions are offering computer aided drafting along with their regular courses in design, more system will become available that incorporate the design parameters and manufacturing control with the drafting software. For the purpose of this study, it was considered to be concerned with engineering analysis rather than the act of conceptualizing.

The computer education available at the universities level has trickle down to secondary school level. Word processing, which was once available only at colleges and trades schools, is now being taught at junior secondary schools. The same analogy may apply to the computer aided drafting technology. If this technology is to trickle down into the secondary schools, as it appears to be doing, a revision of present drafting curriculum become increasingly important even without adopting this technology at the secondary level, skills presently being taught should be examined as to their suitability for the technology of the workplace or further training. Manual drafting, as a vocation is rapidly

disappearing but the need for appropriate drafting skills may be more important now for an increasing number of occupations than ever before.

So the influenced of curriculum in the recognition of changes in technology and incorporating them. AsKachiku (2009) statedthat if industrial arts drafting programs are to remain effective and current, it is Essential that the industrial arts educators scrutinize and incorporate new practicesand innovation of industry into the drafting programs''.

Further support is offered by Danrandah (2006)It is necessary for industrial educators to keep abreast of the rapid advancements in the field of technology, not only must they be cognizant of changes taking place in Industry,they must also find means of implementing these technological changes.

Statement of the Problem

Since Technical drawing is said to be the backbone of the whole computer aided drafting to which people were exposed to real hand working activities like shading, rendering and perspective drawing. Therefore computer aided drafting in whatever form should not be allowed to create barriers that will isolate CAD operators or restrict creativity to hamper the free flow of ideas from one person to another, especially with the modern methods of drawing. Even though, one of the greatest problems facing this modern methodis the shortage of people to handle the program.

Purpose of the Study

The purpose of this study is to identify through survey of industries the prerequisite skills most appropriate to training and or employment in computer aided drafting.

Objectives ofthe Study

1. To find out the educational background of those individuals presently operating CAD system.

2. To determine the predominant methods by which individuals in industry received their CAD training.

3. To find out the area of Drafting where CAD use is more prevalent

4. To find out the ease of operation of different CAD package simplify work in industry

5. To determine the size or type of the CAD system in use in industry.

Research Questions

The following research questions were assumed by the researcher.

1. What is the Educational background of CAD operators in North West Nigerian industry?
2. What are the most suitable methods of receiving CAD training in North West Nigeria industry?
3. How do areas of Drafting were CAD use more prevalent in North West Nigeria industry?
4. How does ease of operation of different CAD package operate in North West Nigeria industry?
5. What is the size or type of the CAD system use in North West Nigeria industry?

Significance of the Study

The finding will enable an informed revision of present curriculum and a variety of related subjects. It will also allow educators to better inform students about specific requirement for CAD related occupations and will help to strengthen the relationship between industry and educational institution in North Western Nigeria.

Area of the Study

The study was carried out in three (3) selected states in North West Nigeria, They are:

1. Kaduna state
2. Kano state
3. Katsina state

Brief history of Kaduna State

Kaduna State was part of the former North – central state, which was created in 1967 when Nigeria change from four (4) Regional systems to 19 state structure in 1967. It was divided into two along the line of the old provincial boundary, thus Katsina province become Katsina state, while Zaria province formed the present Kaduna state.

The state capital is Kaduna, a state it has enjoyed since the old Northern Region days, there are twenty three (23) Local governments in the state, and it covers an area of 44,408.3 square kilometers. The population according to 2006 census is 6,065,562, which then put the density at about 137 persons per square kilometer.

Kaduna state is a major industrial axis in the North; whole Kaduna town has a lot of commercial activities and Industries like the Peugeot car assembly and petroleum refinery. Few textile Industries still exist. The state has an airport, which is accessible all year round because of fair weather. It is also a major railway junction for the entire railway system between the North and the South.

Brief history of Kano State

Kano state was among the 19 states created in May 1967 out of the former Northern Region. The state remained intact until August 27, 1991, when jigawa state was curved out of it. It is located in the North West geo – political zone of Nigeria, Hausa and Fulani, who are predominantly Muslims, Inhabitant Kano state.

Kano state is one of the largest states in Nigeria in terms of population having a population of about 9,383,682, in the 2006 census, it has 44 local

government Areas, with an area of 20,467.6 square kilometer. The population density is about 485 people per square kilometer. The walled city of Kano, which serves as the state capital, is the commercial nerve centre of kano state and indeed the whole of northern Nigeria. Many Immigrants mainly Yoruba, Igbo live in Kano city. Six local government areas (Fagge, Gwale, Tarauni,Kano Municipal, Nasarawa, and Dala) have virtually merged into what a visitor would called Kano Metropolis.

The official language of Kano is Hausa; But English language is commonly spoken as the country's official language. Most natives can also read Arabic literature.

Historically; Kano state has been a commercial and agricultural state, which is known for the production of groundnut. The state has over 18,684 square kilometers of cultivated land and it is noted for its famous markets and it is the most leading Industrial centre in the north. Trading articles in Kano city include leather goods, local crafts, dyed textile materials as well as camels. Giant Industrial plants include textile, oil, motor assembly, bicycles assembly and many agro – based industries. Kano city is linked by road, rail line, and air to all parts of the country and internationally.

Brief history of Katsina State

Katsina State is located in the North West geo – political zone of Nigeria. It was created from old Kaduna state in September 23, 1987, and it has thirty four (34) local government Areas. The capital is Katsina, and land area is 23,920.9 square kilometers. The other main towns are Funtua, Malumfashi, Dutsinma, Daura and Kankiya. They have assumed urban status.

The main languages spoken are Hausa and Fulfulde, Islam is the main religion. The main occupation is farming.

Industrially, Katsina state is making progress with its oil mill and steel rolling mill. The state is very rich in art and cultural heritage, and it is linked by road, rail line and air to other parts of the country.

Limitation of the Study

The study is limited only to those industries in North Western Nigeria use computer aided drafting.

Definition of terms

Computer Aided Drafting (CAD): - Drafting done with the aid of a computer where entry of data is made primarily through graphic construction at the terminal and output is made through an electronic plotter.Bertoline, G.R (1988)

Computer Aided Design: - For this study, design done with the aid of computer where entry of data enables analysis of specific design parameter.Bertoline G.R (1988)

Course: - Organized subject matter in which instruction is offered within a fixed time period and for which credit toward graduation or certification is usually given.www.google.com

Computer: - any machine capable of accepting information performing numerical and logical manipulation and displaying the result. Cheng W.L (1995)

Curriculum: - The planned composite effort of any school to guide pupil learning toward predetermined learning outcomes.www.google.com

Hardware: - The mechanical magnetic, electrical and electronic devices from which a computer is constructed. Ahmad K.Y (2005)

Software: - Computer programs and collection thereof, including compilers and assemblers which can be used to generate other programs. Ahmad K.Y (2005)

Technology: - Industrial science, the science or systematic knowledge of industrial arts, especially as applied to manufacturing. Danrandah S.Y (2006)

Industry: - For this study, any business employing personnel to operate CAD systems. Geotsch B.L (2003)

Industrial education: - For this study education relating to the methods processes and materials of industry.Geotsch B.L (2003)

Vocational education: - Education relating to the acquisition of specific skills for an occupation.www.google.com

Technical Education:- Is provided in general – education and lays the foundation needed to acquire the technical knowledge and skills.www.google.com

Chapter Two

Literature Review and Previous study

In the early 1960's heralded significant changes within the field of drafting and design when major industrial companies, such as Boeing and General Motors in the U.S.A accepted the use of Computer Aided Drafting and Design (CAD) as the latest technological tool in manufacturing.

CAD in Manufacturing Industry

CAD has forced its ways into the manufacturing industry significantly changing the international accepted methods used to produce drawings Bertoline(1988), which has had an effect on the drafting and design industry far greater than all the previous changes combined Fuller(1998). This change is self – evident by the fact that prior to the introduction of CAD the drafting and design industry worldwide was still employing the same tools and instruments that were used by Euclid (the father of geometry and Pythagoras).

CAD Improvement

The improvement of recent CAD technology, coupled with steady reduction in necessary capital investment for essential hardware and software, have been two of the main reasons for CAD increasingly becoming more common place throughout industry.

Despites the general economic downturn in Nigeria, if current trends persist, CAD will reach boom proportions during the year 2020's.

CAD Benefit

The major benefit of any CAD system is increased efficiency which translates directly to greater productivity and in turn higher profitability (Cheng, 1995). CAD system can produce drawings of higher consistency, greater accuracy, neatness, legibility and much faster(Shehu,2003). The production of CAD generated drawings can be from 2 – 10 times faster than manual drafting (Dahiru, 2004).

The increased speed in producing CAD generated drawings is achieved from a range of operating features incorporated within the system. Automatic dimensioning, quick easy lettering selected from an extensive range of styles, the provision of overlay functions, the elimination of repetitive work, storage and recall of information (full and part drawings), and most importantly, the facility to make instant corrections all contribute to the significant increase in production speed and operator efficiency (Goetsch, 2011), (Hall, 2012) and (Giesecke, 2013).

Acceptance ofCADby Industries

Industry's acceptance of CAD technology has had a direct effect on related occupations, (e.g. Architecture, Electrical and Mechanical Engineering) bringing about changes in the numbers of workers required and the very nature of the occupations involved. Computer – Aided Manufacturing (CAM), an evolutionary extension of CAD, is now extensively being used to help plan, operate and manage complex production systems.

CAD/CAM in Automotive Industries

CAM is helping to automate industries in order that their operations may become more productive through the freeing of people from boring repetitive task and allowing them more time to be creative and solve problems, It has been estimated Mamman(2001) that by the turn of the century there will be in excess of 1.2 million jobs created for CAD/CAM within the U.S.A. If this projection proves correct, than given the same circumstances, the growth in demand for CAD/CAM related occupations (proportionate to population) is likely to occur in Nigeria. Similarly, with increase of automation in manufacturing there is high probability of a corresponding increase for more CAD operators.

Western Australia is recognized as a leader in the field of CAD (Lingana, 1999), especially within the areas of mining and geology. The West Australian State Energy Commission (SECWA) is the largest user of CAD in Australian

(Lingana, 1999). In the light of this evidence there is a strong suggestion that CAD technology, which is gathering ever – increasing acceptance by the drafting and design industry, has a significant potential benefit to the needs of industrialized society.

The significance to society in general has been put into perspective by (Fuller, 1998) who states that a computer – aided drafting system is to drafting what a word - processor is to Word and writing".

CAD Training Requirement by Industry

Industry's requirement for employees trained in the use of CAD systems is quite clear. If the education system cannot provide industry with computer literate people then industry will be set back up to two years (Hall, 2012).The establishment of computer aided drafting and design within Tertiary institutions will not only confirm in the minds of students the relevance of current technology, but will ensure that graduates take with them into industry their CAD background. Both industry and students derived benefit (Shehu, 2007) and(Dahiru, 2010). Therefore, responsibility falls to the schools to aid industry in meeting its needs.

Virtually every type of drafting is being done with the assistance of CAD (Mamman, 2014), but it should be stressed that the computer does not draw, the

operator does. Therefore, this suggest that the operator needs to be aware of the concepts and meanings of drafting techniques (Perasand Hoggard, 2002) and have the ability to visualize objects within this context in order to obtain a basic mastery of Technical Drawing. Consequently, Traditional drafting classes will not be replaced by CAD, but will be a necessary pre – requisite (Danranda, 2008). The research suggests that CAD should be related to and incorporated within the existing curriculum, rather than become a separate course of study and simultaneously students need to be reminded that drafting is a dynamic and changing field Noderer(1999) in which CAD has become a valuable aid.

CAD operators need to be given a general understanding of basic concepts and principles of CAD followed by 'hands – on' experience, because they tend to forget the instruction over a period of time if not practice (John, 2003). CAD should not be seen as a video game to be learned by trial and error. Instruction needs to be structured, whilst providing a measure of freedom for student self – expression (Bognet, 2005). Although CAD does de - emphasize the use of traditional drafting instruments (Peres and Hoggard 2002) Technical Drawing remains a skill oriented subject, rather than pretty picture development (Sweet, 2008).

Methods of CAD instruction would vary in relationship to the ratio of students to computers. Becker (1997 p. 27) suggests that there are four viable (if not ideal) methods of CAD instruction with limited facilities, i.e.:

1. Class lecture with supplement hand – out
2. Step by step self tutorial
3. Rotation of students
4. Students aides

Some of the more traditional aspects of Technical Drawing (e.g. lettering, construction techniques, dimensioning) are performed automatically when using a CAD system to produce drawings. This being the case, it permits a greater emphasis to be placed on creativity and problem solving. (Sweet,2008) (Fesolowich, 2007) and(Sorensen, 2008).

The increasing acceptance of computer - aided drafting represents a serious challenge to drafting instructors and Technical Drawing teachers with respect to the need to update their educational skills (Goetsch, 2003). It may be suggestedthat traditional methods of assessment and evaluation may no longer be relevant and demand re – definition.

CAD produces drawings plotted to program uniformly, eliminating the need for line quality assessment. Sweet (2008) makes the observation that it is difficult to

assess student CAD work, but the literature offers no suggestion as to how this problem for teachers might be overcome. Shehu (2000) stated that he doesn't mark any of the students work, but only records completion of set exercises.

Following the introduction of CAD into Technical Drawing classes some teachers have observed a significant increase in students motivation and enthusiasm (Mamman, 2014) Ahmad (2005) suggests that there is a flow on of enthusiasm to the instructor, which if correct should contribute to a more positive and beneficial learning environment within Technical Drawing in general.

The need to improve the curriculum of Architecture courses has been the subject of heated discourse and strategic positioning over the last decade (Chukwuali, 2001)(Mbina, 2007)(Nkwogu, 2003)(Sa,ad 2001).Many of the champions of change are in a position to implement their visions, and so there has been a gradual realignment of the curriculum to 21st century realities. There has been a general agreement on the need to introduce CAD proficiency into the curriculum, but the extent and rate is still the subject of debate (Ogunsote2001)

A very problematic area is whether or not a CAD trainee should be allowed to produce only CAD version of their final year projects, given the ease with which

projects can be copied the internet. The issue of lack of a standard curriculum for CAD raised by Ogunsote(2003) should however be urgently addressed.

Ogunsote (2002) identified the following categories of Computer Aided Drafting software.

Categories of Computer Aided Drafting Software

1. 2D and 3D modeling software
2. Rendering software
3. Animation software
4. Bitmap (Photo) editing software
5. Graphics software
6. Presentation software
7. Desktop publishing software

These categories are group into two classes: CAD software and Graphics software, which mentioned in table 2.1 and 2.2 below

Table 2.1 CAD software categories.

Category	Examples of software

2D and 3D modeling software	AutoCAD 2004, Architectural Desktop 2004, ArchiCAD 8
Rendering software	Autodesk 3D Studio viz, Auto Desk3D Studio Max, Accurender, Architectural Desktop 2004, AchiCAD, AutoCAD 2004
Animation software	Auto Desk 3D Studio Max, Architectural Desktop 2004, Corel Photo Paint

Table 2.2 Graphic software categories

Category	Example of Software
Bitmap (Photo) editing software	Adobe Photoshop, Microsoft paint, Corel Photo paint, Micrographic picture publisher.
Graphics software	Corel Draw, Micrographic Designer
Presentation software	Microsoft Power Point, Harvard Graphics
Desktop Publishing software	Adobe PageMaker, Microsoft publisher
Device drivers	HP Photo real, Adobe Postscript, Scanner drivers, Digital camera drivers
Software tools	Acrobat distiller, Acrobat Reader, Imaging for

	Windows

CAD Expertise Area

CAD requires expertise in the following areas:

1. Basic computer literacy
2. CAD concept and theory
3. Graphics software
4. 2D CAD
5. 3D CAD and visualization

CAD/CAM should be taught only to those trainees who require it;there are circumstances where it is more efficient to offer some courses as service courses to several departments. There are some basic skills that should be acquired by all trainees of CAD, Architecture, Planning and Engineering. This skill can be acquired through common courses.

CAD concept and theory

There are several concepts and theoretical constructs that form the basis of CAD software. These concepts include layers, block, arrays, color, line types, line weights, and text and dimension styles, coordinate systems, relative and absolute

coordinates, layouts, paper space, model space views viewpoints, plotting, hatching, dimensioning, object selection, object properties, object snap, lighting, materials, panning, zooming and orbiting. While these concepts are best understood when demonstrated on a computer, it is important to teach these concepts in a classroom environment. Good understanding of these concepts is essential in understanding and using CAD software. A workshop environment where theory can be discussed and concepts demonstrated is best. However, these concepts can still be taught successfully where there are very few computers.

Shehu (2003) stated that Computer- aided design (CAD) refers to the process of using computers and specialist software to create virtual three-dimensional model and two-dimensional drawings of products. Vary different types of (CAD) software have been developed for use across a range of applications and industries. Dahiru (2004) opined that, Computer – aided Design (CAD) in context is generally computer software used by computer system to generate, alter or optimize a design and to support in precision drawing.

Basic computer literacy

Every trainee should have a certain minimum level of computer literacy which must be part of the training.

1. **Computer Appreciation.** This course should teach the basic and history of computing, including familiarization with the hardware and software. At the trainee should be able to work independently on a computer performing simple task.
2. **Operating systems**. This should cover the latest or recent version of Microsoft Windows and other operating system as applicable. At the end trainee should be able to work freely in a Windows environment, even without a pointing device.
3. **Internet Appreciation**. Each trainee should be able to work freely on the World Wide Web using email, chat rooms, search engines and directories.
4. **Application package**. Every trainee should learn how to use the most popular word processing, spreadsheet and data base and presentation software. This may include Microsoft word, Microsoft Excel, Lotus 123, Microsoft Access and Microsoft PowerPoint,

Graphics Software

Shehu (2003) opined that even the best CAD design will lose its impact if poorly presented, many aspect of trainee also require advanced skills in report writing, sketching, formatting and presentation. A good knowledge of graphics software such as Adobe Photoshop, Microsoft paint, Corel photo point etc

2D CAD

Proficiency in two – dimensional (2D) Computer Aided Drafting includes the ability to independently produce basic drawings such as plans, elevations, section details and schedules at a professional level, Mastering CAD software such as Auto CAD 2004 is essential.

3D CAD and Visualization

Dahiru (2004) opined that 3D covers the ability to produce life – size and detailed models of buildings and complexes using advance techniques including day lighting, artificial lighting, materials and landscape element such as plants, people, animals and vehicles. Trainee should be able to produce photo- realistic renderings and animations at a professional level. Mastering CAD software's such as: AutoCAD 2004, Auto Desk and Architectural Desktop 2004.

Shehu (2003) stated that Computer- aided design (CAD) refers to the process of using computers and specialist software to create virtual three-dimensional model and two-dimensional drawings of products. Vary different types of (CAD) software have been developed for use across a range of applications and industries. Dahiru (2004) opined that, Computer – aided Design (CAD) in

context is generally computer software used by computer system to generate, alter or optimize a design and to support in precision drawing.

Previous Studies:

1. Study of Dikko, S. (2009). Titled: *Attitude of Design Students toward Usage of ComputerAided Drafting*:Aimed of the study is to examine the attitude of Design Students toward usage of Computer Aided Drafting/Design. The

researcher used Survey research method, and the instrument used for data collection is closed questionnaire. The sample method used is Random sampling method.

Results are:

1. It is found that this attitude correlates with their attitude toward computer Aided Drafting in general
2. There is no correlation between this attitude and students perception of their instructors

2. Study of Dahiru, K. (2013). Titled: *Effect of the use of Computer Aided Design (CAD) on Architecture*: Aimed of the study is to find out the effect of use of Computer Aided Drafting/Design (CAD) on Architecture, A quantitative approach. The researcher used Quantitative research approach and the instrument used for data collection is by open ended interview method. The sample method for the study is Random sampling method

Results are:

1. The use of Computer Aided Drafting/Design (CAD) has overriding advantages over the traditional Drafting/Design construct

2. Computer Aided Drafting/Design is a mere tool that assist the Drafting procedure
3. Physical tangible tool which transforms the obstruction of the user into reality on the paperless board just like the old traditional methodology of Drafting does too

3. Study of Bognet, J.Y (2014) Titled:*Achieving Computer Aided Drafting/Design(CAD) proficiency by Architecture Graduate in Nigeria*. The researcher used Survey research method and the data collected is by closed form questionnaire. The sample method used for the study is Random sampling method.

Results are:

1. Several schools of Architecture already have large computer laboratories, while practically all schools have computers
2. Problem of Computer Aided Drafting/Design (CAD) illiteracy in lecturers is also gradually becoming a thing of the past with most lecturers now having their own computers.
3. Students have started buying their own computers.
4. To integrate Computer Aided Drafting/Design (CAD) proficiency into Architecture Curriculum.

4. Study of El-ladan, M. N (2012) Titled:*The Impact of Computer AidedDrafting/Design (CAD) Technologies on Engineer's Education*. The aimed of the study is to find the Impact of Computer Aided Drafting/Design (CAD) Technologies on Engineer's Educators. The researcher used Survey research method and data collected by using closed form questionnaire. The sample techniques used by the researcher is Random sampling method.

Results are:

1. Lack of specific knowledge that manifest in increase demand to faculties and educational centers
2. Demand for Computer Aided Drafting/Design (CAD) courses from companies are very often inspired because of the increased cooperation with foreign companies that mostly used parametric and features based part and assembly computer models in their production.

Summary

The literature reviewed in this document has illustrated clearly the need of industry for CAD trained employees; plus the responsibility of the education system (within North western Nigeria) to provide the opportunity for students to gain the appropriate exposure to the latest technology currently used in drafting and design.

Attention has been drawn to the widely held view Shehu(2003) Dahiru(2004) Dan randa, (2005)Mamman and Ahmad (2006) that fundamental and traditional concepts, conventions and standards of drafting need to be taught to and understood by students as a pre – requisite to CAD experience.

Opposition to this is Bognet, but John (2011) states the basics of drafting can be learned if a CAD system is used from the start.

The literature suggests that because of the nature of CAD and the limited resources available within schools generally, there would tend to be necessary adaption's required to teaching strategies on the part of Technical Drawing teachers Ahmad(2004)

Chapter Three

ResearchMethodology and Design

Introduction

This chapter describes the design of the study, area of the study, population, instrument for data collection, validity of the instrument, reliability of the instrument, method for data collection and methods for data analysis.

Research design

The research design used for the study is a simple survey research design. According to Van (2010) a survey research is one which involves the assessment of public opinion using questionnaire and sampling methods, when conducting survey, researcher collected detailed descriptions of existing phenomena with the intents of employing the data to justify current conditions and practices or to make more intelligent plan for improving them.

Population of the Study

The target populations of this research study are fifty five (55) CAD operators in industries of North West Nigeria states. But the accessible population is forty eight (48) Computers aided drafting / design (CAD) operators in industries (firm) of North western Nigeria states.

Sample of the Study

The sample size of the study is obtained by using the 'Yaro Yamane' formula for a finite population. The formula is given as

$$n = \frac{N}{1 + N\,(e)^2}$$

Sampling techniques

The Sampling techniques use for the study is Purposive sampling method.

Instrument for data collection

The researcher constructed the questionnaire meant for data collection which covers all aspect of the research questions. The questionnaire were designed in a fixed respondent form using Likert 5 points rating scale, that is 1 = Strongly disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, 5 = Strongly agree. The data were collected with a view of establishing the implementation level of Computer aided design within the North western Nigeria industries

Validation of the instrument

For the purpose of content validation, the questionnaires were presented to three (3) lectures of the Department of Education (Technical), Kaduna polytechnic, Kaduna state Nigeria. For constructive criticism, scrutinizing and suggestions before were finally administered. This is to ensure that the instrument is capable of eliciting the intended information from the respondents. Thus satisfying content and face validity as well as eliminating any form of ambiguity.

Reliability of the instrument

A reliability analysis was carried out on the perceived task values scale comprising 25 items. Cronbach's alpha showed the questionnaire to reach acceptable reliability = 0.83. Most items appeared to be worthy of retention, resulting in a decrease in the alpha if deleted.

Procedure for data collection

To ensure good return of questionnaires the researcher were actively involved in both in administering and collection. There were cases where friends rendered valuable assistance in that respect.

Procedure for data analysis

The data were analyzed using graphs and Chi – square statistical distribution. This method was used to ensure adequate and comprehensive data presentation. In applying this method, the responses to the questions in the questionnaire were collected according to the option given. The data collected were presented using tables, graph (bar chart) and hypothetical test was conducted using chi – square statistical techniques. If the computed value of the chi – square is found to be higher than the critical table value, than, it will lead to the rejection of the null hypothesis or vice versa.

Equation for Chi – Square value

By using the equations below the chi - square value is computed as

H_0: $W = W_0$ ……Equation (1)

Where, W and W_0 represent the Chi – square statistic and the hypothesized value of the Chi – square statistic respectively. Equation (2) defines W:

$$W = \chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{c}\left(o_{ij} - e_{ij}\right)^2 / e_{ij}$$ ……Equation (2)

Whereas

$e_{ij} = \frac{ri \ x \ cj}{Grand\ total}$

When n is the number of interval i (i = 1, 2…n) and o_i and $e_i$the observed and expected frequency for each interval i.

Where $o_{ij}$and $e_{ij}$are the observed and expected frequency values in row *i*and column *j* of the table the number of rows (r) and columns (c). Setting*ij* = *i*, then $o_{ij} = o_i$ and $e_{ij} = e_i$

The test was conducted as follows:

Step 1: Select a hypothesized distribution for the given sample and depict the sample space used.

Step 2: Select a specified significant level α. α =0.05 was used in this work.

Step3: The rejection region was set as $R \geq \chi^2_{1-\alpha}(n-m-1)$, where $\chi^2_{1-\alpha}(n-m-1)$ is the (1 – α) 100 percentile of the Chi – square distribution with (n-m-1) degrees of freedom. m is the number of parameters estimated from the sample.

Step 4: The chi – square statistic W. was calculated using Equation (2)

Step 5: The null hypothesis is rejected if W >R; otherwise it is not rejected.

Chapter Four

Data Presentation and Analysis

The purpose of this study was to determine, through a survey of industry the prerequisite skills and knowledge for employment in the field of computer aided drafting. Closed questionnaires were sent to representatives industries and the returned data tabulated and analyzed.

The data were analyzed using a chi – square test of independence and percentage frequency. If the computed value of the chi – square is found to be higher than the critical table value, then, it will lead to rejection of the null hypothesis; otherwise, it will not be rejected.

Table 4:1a Analysis of items 1 to 5 on the questionnaire which translate research question no 1.

What is the Educational background of CAD operators in your industries?

Questions	SD	D	U	A	SA	TOTAL
Draftsperson retrained for CAD	8	2	1	7	10	28
Technicians or Technologist	15	16	20	13	15	79
Trained CAD Draftsman	15	17	15	15	11	73
Computer Specialist	10	12	12	11	8	53
Professional	0	1	0	2	4	7
TOTAL	48	48	48	48	48	240

Hypothetical test: The null hypothesis represented by equation (1), states that "There is no significant relationship between Draftsperson retrained for CAD, Technician or Technologist, Trained CAD Draftsman, Computer Specialist and professional.

Table 4:1b. Chi – square distribution test table of research question number 1.

o_{ij}	e_{ij}	$(o_{ij} - e_{ij})^2$	$(o_{ij} - e_{ij})^2 / e_{ij}$
8	5.6	5.76	1.0286
15	15.8	0.64	0.0405
15	14.6	0.16	0.0110
10	10.6	0.36	0.0340
0	1.4	1.96	1.4000
2	5.6	12.96	2.3143
16	15.8	0.04	0.0025
17	14.6	5.76	0.3945
12	10.6	1.96	0.1849
1	1.4	0.16	0.1143
1	5.6	21.16	3.7786
20	15.8	17.64	1.1165
15	14.6	0.16	0.0110
12	10.6	1.96	0.1849
0	1.4	1.96	1.4000
7	5.6	1.96	0.3500
13	15.8	7.84	0.4962
15	14.6	0.16	0.0110
11	10.6	0.16	0.0151
2	1.4	0.36	0.2571
10	5.6	19.36	3.4571
15	15.8	0.64	0.0405
11	14.6	12.96	0.8877
8	10.6	6.76	0.6377
4	1.4	6.76	4.8286
		W	**22.996**

The table 4:1b above is the calculated Chi – square statistic value of questionnaire items 1 to 5 statement which translates research question number 1, is calculated as 22.996 The value of R = $\chi^2_{0.05}$ (19) from the standard Chi – square distribution table is 30.1435. Since W > R, the null hypothesis which states that "there is no significant relationship between Draftsperson retrained for CAD, Technician or Technologist, Trained CAD Draftsman, Computer Specialist and professional is not rejected.

Table 4:1c is the value of chi – square run by using spsssoftware which read 22.996.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	22.996[a]	16	.114
Likelihood Ratio	26.138	16	.052
Linear-by-Linear Association	.008	1	.929
N of Valid Cases	240		

a. 5 cells (20.0%) have expected count less than 5. The minimum expected count is 1.40.

Table 4:2a: Analysis of items 6 to 10 on the questionnaire which translate research question no 2.

What are the most suitable methods of receiving CAD training in your industries?

Questions	SD	D	U	A	SA	TOTAL
Self taught CAD	5	6	9	10	9	39
Technical college CAD courses	16	18	16	16	15	81
University Courses In CAD	15	11	10	14	9	59
Post graduate courses in CAD	11	11	11	8	13	54
In – house courses in CAD	1	2	2	0	2	7
TOTAL	48	48	48	48	48	240

Hypothetical test: The null hypothesis represented by equation (1), states that "There is no significant relationship between self taught, Technical college CAD courses, Universities Courses in CAD, Post graduate courses in CAD and in – house courses in CAD.

Table 4:2b. Chi – square distribution test table of research question number 2.

o_{ij}	e_{ij}	$(o_{ij} - e_{ij})^2$	$(o_{ij} - e_{ij})^2 / e_{ij}$

5	7.8	7.84	1.0051
16	16.2	0.04	0.0025
15	11.8	10.24	0.8678
11	10.8	0.04	0.0037
1	1.4	0.16	0.1143
6	7.8	3.24	0.4154
18	16.2	3.24	0.2000
11	11.8	0.64	0.0542
11	10.8	0.04	0.0037
2	1.4	0.36	0.2571
9	7.8	1.44	0.1846
16	16.2	0.04	0.0025
10	11.8	3.24	0.2746
11	10.8	0.04	0.0037
2	1.4	0.36	0.2571
10	7.8	4.84	0.6205
16	16.2	0.04	0.0025
14	11.2	7.84	0.7000
8	10.8	7.84	0.7259
0	1.4	1.96	1.4000
9	7.8	1.44	0.1846
15	16.2	1.44	0.0889
9	11.2	4.84	0.4321
13	10.2	7.84	0.7686
2	1.4	0.36	0.2571
		W	8.8265

The table 4:2b above is the calculated Chi – square statistic value of questionnaire items 6 to 10 statement which translates research question number 2, is calculated as 8.8265. The value of R = $\chi^2_{0.05}$ (19) from the standard Chi – square distribution table is 30.1435. Since W > R, the null hypothesis which states that “there is no significant relationship between self taught, Technical college CAD courses, Universities Courses in CAD, Post graduate courses in CAD and in – house courses in CAD is not rejected.

Table 4:2c is the value of chi – square run by using spsssoftware which read 8.449

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.449[a]	16	.934
Likelihood Ratio	9.909	16	.871
Linear-by-Linear Association	.632	1	.427
N of Valid Cases	240		

a. 5 cells (20.0%) have expected count less than 5. The minimum expected count is 1.40.

Table 4:3a: Analysis of items 11 to 15 on the questionnaire which translate research question no 3.

How do areas of drafting were CAD use more prevalent in your industries?

Questions	SD	D	U	A	SA	TOTAL
Electrical Drafter is prevalent	6	6	6	4	2	24
Mechanical Drafter is prevalent	0	2	3	1	2	8
Survey, Mapping and Topographies Drafter is prevalent	17	19	10	14	11	71
Civil (Structural) Drafter is prevalent	8	10	12	12	14	56

Architecture Drafter is prevalent	17	11	17	17	19	81
TOTAL	48	48	48	48	48	240

Hypothetical test: The null hypothesis represented by equation (1), states that "There is no significant relationship between Electrical and Electronic Drafter is prevalent, Mechanical Drafter is prevalent, Survey, Mapping and Topographies Drafter is prevalent, Civil Drafter is prevalent and Architecture Drafter is prevalent.

Table 4:3b. Chi – square distribution test table of research question number 3:

o_{ij}	e_{ij}	$(o_{ij} - e_{ij})^2$	$(o_{ij} - e_{ij})^2 / e_{ij}$
6	4.8	1.44	0.3000
17	16.2	0.64	0.0395
17	14.2	7.8	0.5521
8	11.2	10.24	0.8982
0	1.6	2.56	1.6000
6	4.8	1.44	0.3000
11	16.2	27.04	1.6691
19	14.2	23.04	1.6225
10	11.2	1.44	0.1286
2	1.6	0.16	0.1000
6	4.8	1.44	0.3000
17	16.2	0.64	0.0395
10	14.2	17.64	1.2423
12	11.2	0.64	0.0571
3	1.6	1.96	1.2250
4	4.8	0.64	0.2000
17	16.2	0.64	0.0006
14	14.2	0.04	0.0432
12	11.2	0.64	0.0077
1	1.6	0.36	0.9941
2	4.8	7.84	1.4696
19	16.2	7.84	0.7903

11	14.2	10.24	0.1441
14	11.2	7.84	1.0178
2	1.6	0.16	1.500
		W	16.2413

The table 4:3b above is the calculated Chi – square statistic value of questionnaire items 11 to 15 statement which translates research question number 3, is calculated as 16.2413 The value of R = $\chi^2_{0.05}$ (19) from the standard Chi – square distribution table is 30.1435. Since W > R, the null hypothesis which states that "there is no significant relationship between Electrical and Electronic Drafter is prevalent, Mechanical Drafter is prevalent, Survey, Mapping and Topographies Drafter is prevalent, Civil Drafter is prevalent and Architecture Drafter is prevalent is not rejected.

Table 4:3c is the value of chi – square run by using spsssoftware which read 16.684

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	16.684[a]	16	.406
Likelihood Ratio	19.866	16	.226
Linear-by-Linear Association	1.306	1	.253
N of Valid Cases	240		

a. 9 cells (36.0%) have expected count less than 5. The minimum expected count is 1.53.

Table 4:4a: Analysis of items 16 to 20 on the questionnaire which translate research question no 4.

How does ease of operation of different CAD package operate in your industries?

Questions	SD	D	U	A	SA	TOTAL
Very easy	15	15	16	14	12	72
Relatively simple	11	12	9	10	10	52
Moderately difficult	12	13	11	14	12	62
Difficult	9	7	12	10	11	49
Frustrating	1	1	0	0	3	5
TOTAL	48	48	48	48	48	240

Hypothetical test: The null hypothesis represented by equation (1), states that "There is no significant relationship between Very easy, relatively simple, moderately difficult, Difficult and Frustration.

Table 4:4b. Chi – square distribution test table of research question number 4:

o_{ij}	e_{ij}	$(o_{ij} - e_{ij})^2$	$(o_{ij} - e_{ij})^2 / e_{ij}$
11	10.4	0.36	0.0346
15	14.4	0.36	0.0250
12	12.4	0.16	0.0129
9	9.8	0.64	0.0653
1	1	0	0.0000
12	10.4	2.56	0.2462
15	14.4	0.36	0.0250
13	12.4	0.36	0.0290
7	9.8	7.84	0.8000
1	1	0	0.0000
9	10.4	1.96	0.1885
16	14.4	2.56	0.1778
11	12.4	1.96	0.1581
12	9.8	4.84	0.4939
0	1	1	1.0000
10	10.4	0.16	0.0154
14	14.4	0.16	0.0111
14	12.4	2.56	0.2065
10	9.8	0.04	0.0041
0	1	1	1.0000

10	10.4	0.16	0.0154
12	14.4	5.76	0.4000
12	12.4	0.16	0.0129
11	9.8	1.44	0.1469
3	1	4	4.0000
		W	**9.0686**

The table 4:4b above is the calculated Chi – square statistic value of questionnaire items 16 to 20 statement which translates research question number 4, is calculated as 9.0686 The value of R = $\chi^2_{0.05}$ (19) from the standard Chi – square distribution table is 30.1435. Since W > R, the null hypothesis which states that "there is no significant relationship between Very easy, relatively simple, moderately difficult, Difficult and Frustration is not rejected.

Table 4:4c is the value of chi – square run by using spsssoftware which read 9.068

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.068[a]	16	.911
Likelihood Ratio	9.725	16	.881
Linear-by-Linear Association	1.337	1	.248
N of Valid Cases	240		

Table 4:5a: Analysis of items 21 to 25 on the questionnaire which translate research question no 5.

What is the size or type of the CAD system use in your industries?

Questions	SD	D	U	A	SA	TOTAL
Personal computer	16	19	20	16	11	82
Multi – user computer	10	6	4	8	13	41
Mini – computer	15	8	11	15	10	59
Dedicated computer	6	13	11	8	14	52
Large main frame computer	1	2	2	1	0	6
TOTAL	48	48	48	48	48	240

Hypothetical test: The null hypothesis represented by equation (1), states that "There is no significant relationship between Personal computer, multi – user computer, minicomputer, dedicated computer and large main frame computer.

Table 4:5b. Chi – square distribution test table of research question number 5:

o_{ij}	e_{ij}	$(o_{ij} - e_{ij})^2$	$(o_{ij} - e_{ij})^2 / e_{ij}$
10	8.2	3.24	0.3951
16	16.4	0.16	0.0098
15	11.8	10.24	0.8678
6	10.4	19.36	1.8615
1	1.2	0.04	0.0333
6	8.2	4.84	0.5902
19	16.4	6.76	0.4122
8	11.8	14.44	1.2237
13	10.4	6.76	0.6500
2	1.2	0.64	0.5333
4	8.2	17.64	2.1512
20	16.4	12.96	0.7902
11	11.8	0.64	0.0542

11	10.4	0.36	0.0346
2	1.2	0.64	0.5333
8	8.2	0.04	0.0049
16	16.4	0.16	0.0098
15	11.8	10.24	0.8678
8	10.4	5.76	0.5538
1	1.2	0.04	0.0333
13	8.2	23.04	2.8098
11	16.4	29.16	1.7780
10	11.8	3.24	0.2746
14	10.4	12.96	1.2462
0	1.2	1.44	1.2000
		W	18.9186

The table 4:5b above is the calculated Chi – square statistic value of questionnaire items 20 to 25 statement which translates research question number 5, is calculated as. 18.9186. The value of R = $\chi^2_{0.05}$ (19) from the standard Chi – square distribution table is 30.1435. Since W > R, the null hypothesis which states that "there is no significant relationship between Personal computer, multi – user computer, minicomputer, Dedicated computer and large main frame computer is not rejected.

Table 4:5c is the value of chi – square run by using spsssoftware which read 18.083

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.083[a]	16	.319
Likelihood Ratio	19.542	16	.242
Linear-by-Linear Association	.007	1	.934
N of Valid Cases	230		

a. 5 cells (20.0%) have expected count less than 5. The minimum expected count is .99.

Percentage Analysis

Research question number 1.

Table 4:6 percentage analysis of Questionnaire item 1 to 5.

Opinion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	28	11.7	11.7	11.7
	D	79	32.9	32.9	44.6
	U	73	30.4	30.4	75.0
	A	53	22.1	22.1	97.1
	SA	7	2.9	2.9	100.0
	Total	240	100.0	100.0	

CAD Operators Background

Industries indicated that their CAD operators were usually trained CAD Draftsman with responded of 32.9% and Draftsperson retrained for CAD 30.4%, Technicians or Technologist with 22.1% Computer specialist has responded of 11.7% and the least among them is professional staff with 2.9%.

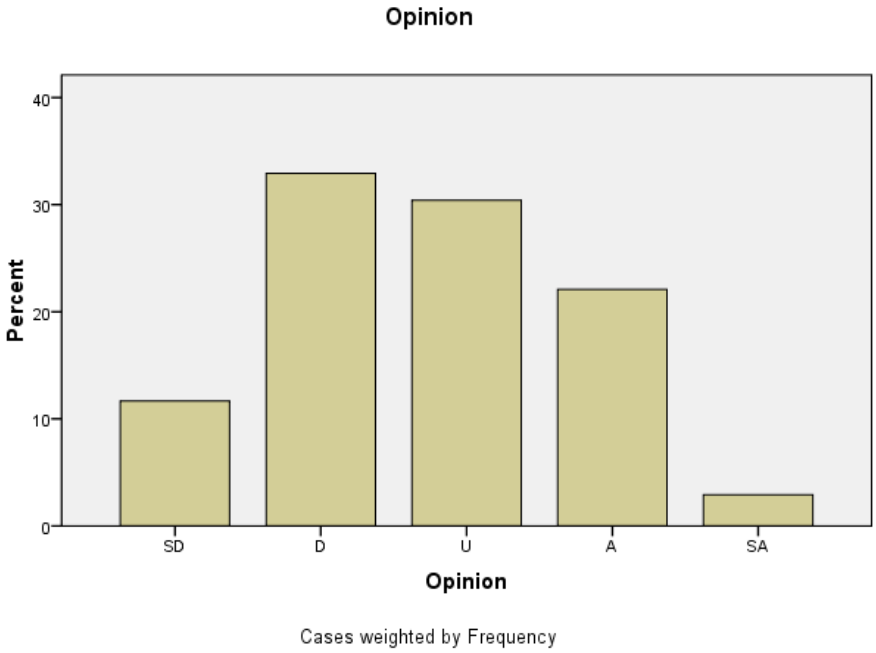


Figure 4:1 Graph analyses of questionnaire items 1 to 5

Research question number 2:

Table 4:7 percentage analyses of Questionnaire items 6 to 10.

Opinion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	39	16.2	16.2	16.2
	D	81	33.8	33.8	50.0
	U	59	24.6	24.6	74.6
	A	54	22.5	22.5	97.1
	SA	7	2.9	2.9	100.0
	Total	240	100.0	100.0	

CAD Operators Training.

Only 80.9% of the respondents indicate that their operators had received their training through an educational institution. The rest had obtained training through self teaching represent 16.2%, in – house training/courses it represent 2.9%. So this indicates that there is availability of appropriate courses for employment at the time that training was required.

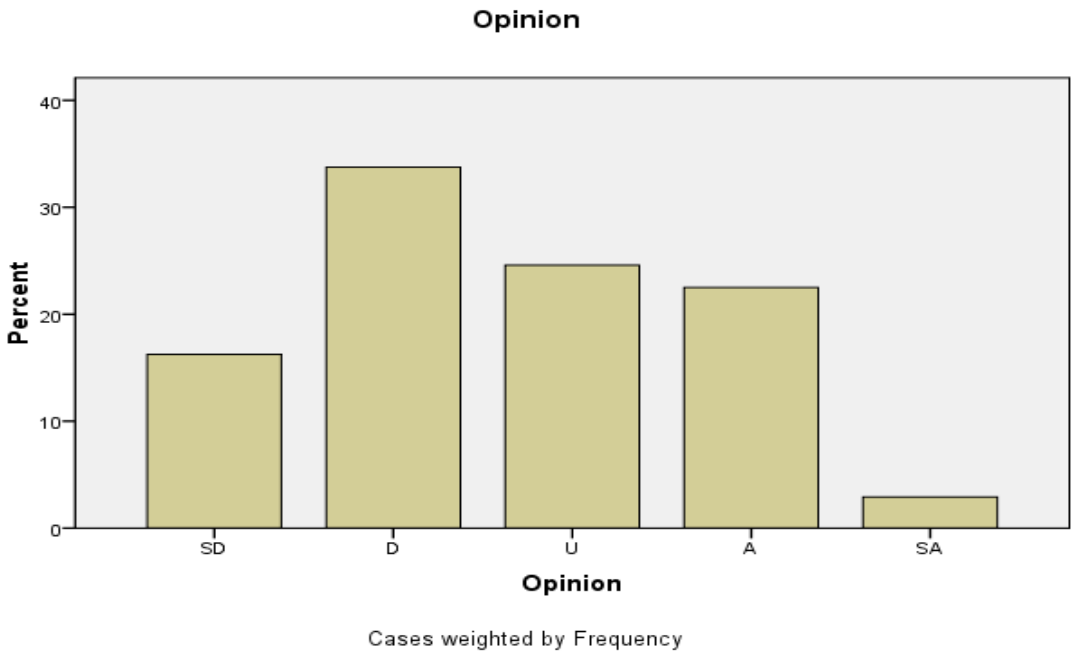


Figure 4:2 Graph analyses of questionnaire items 6 to 10

Research question number 3:

Table 4:8 percentage analyses of Questionnaire items 11 to 15.

Opinion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	24	10.0	10.0	10.0
	D	81	33.8	33.8	43.8
	U	71	29.6	29.6	73.3
	A	56	23.3	23.3	96.7
	SA	8	3.3	3.3	100.0
	Total	240	100.0	100.0	

Areas of CAD Use:

The industries survey indicated that their major use of CAD was for Architecture and Survey, mapping and Topographies with 33.8% and 29.6% respectively. The next major area was civil (Structural) with 23.3% followed by Electrical/Electronic with 10.0%. Mechanical received 3.3%.

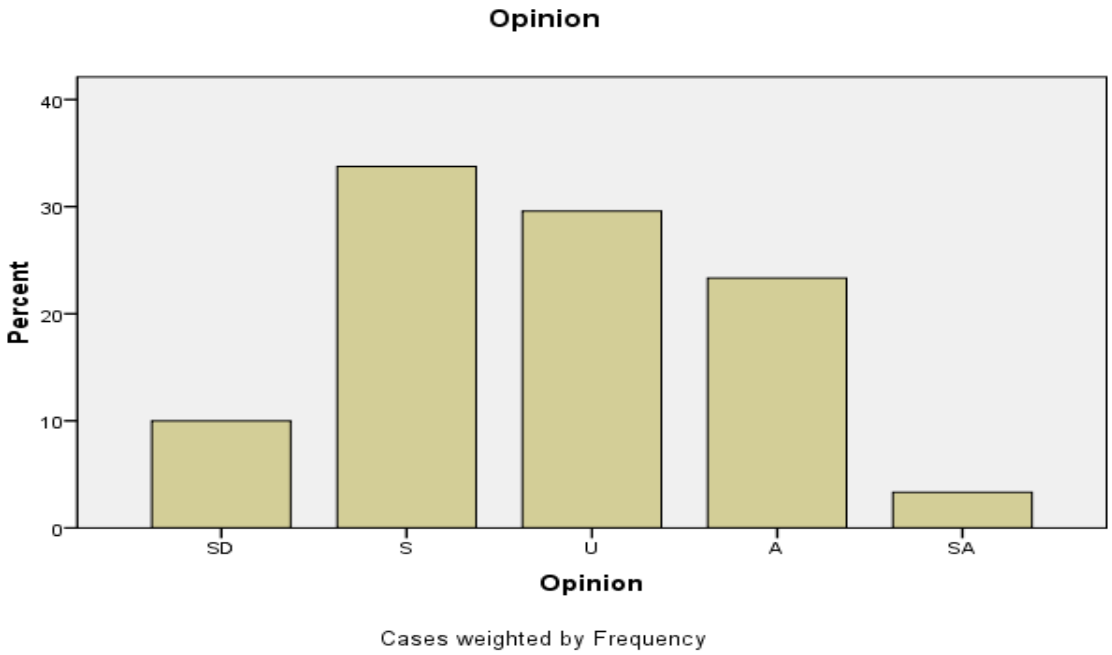


Figure 4:3 Graph analyses of questionnaire items 11 to 15

Research question 4:

Table 4:9 percentage analyses of Questionnaire items 16 to 20.

Opinion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	52	21.7	21.7	21.7
	D	72	30.0	30.0	51.7
	U	62	25.8	25.8	77.5
	A	49	20.4	20.4	97.9
	SA	5	2.1	2.1	100.0
	Total	240	100.0	100.0	

CAD System Eases of Operation

It was originally thought that there might be a relationship between the size or complexity of a CAD system and the relative ease of operating it. Many of the early mainframe CAD system were plagued with programming problems and were difficult to operate in comparison to the personal computer system that are in the market now. The responses to this question indicates that most of the CAD systems in the survey sample are considered as relatively simple to operate but there is a small number of each respondents that suggest some degree of difficulty. When these individual questionnaires were analyzed, 30.0% shows that CAD operating is very easy while 25.8% of the respondents believed that operating CAD is relatively easy. 21.7% moderately difficult. 20.4% and 2.1% of the respondents shows that it is difficult and frustrating

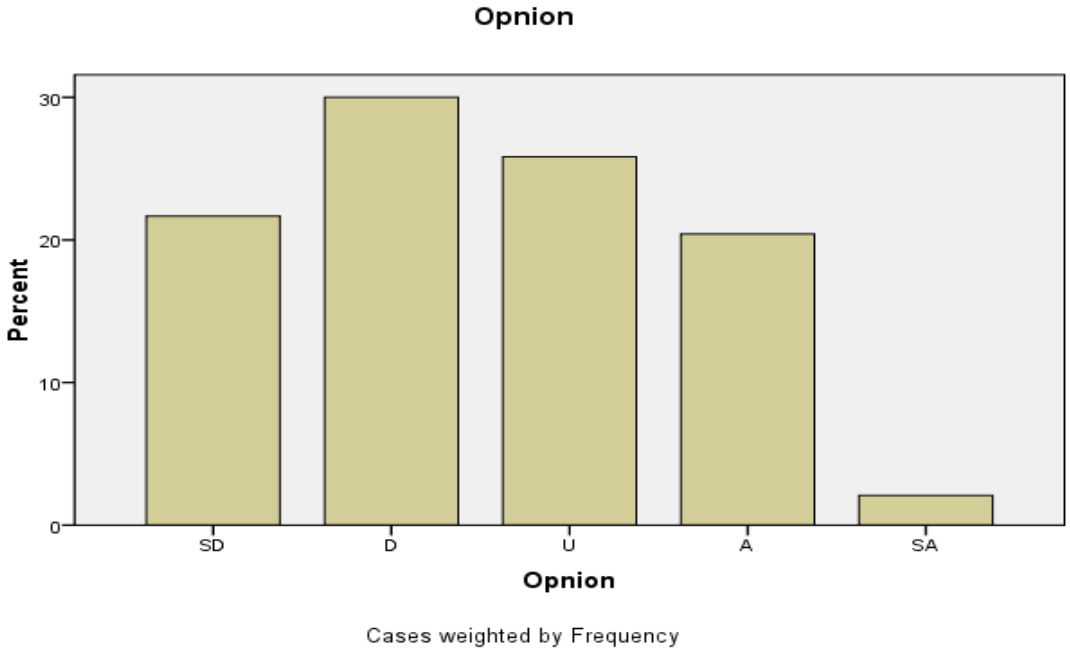


Figure 4:4 Graph analyses of questionnaire items 16 to 20

Research question 5:

Table 4:10 percentage analyses of Questionnaire items 21 to 25.

Opinion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	SD	41	17.8	17.8	17.8
	D	72	31.3	31.3	49.1
	U	59	25.7	25.7	74.8
	A	52	22.6	22.6	97.4
	SA	6	2.6	2.6	100.0
	Total	230	100.0	100.0	

CAD System Description:

The question dealing with the type of CAD system being used was designed mainly to determine the degree of which personal computer were being use for CAD purposes in industry.

Few industries can afford the massive investment required for large main frame CAD system. The personal computer based CAD system appears to be performing well with 31.3% Multi – user computer and Mini - computer has 25.7 % and 22.6% respectively. 17.8%. For dedicated computer while large main frame is 2.6%/.

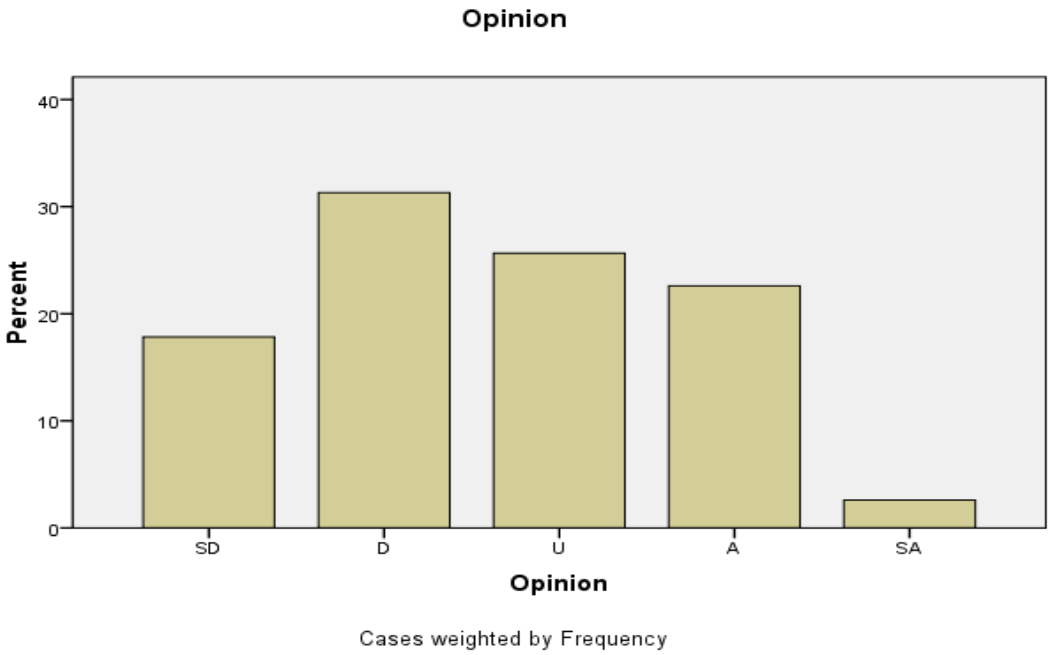


Figure 4:5 Graph analyses of questionnaire items 21 to 25

Finding of the studies:

1. The finding shows all CAD operators surveyed in the study have different types of Educational background it depend on the types of industries or firm they work. But it revealed that most of the operators of the CAD were usually trained CAD Draftsman and Draftsperson retrained for CAD. It indicates that the operators have Manual Drafting skills and good background in Technical Drawing.

2. The finding indicates that the suitable method of receiving CAD training is through an Educational institution. Because Educational institution has all the learning facilities and qualified instructors that will guide the students. More so Educational institution provide enabling environment for theory class and practical class

3. The survey shows that 83.7% of the respondents feel that areas were CAD is more prevalent is in the area of Architecture, Survey, mapping and topographies and Civil (structure) which are all construction base industries.

4. The study tells us that not all CAD operators find it easy/simple to operate CAD package which represent 22.5% and this has to do with their skills background of not attending technical drawing classes at early stage of their studies. But 77.5% find it easy/simple to operate due to their good background of Manual drafting. The study revealed that CAD improved accuracy, draw to scale, layout the drawing conveniently, very flexible to organized drawing information, establishing drafting standard, draw efficiently, view drawing, create dimensions and text and modify drawing easily.

5. My dealings with CAD operator's shows that they prepare to use personal computer than other types of computer in doing their work. Because personal computers (PC) are used occasionally at home or place of work.

Summary of Findings

The primary focus of this research is to determine the impact of CAD on industries.

1. It indicates that, the level of integration of CAD in industries will never be overemphasized as a result of its simplicities and ease of operation.
2. The transition from Manual drafting methods of design to modern methods of design is clearly established.
3. Also CAD tools were designed to mimic manual drafting methods of design with the drawing board and pencil. Principles of shape grammar,

basic drafting and lettering and color combination among others are needed to become proficient in the CAD operations.

4. CAD operators that are able to use principles learnt from Manual drafting methods of design have higher proficiency than late bloomers.

Chapter Five

Conclusion, Recommendation Suggestion for Further Study

The purpose of this study was to survey industries using computer aided drafting technology in order to assess the impact of this technology on industries. A closed – form questionnaire was sent to thirty – five industries working with CAD and the returned data tabulated in bar chart graph format and percentages to facilitate easier interpretation of the results. The questionnaire was designed to ascertain the training and background of CAD personnel, the type of CAD equipment in use, the areas of drafting using CAD, the training and hiring preferences of industries. The survey instrument was tested and revised before being distributed to the survey participant.

The survey of industries in North West of Nigeria utilizing CAD required the compilation of a CAD directory as no published compilation could be found.

Conclutions:

1. Drafting, especially computer aided drafting, should be approached as a necessary skill for a wide variety of occupations and not as a vocation in itself. This would require a conscious effort to open secondary school drafting to all students, not just those in industrial programs
2. Drafting educators should acquaint themselves with the changing technology of drafting including contact with post training institutions and representative industry.
3. Secondary school drafting programs should introduce students to computer aided drafting.

4. More emphasis should be place on dimensioning and to standard and areas of drafting that involve viewing an object in three dimensions.
5. Secondary school curriculum should be modified to include more drafting time and place more emphasis on computational and communication skills.
6. The survey indicated that industries in a wide variety of endeavors are using computer aided drafting system and that they are retraining their present drafting and professional personnel to operate the systems. They do indicate, however, that they do employ an individual, predominantly draftsperson, with computer aided drafting skills.
7. Manual drafting skills and good problems solving abilities were identified in both surveys as the prerequisites for CAD success.

Recommendation:

To the extent that industries interest indicates the need for curriculum modification at the secondary level, the results of survey would support the following recommendation:

1. That students to be counseled to approach drafting, especially computer aided drafting, as a necessary skills form wide variety of occupation not as a vocation in itself.
2. That drafting educators in North West of Nigerian schools should acquaint themselves with the changing technology of drafting.
3. That whatever economically possible, secondary school drafting programs should introduce students to computer aided drafting. The choice of

system should reflect the growing trend in industry to utilize personal computer based system.

4. That drafting educators should maintain contact with post secondary training institutions in an effort to standardized secondary drafting curriculum emphasis.
5. That secondary drafting courses place more emphasis on the areas of drafting that involve viewing or manipulating an object in three dimensions as opposed to the traditional orthographic representation. These would include pictorial (isometric/oblique), parallel and radial line developments. Producing views by revolution, perspective drawing and freehand sketching.

Areas for Further Study:

1. A survey of individuals operating computer aided drafting system in order to assess the extent of their skills and responsibilities.
2. A study to determine the extent to which computer aided production technology has changed skills requirements and employment demand.
3. A study of the success rate of individuals enrolling computer aided drafting technology programs in North West of Nigeria in relation to the admission standards of the institution and to the academic standard of the individual.

References

1. Ahmad K.Y. (2005), '*Man and the computer Technology as an agent ofsocial change*
2. Bertoline, G.R. (1988). *Fundamental of CAD*, Delmar Publisher Inc. New York
3. Becker K. L. (1997), '*Incorporating CAD into the Curriculum.''* Industrial Education November p.27
4. Bognet J. Y. (2005), *The use of computers for Architectural Education AtAhmadu Bello University, Zaria*: Seminar paper presented during environmental Design Complex week in commemoration of the silver jublee of Ahmadu Bello University Zaria, December 7 – 11
5. Bognet J.Y (2014), *Achieving Computer Aided Drafting/Design (CAD)Proficiency by Architecture Graduate in Nigeria*. Seminar paper presented during Environmental Design Students Week Of Kaduna Polytechnic
6. Cheng. W.L. (1995), The North Dakota high technology mobile laboratory project, *ComputerAided Design: Instructional manual*
7. Chikwuli, C.B (2001). *The Basic Problems of Architectural Education:* A Nigeria Perspective in: Architects and Architecture in Nigeria: A Tribute to Professor E.A Adeyemi, Edited by Nkwogu, U.O AARCHES, Akure.
8. Dahiru K. (2002), *CAD and Creativity: Does the computer help*? Journal of Architecture vol. 35, N0 3 pp 222 - 235
9. Dahiru, K. (2004) "*More thought on the future of CAD and traditionalDrafting"*.
10. Dahiru, K. (2010); *A Comparison of Beginning drafting achievement students using Traditional Equipment and students using computer aided*

*design and drafting equipment;*The trade and industrial education research committee. Proceeding of Technical and Vocational conference, Kaduna.

11. Dahiru K. (2013); *Effect of the use of Computer Aided Design (CAD) onArchitecture*. A paper presented At Annual General Meeting of Nigerian Institute of Architecture.
12. Dikko S, (2009); *Attitude of Design Students towards usage of computerAided Drafting*. The Nigerian Institute of Architects Journal, 4,7, 23 - 27
13. Danranda S.Y. (2006), *Managing Technological change in Technicaldrawing Practice*. Gaskiya Printing press, Zaria.
14. Danrandah S.Y. (2008) *Built students interest in drafting through ''Engineering style''* The Nigerian Institute of Architects Journal, 4,7, 3-4
15. El – Ladan M. N (2012);*The Impact of Computer AidedDrafting/Design(CAD) Technologies on Engineers Education.*Ahmadu Bello University Press, Zaria.
16. Fesolowich, H. U. (2007), *ABC of Computers*, ASC Press Kaduna.
17. Fuller, J.E. (1998), *Using AutoCAD, 2nd Edition,*DelmerPub.Inc New York
18. Giesecker, F.E (2013), *Engineering Graphics 3rd Edition,* Macmillan publishing co.
19. Geotsch, D.L. (2011) *''Computer Aided Drafting Workshop''* A workshop booklet for okaloosaWalton Junior college Niceville , Florida
20. Geotsch, B.L. (2003). *Education and Industrial Evolution*. New York. McMillan Publisher

21. Hall, T. (2012), *State wide conference on Technology*, A paper presented on behalf of the Texas Advisory council for Technology Vocational Education, Austin, Texas.
22. John, Z.F (2003).*Teaching CAD with limited facilities. Industrial Education*
23. Kachiku, J.J (2009),*Architectural Technology past and future*. Journal of the Association of Architectural Educators in Nigeria.(AARCHESJ)
24. Lingana, D. (1999),*Perth a leader in computing arenas;* West Australian.
25. Mamman, Y. (2001) *State of the field of Drafting, is traditional content dead.* S.Y. Printing Press Kano
26. Mamman, Y. (2014).*A prototype of CAD/CAM education in TechnicalCollege.* Paper presented at the annual national conference, Kaduna.
27. Mbina, A.A (2007) *Architecture Education in Nigeria. Environ*: Journal of Environmental Studies1:1 69-76. Faculty of Environmental Design, ABU, Zaria
28. Mbina, A.A (2007) *Engineering drawing and design*
29. Noderer, S. (1999*) Education in North Western Nigeria problems and prospect*
30. Nkwogu, U. O (2003). *Avenues to specialization in Architecture inNigeria*. The Association of Architectural Educators in Nigeria (AARCHES) 2003, Annual General Meeting andConference. Theme: Methodological Issues in Architectural Research.
31. Ogunsote, O. O (2001). *A guide to Setting up a Workshop for Computer AidedDesign and Drafting:* In Architecture in Nigeria.

32. Ogunsote O. O. (2003). *Three dimensional Modelling in AutoCAD 2000:* Production of drawingUsing multiple layers and layout in paper space. Journal of the Association ofArchitectural Educators in Nigeria.
33. Ogunsote O. O. (2002). Klimax*: A computer program for climatic siteAnalysis:* ValedictoryConference of the Association of Architectural Educators in Nigeria.
34. Pares, M.J. and Hoggard, D. (2002) *A suggested computer aided draftingcurriculum*. A paper Presented at the annual conference of the American vocational Education Association Atlanta, Geogia.
35. Shehu D. (2000), *Architecture Education in Nigeria.* Journal of Environmental Studies, 1:1, 69 – 76. Faculty of Environmental Design ATBU Bauchi.
36. Shehu D. (2002) *Impact of CAD tools on Creative problem solving inengineering design:* Computer Aided Design 41 (3) 136 - 146
37. Shehu, D. (2003).*Beyond drafting classes alone:* CAD takes new direction. Mint printing press
38. Shehu. D. (2007). *A statewide demonstration site for teaching CAD:*Instructional strategiesfor Using Micro computer in vocational Education. Lagos
39. Sweet. D.A. (2008) *High school Ads computer design to draftingprogram.*
40. Sorensen, S. U. (2007) *Computer integrated manufacturing – itsapplication and justification:* Engineering Digest
41. Sa'ad, H. T (2001), 7. *The changing role of the Architect and Architecture in the context ofthe Ever –Changing technological, socio- economic and political global environment.*

42. Van, J. Y (2010) *Educational Research an introduction* (3rd Ed). New York: Longman.

Appendix A

Industries surveyed using computer Aided Drafting Software.

1. S.Y Technical Services IBB Way, Katsina State.
2. Double click ConstructionNigeria limited, Opp. Raba Road, Kaduna State.
3. DEE Electrical EngineeringOpp. Hamada CarpetHassan Usman Road Katsina State
4. Katsina Steel Rolling Mills.Shehu Musa Yar'aduawayKatsina State.
5. Standard Construction Nigeria Limited ,Opp. Trade Fair Complex, Kano State
6. AFDIN Construction, Nigeria LimitedTafawa Balewa Way, Katsina State.
7. SAMD BUILD Nigeria LimitedSultan Road, Kano State.
8. Samha Engineering ServicesSarkiAbdulrahman wayKatsina State.
9. Triad ArcchitectsRaba Road, Kaduna State
10. Jamil Technical ServicesGhana Road Malali Kaduna State
11. BadarawaMachining and fabrication, Ribado Road, Kaduna State
12. 2D – 3D Nigeria LimitedLamido crescent, Kano State
13. J.K Engineering Nigeria LimitedClub Road, Kano State.
14. Dangul Construction Nigeria LimitedBarnawa, Kaduna State.
15. SAMD Electrical Engineering Nigeria Limited, Alkali Road, Kaduna State
16. A.Y.G Construction, Nigeria LimitedBadiko, Kaduna State
17. Safa Engineering Nigeria LimitedIndependence way, Kaduna State
18. Gizo – Gizo Construction Nigeria Limited, Katsina Road, Kano State
19. A. S Technical Services, Kabir Usman Road, Katsina State.

20. Alim Engineering and Fabrication Nigeria Limited, Gwamna Road, Kaduna State
21. Dansa Technical Services, Barnawa, Kaduna State.
22. Soft skills Architecture, Dunya close, Kaduna State.
23. D.D Engineering, Kangiwa Road, Katsina State.
24. Cee – Cee Engineering Nigeria Limited, Inuwawada, Kaduna State
25. Manda General enterprises, Kabir Usman Road, Katsina State
26. S and D Construction Nigeria Limited, Rumfa close, Kano State
27. S.K.Y Engineering Nigeria Limited, Alkali Road, Kaduna State
28. Oggo Fabrication Company, Mondo Road, Kaduna State
29. Giginya Technical Services, Bayajidda Road, Katsina State.
30. Saulawa Engineering Nigeria Limited, Kurna Road, Katsina State
31. Dan Baiwa Construction Nigeria Limited, Nagogo Road, Katsina State
32. Dan Tarwa Technical Services, Kano Road Tudunwada, Kaduna State
33. Marke Fabrication Company, Road Y Barhin Quarters, Katsina State
34. Saulawa Machining Fabrication Company, Mani Road, Kaduna State
35. Dan aunai Construction Company, Zaria Road, Kano State.

Appendix B

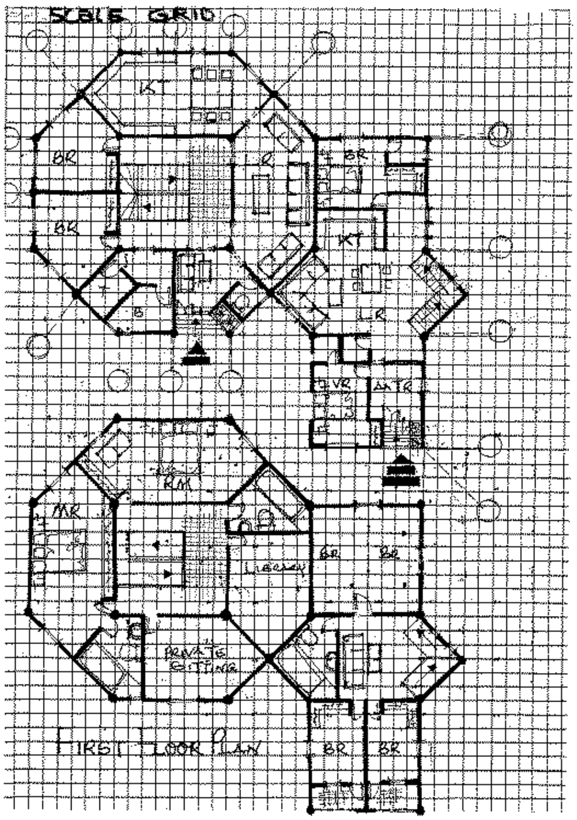
Questionnaire Sample

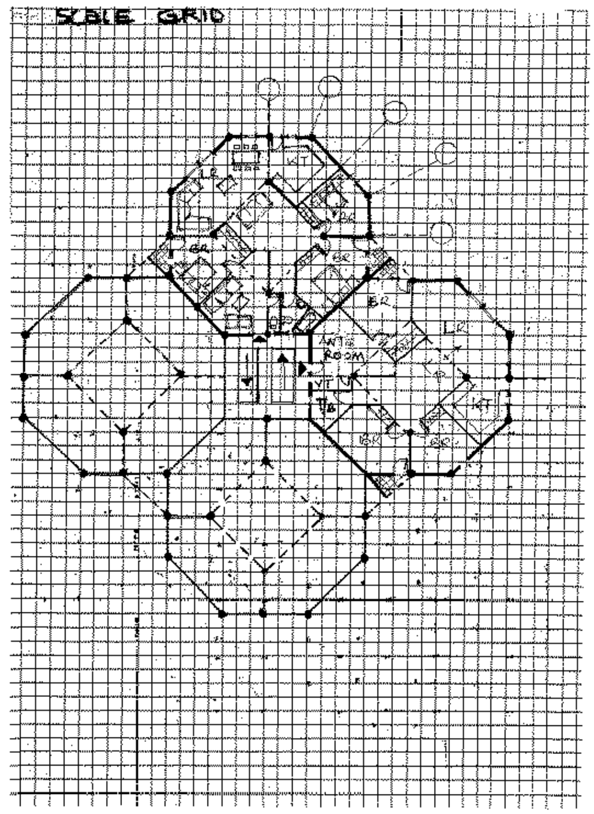
S/NO	QUESTIONNAIRE ITEMS	SD	D	U	A	SA
1	Draftsperson retrained for CAD					
2	Technicians or Technologies					
3	CAD Draftsman					
4	Computer specialist					
5	Professional					
6	Self taught					
7	Technical college CAD courses					
8	University courses in CAD					
9	Post graduate courses in CAD					
10	In – house courses in CAD					
11	Electrical/Electronic					
12	Mechanical					
13	Survey, Mapping and Topographies					
14	Civil					
15	Architecture					
16	Very easy					
17	Relatively simple					
18	Moderately Difficult					
19	Difficult					
20	Frustrating					
21	Personal computer					
22	Multi user computer					
23	Mini computer					

24	Dedicated computer					
25	Large main frame computer					

Appendix C

Typical 2D floor plan done using traditional method (Source by Author)


SCALE GRID
KT
BR
BR
LR
BR
KT
LR
RM
MR
LIBRARY
BR
BR
PRIVATE SITTING
FIRST FLOOR PLAN
BR
BR

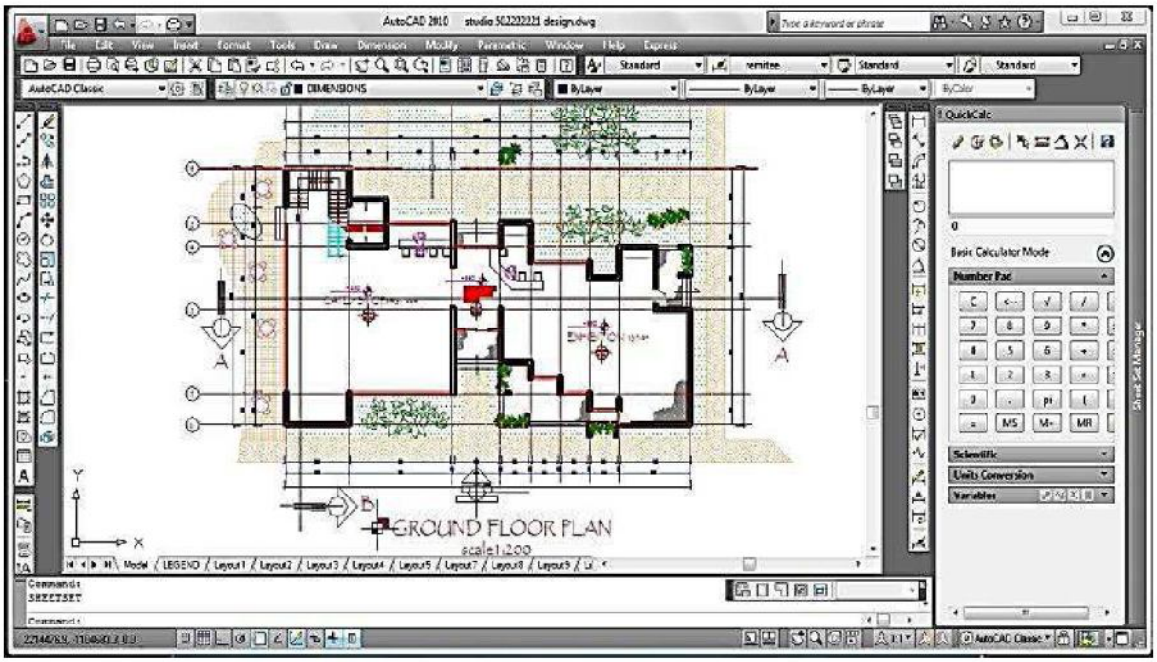

SCALE GRID
KT
BR
BR
LR
ANTE ROOM
KT

Appendix D

Typical 3D using traditional method

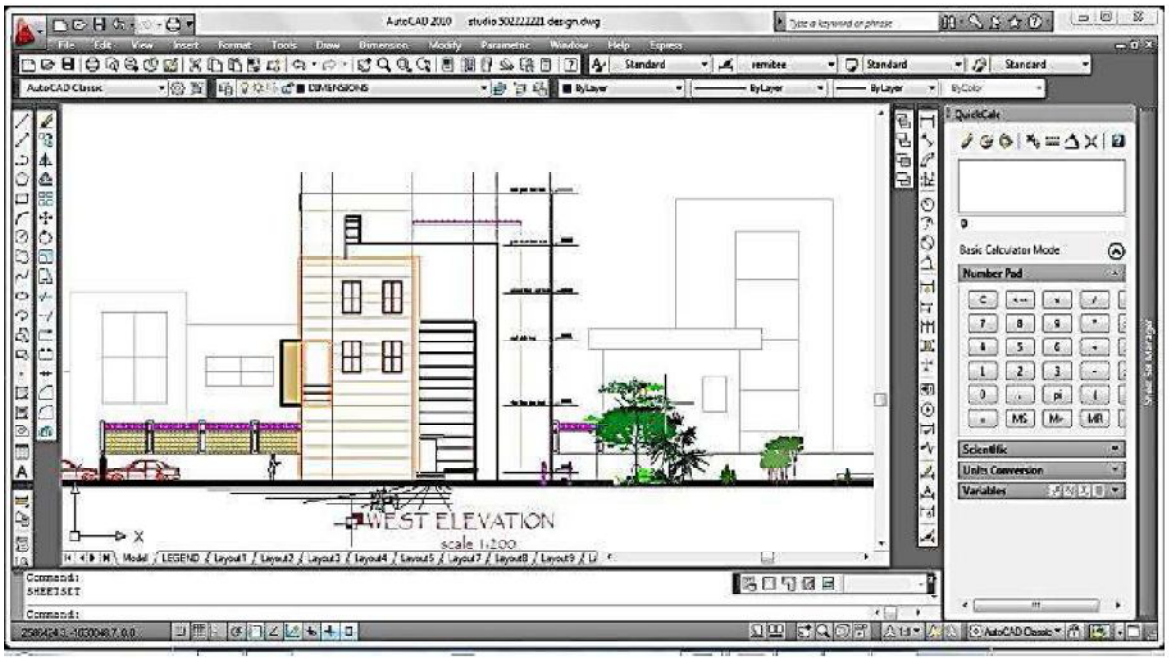
Appendix E

Typical 2D drawing (floor plan) done with AutoCAD 2010 interface (Source by Author)



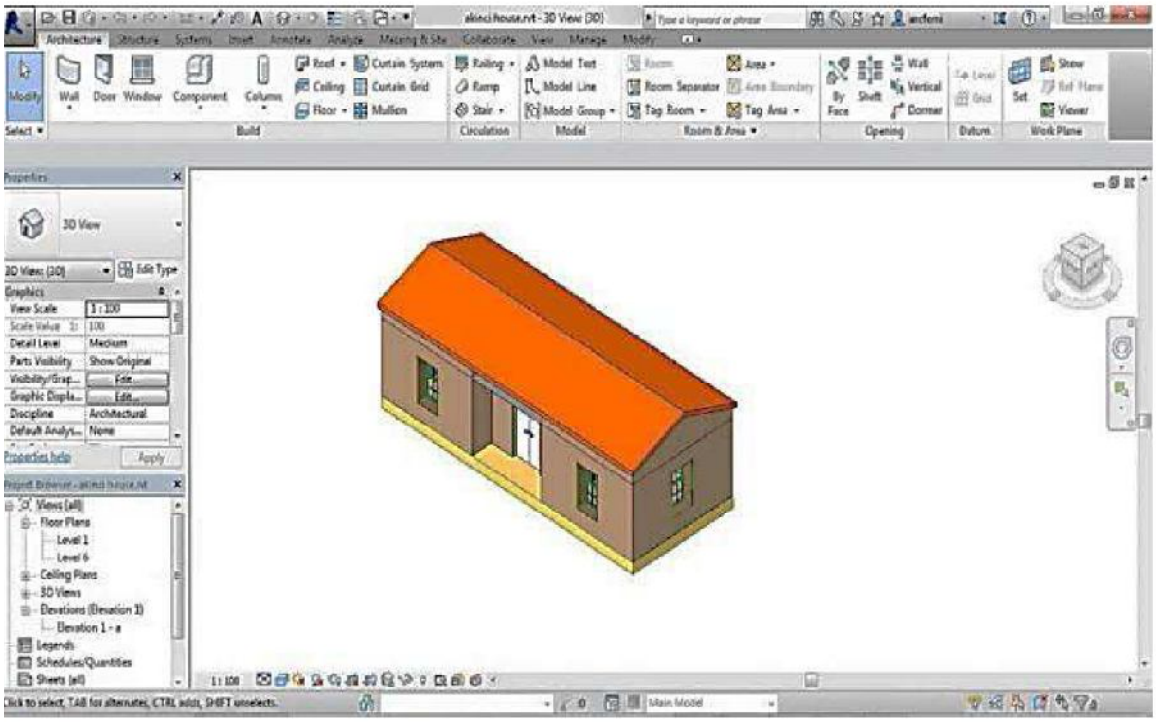
Appendix F

Typical 2D drawing (elevation) done with AutoCAD 2010 interface (source by Author)



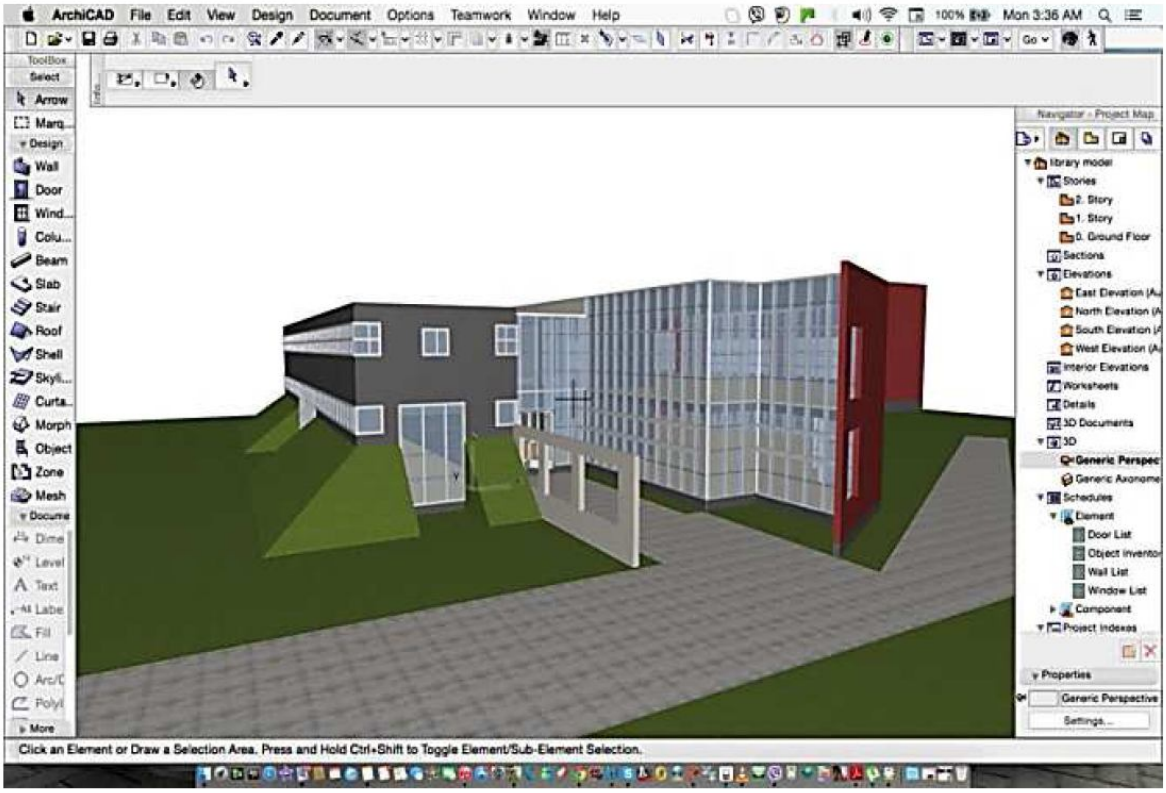
Appendix G

Typical simple 3D drawing done using Revit Architecture software (source by Author)



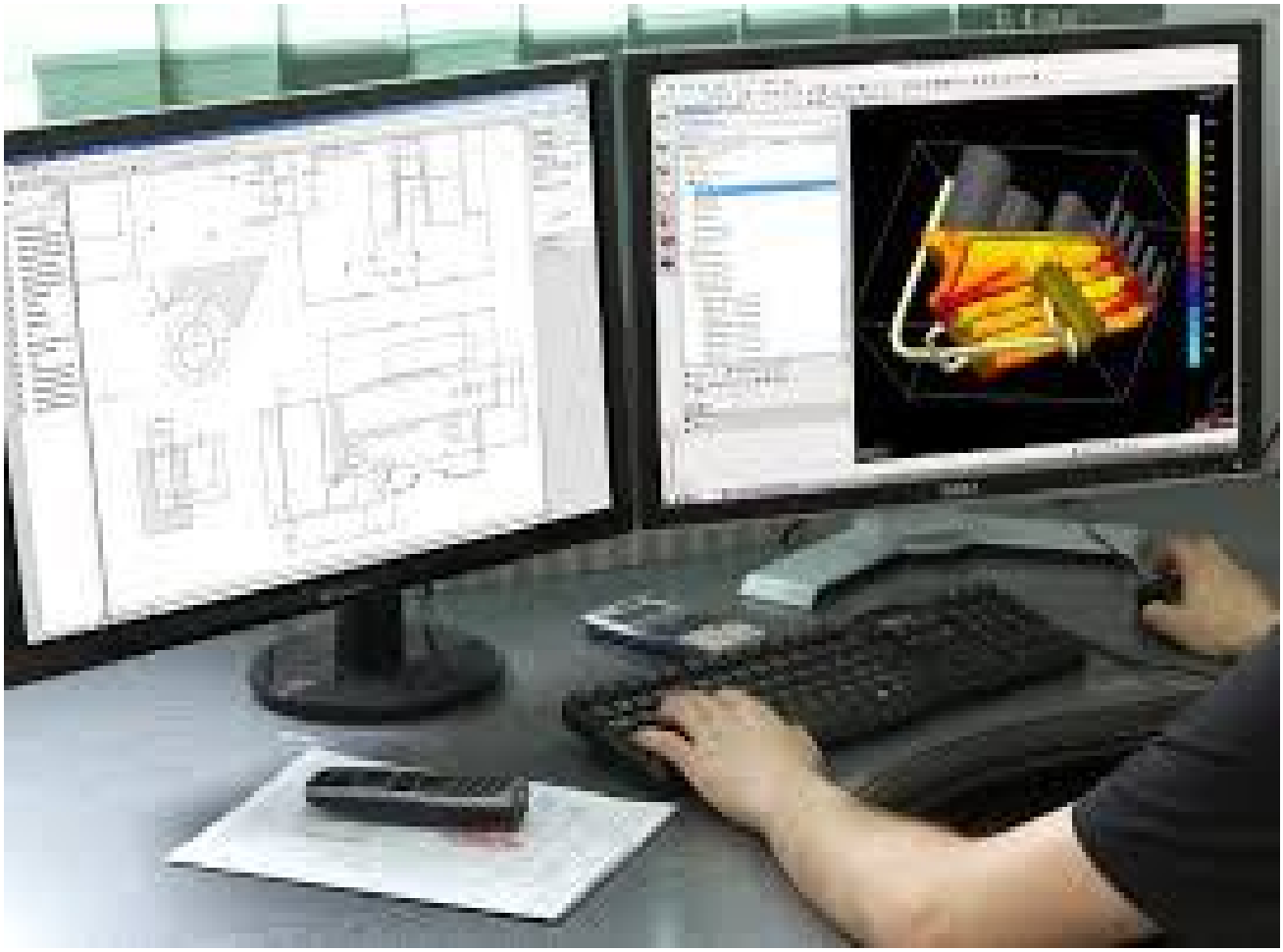
Appendix H

Typical Simple 3D drawing done using ArchiCAD software (source by Author)



Appendix I

A Drafter using computer for his drawing with CAM software

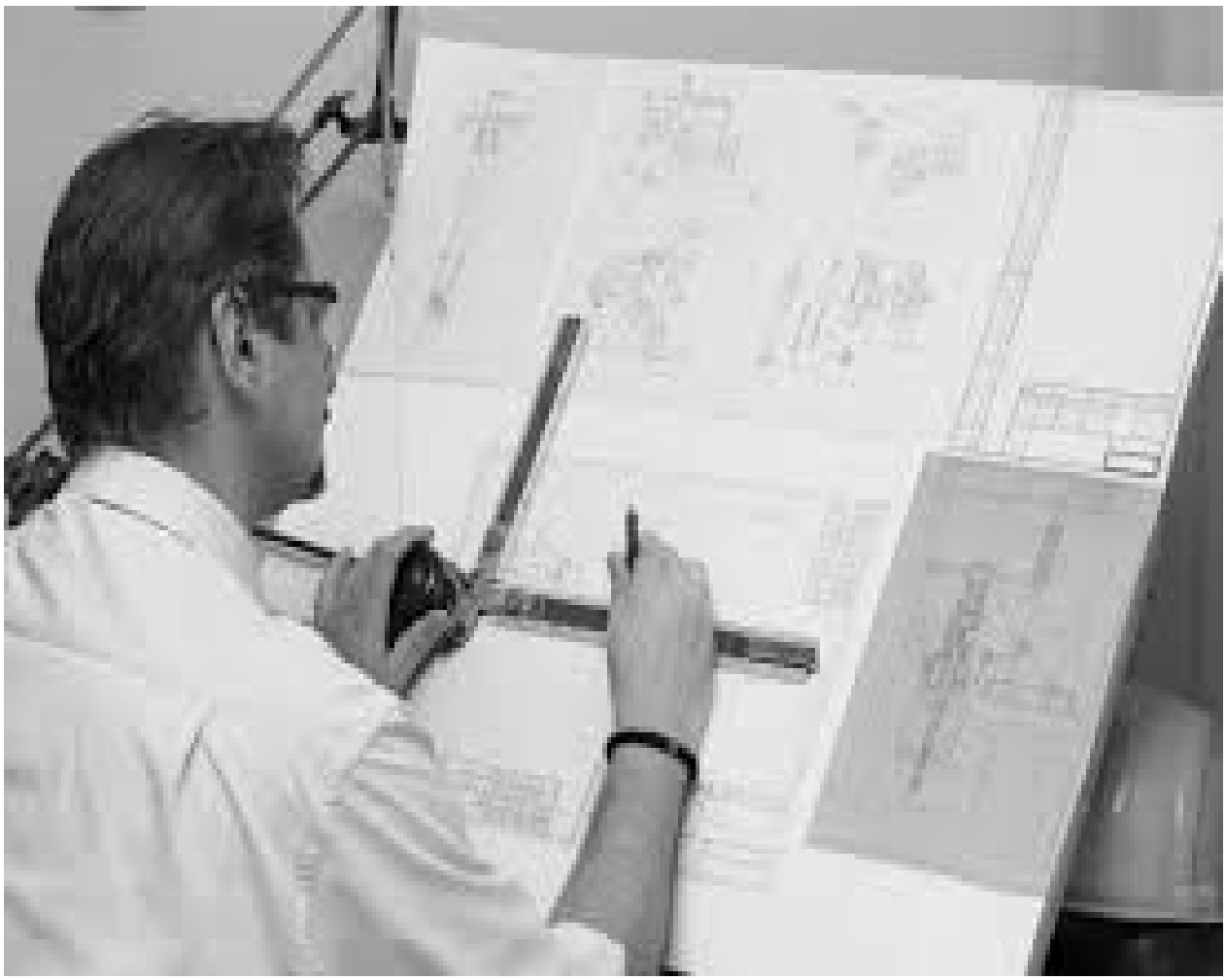


Appendix J

Manual Drafting tools: Scales rule, Compass, Pencil, Clutch pencil and Tracing Paper

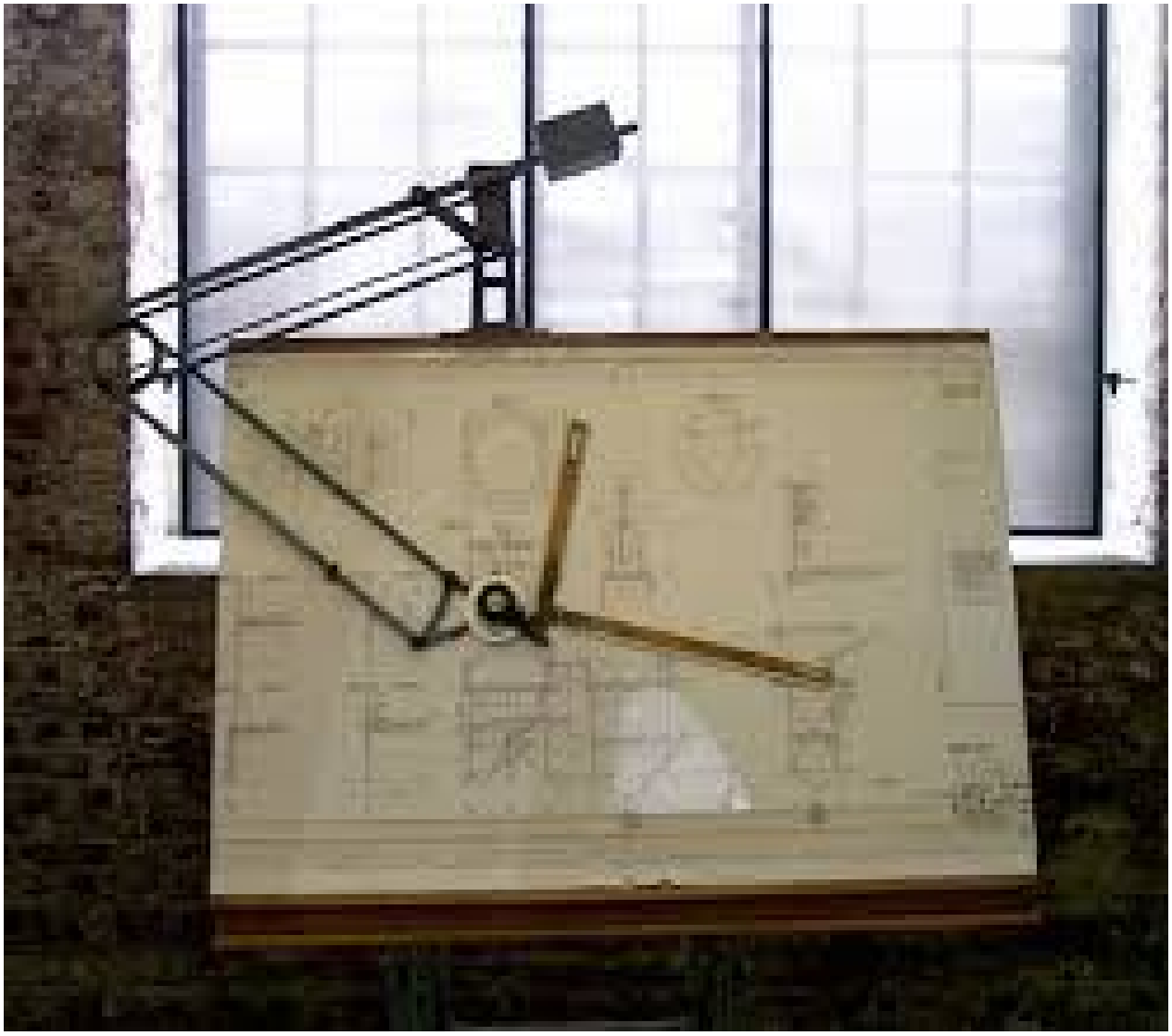
Appendix K

Drafter using Drafting tables for his drawing



Appendix L

Drafting tables with movable arms

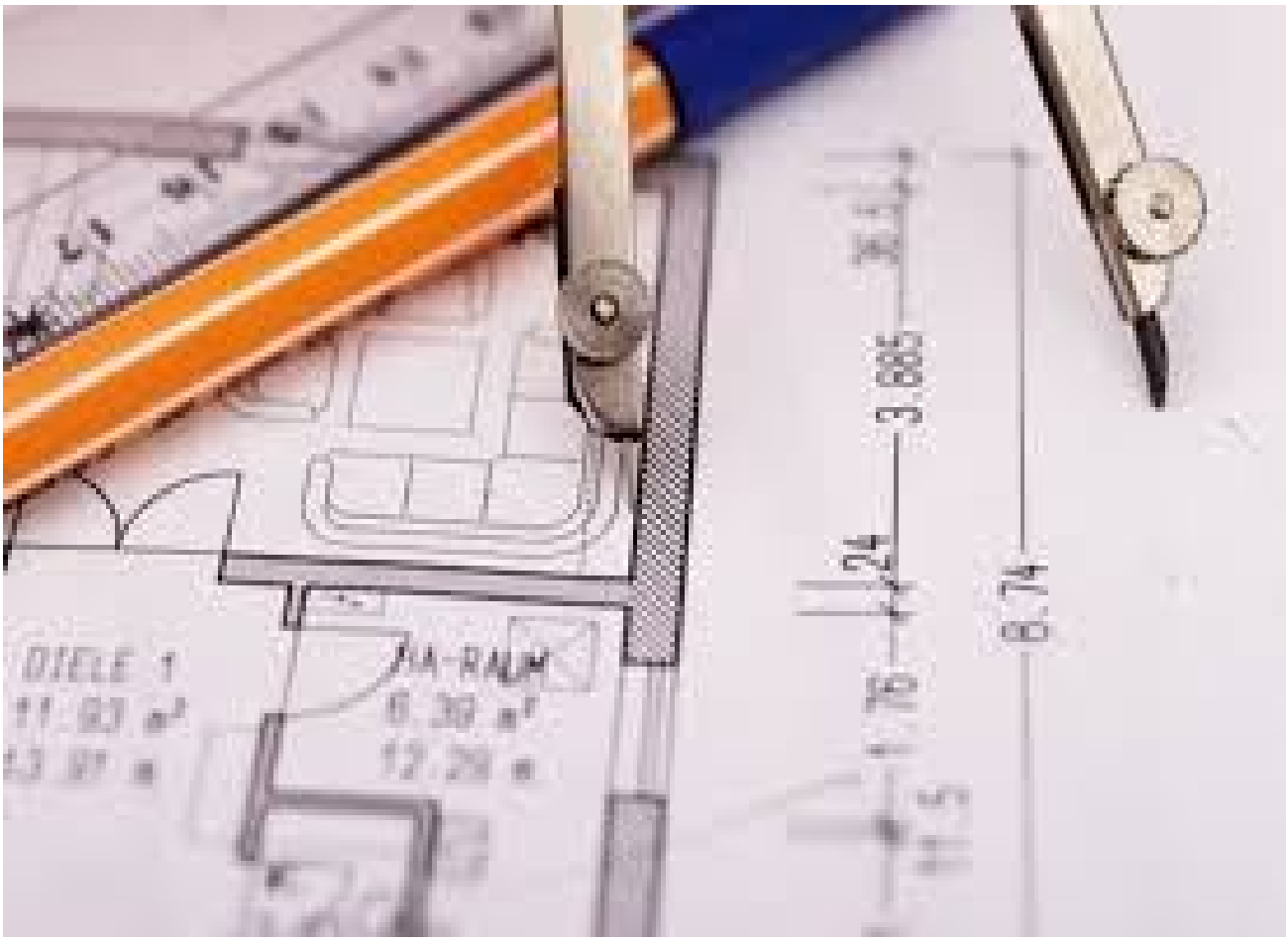


Appendix M

Floor plan drawn manually by using Drafting tools

Appendix N

Dimensioning and Furniture drawn manually with aid of Furniture and Dimensioning Templates



Appendix O

Manual Drafting tools: Set square 45^0 , 30^0 by 60^0 , Scale rule, Tee – square, pencils and Drawing paper