

Assessment of the Awareness of Structural Computer Aided Design Programs of Universities in Ghana

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Abstract

The few past decades have seen the use of Computer Aided Design (CAD) software application in the area of built environment. In view of this, more CAD software programs have been developed to design and analyze buildings and structures. This makes CAD an important part of the design and construction industry. This paper reports the assessment of the level of awareness and usage of structural CAD programs by students in Universities offering Civil Engineering and related programs in Ghana. The design used for this study was survey which relied on questionnaire to generate data for the analysis and discussions. The study established that the respondents knew the General CAD programs of which 69.9% knew AutoCAD. However, majority (64.8%) of the respondents did not know about any of the Structural CAD software packages, indicating a low awareness level of Structural CAD software programs. Recommendations are made for the inclusion of Structural CAD programs in the courses of the Universities offering Civil Engineering and related programs in Ghana.

Keywords: Computer Aided Design (CAD), Three-Dimension (3D) modeling, Computer Aided Manufacturing (CAM) systems, Digital Product Development (DPD).

1. Introduction

Computer Aided Design (CAD) software emerged in the early 1960s and has since gone through number of changes till present. The software programs have assisted engineers and designers in a wide variety of industries to design and manufacture physical products such as dams, bridges, roads, buildings, cars and aircraft, to mention a few. CAD is used in most of the manufacturing process from creating drawings to three-dimension (3D) modeling. The entire process saves time and money and ensures precision and accuracy (Jason, 2010). CAD software programs are used worldwide in many fields of engineering such as architecture, building and construction, electronic, electrical, machinery, automotive, aerospace and ship building (Herron, 2010). Some of the software programs available are ArchiCAD, AutoCAD, Corel Draw, Autodesk Revit, 3D Studio Max, Robot, Lira, Sketch UP Pro, Monomakh and AccuRender (Carlson, 2003).

Structural design and analysis CAD software programs have become popular in most Construction Industries and Universities offering civil engineering and related programs in the globe. Today, computers are being used by nearly everyone in the construction industry, be it fresh graduates or experienced structural designers. In parallel to this development, most higher learning institutions have now equipped their graduates with adequate skills of using computer software programs that will help them in carrying their daily task in the industry (Bozdoc, 2004).

However, limited information could be found in relation to whether Universities offering civil engineering and related programs in Ghana are training recent graduates in the use of structural CAD applications which are relevant and useful in the construction industry. There is therefore the need to assess the level of awareness and usage of Structural CAD programs by students of Universities in Ghana. With computer technology becoming a very important to the field of construction, students need to be taught the skills of using these resources prior to graduation so as to expose them to the right application that will be useful later in the working world (Harwood, 1989). The objectives of the study are to fine out the level of awareness and usage of General CAD programs and Structural CAD programs by students of Universities in Ghana.

2. History and Uses of CAD Software Programs

In 1957, Dr. Patrick J. Hanratty developed the world's first Computer-Aided Design & Drafting (CADD) software called PRONT, commercial numerical control program system. For this reason it is Dr. Hanratty who is most often called 'the father of CAD'. In the early 1960s, Ivan Sutherland also created CAD software called 'sketchpad' (Euclid, 2004). CAD software started its migration out of research and into commercial use in the 1970, and was still two-dimensional (2D) replacement for drafting. In the 1980s HP set up its commercial CAD software group to develop its CAD software, and UNIX workstation also inevitably shifted the CAD market to 3D and solid modeling (Farin *et al.*, 2002).

In the 1990s, Microsoft released its first 32-bit operating system for PCs, Windows NT, and Intel also released the first 32-bit Pentium Pro chips (Pillers, 1998). CAD software vendors breathed a sigh of relief as it became evident that fear of Y2K problems were not to materialize in the year 2000. Autodesk released AutoCAD 2000 in mid 2000 which was their first Web enabled CAD software (Harrington *et al.*, 2001). Ford also released the Mondeo 3D CAD software for internet usage. In July 2004, the CAD software industry was dominated by IBM-Dassault Systems and Autodesk (Herron, 2010).

Engineering industries, especially mechanical engineering based companies, use CAD in a variety of ways. 3D modeling and pro-engineering packages allow engineering companies to design products or components for machinery (Euclid, 2004). Electrical and electronic engineering industries use CAD for things like PCB designs and wiring layout designs. The construction industry use Structural CAD programs for not only designing and analysis of buildings and structures but also for application of reinforcement (Piotrowski, 2010).

3. Research Methodology

3.1. Research Design

The design used for this study was that of survey which relied on questionnaire to generate data for the analysis. The study was to find out the level of awareness and usage of structural design and analysis CAD programs of students in Universities in Ghana offering civil engineering and related programs.

3.2. Population and Sampling

The population for the study was students who offer civil engineering and related programs in Universities in Ghana. The population was stratified into three consisting of: civil engineering department of Kwame Nkrumah University of Science and Technology (KNUST), construction section of University of Education, Winneba – Kumasi Campus (UEW-K) and civil engineering department of KAAF University College in Ghana. They were further stratified according to levels (level 100 to 400) or year of study. 50% of students from each department/section were selected for the study. The three Universities were selected because they offer civil engineering and related programs.

3.3. Instrument and Data Collection

Questionnaire was used for the study. The questionnaire items were based on the demographic of the respondents, students’ awareness of the General CAD programs, students’ awareness of Structural CAD programs, importance and usefulness of Structural CAD programs. The questionnaire were personally administered by the researcher that gave him the opportunity to interact with the respondents, explained in details the rationale for the research and gave explanation where necessary. Enough time was giving to the respondents to answer the questionnaire of which some were collected on the same day and others after a few days. 300 questionnaires were distributed out of which 250 were returned (Table 1), representing 83% response rate.

Table 1: Population from the universities

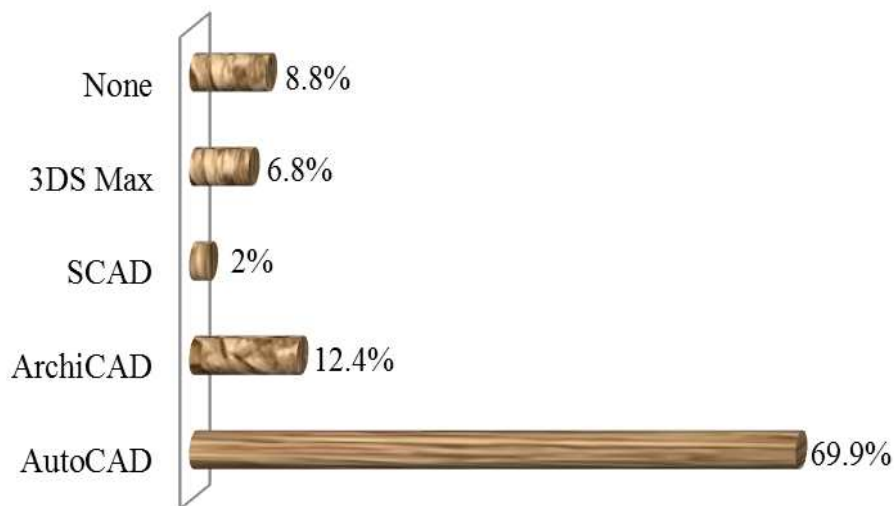
University	No. of questionnaires distributed	No. of questionnaires returned	Response rate (%)
KNUST	100	82	82.0
UEW-K	150	132	88.0
KAAF	50	36	72.0
Total	300	250	83.0

4. Results and Discussion

4.1. Type of known General CAD Software

The respondents were asked to indicate the type of General CAD program they know. The summary of their response is presented in Figure 1.

Figure 1: Type of known CAD software



The result indicates that the respondents knew some of the general CAD software programs such as AutoCAD, ArchiCAD, SCAD, 3D Studio Max and others, of which majority (69.9%) of them knew AutoCAD. This implies the most known general CAD software program in the Universities in Ghana offering civil engineering and related programs is AutoCAD, while few of the respondents knew about other general CAD software programs. This is due to the fact that some of the universities taught AutoCAD as a course and it is a general program used by some specialists in the built environment. Harrington (2010) said the earliest 2D drafting application, coupled with tremendous market effort during its introduction, the AutoCAD name has been synonymous with architects and

draftsmen when it comes to 2D drafting. Thus AutoCAD, is one of the earliest CAD programs, and therefore popular in the construction industry and engineering training institutions. However, 8.8% of the respondents did not know at all about any of the software programs, which means these respondents' have not been introduced to any of the general CAD software programs.

4.2. Type of General CAD Software Use

The respondents' responses on the type of General CAD software they use are presented in Table 2.

Table 2: Type of CAD software use

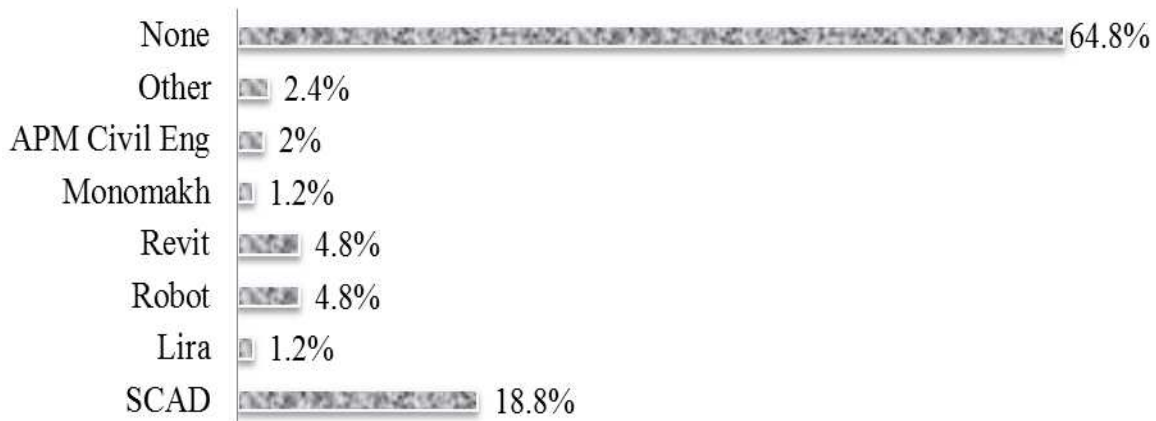
CAD	Number of respondents	Percentage (%)
AutoCAD	181	72.4
ArchiCAD	15	6.0
SCAD	3	1.2
3DS Max	9	3.6
None	42	16.8
Total	250	100.0

The findings of the current study have many similarities with the results of Mohd-Nor et al., (2009) study on how the professional practice and the architecture education in Malaysia is catching up with the development of CAD. Their study found that the huge difference on the number of users between AutoCAD, which sits at first place, and its closest rival shows that AutoCAD seems to be dominating the current CAD market in Malaysia. This study also found that 72.4% of the respondents used AutoCAD, which suggests that the general CAD software program most of the respondents used in their institutions is AutoCAD. This confirms the fact that it is the software program taught in most of the universities in Ghana. This also suggests that the use of other software programs is very low. The result also shows that 16.8% of the respondents did not at all use any of the CAD software programs, which implies some of the respondents have not acquired the skills in applying the software.

4.3. Type of known Structural CAD Software

The respondents were asked to indicate the type of Structural CAD program they know. The summary of their response is presented in Figure 2.

Figure 2: Type of known Structural CAD software



The data shows that 35.2% of the respondents knew about Structural CAD programs such as SCAD office, Revit Structural Suit, Robot Structural Analysis, Lira, APM Civil Engineering,

Monomakh and others, while majority (64.8%) of the respondents did not know at all about any of the Structural CAD software programs depicting a very low awareness level. One possible reason for this result might be that the programs are not taught in the Universities in Ghana. This may be due to lack of lecturers who have the skills and competency to teach the software programs. According to Jason (2010), CAD is used in almost all engineering based industries like architecture, automotive, construction, to mention a few. This result contradicts Jason’s assertion, since majority of the respondents did not know at all about the CAD programs, and therefore could affect their performance in the industry after their studies. For this reason, both the educator and the practitioner have a similar goal in wanting a graduate student who is fully competent (Hardwood, 1989). The knowledge and application of the Structural CAD programs helps one to be abreast with and acquired the necessary skills and competencies of the technological requirement of the modern construction industry.

4.4. Type of Structural CAD Software Used

The respondents’ responses on the type of Structural CAD they used are presented in Table 3.

Table 3: Type of Structural CAD software use

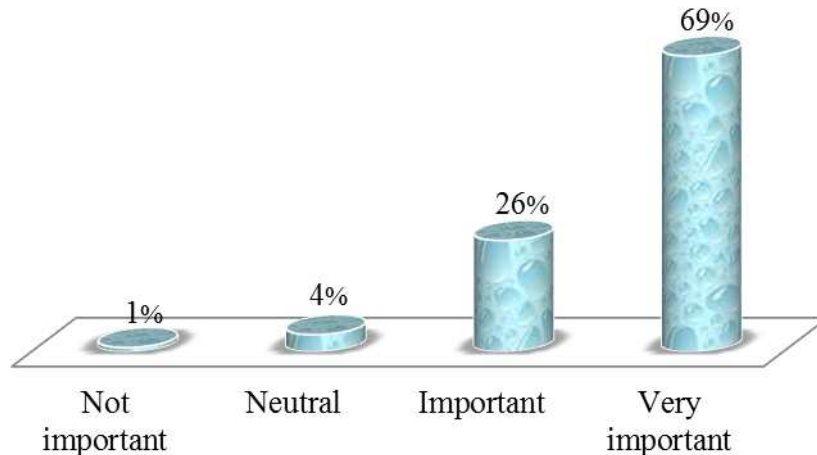
Structural CAD	Number of respondents	Percentage (%)
SCAD	48	19.2
Lira	2	0.8
Robot	5	2
Revit	4	1.6
Monomakh	3	1.2
APM Civil Eng	5	2
Others	7	2.8
None	176	70.4
Total	250	100.0

The result indicates that total of 29.6% used Structural CAD programs such as SCAD office, Robot Structural Analysis, APM Civil Engineering and other software programs such as STAAD, while 70.4% of the respondents did not use any of the software programs at all. This result suggests a very low usage of the Structural CAD software programs in Ghana, which might possibly be due to lack of awareness of its importance and lack of teaching staff that know and can teach the programs in the Universities in Ghana. According to Bozdoc (2004), CAD enables civil engineers and architects in a variety of ways like aiding them in architectural, electrical, structural, and interior designs. The result of this study proves a low usage of the Structural CAD programs by the respondents as against Bozdoc’s point of view which presents different uses of the software programs by engineers and architects. Piotrowski (2010) also numerated some of the uses of Structural CAD programs as designing of buildings and structures, analysis of buildings and structures and the application of reinforcement. Structural CAD software programs can be used to make design models such as 2D frames, 2D trusses, 3D frames/solids, flats, shells and plane structures, axisymmetric structures, volumetric structures, parametric structures, geodesic domes, Reinforced Concrete (RC) beams, RC slabs, RC columns, RC walls and connections.

4.5. Importance of Structural CAD Software

The respondents’ rating of the level of importance of Structural CAD software programs are presented in Figure 3.

Figure 3: Importance of Structural CAD software



The data suggests that total of 95% of the respondents rated it important and very important. This is because the software programs are useful for design and analysis of buildings and structures which manual means cannot do accurately. Though the respondents do not know how to use the software programs, they might have seen, read or heard about some of the projects which were done with the software programs, such as videos on mega structures. This result is parallel with Allen and Stimpson (1990), who stated that the Structural CAD programs is important and have definitely reduced the need for manual drawing. They further stated that all particulars of building, including its floors plans, sections, elevations, perspective views, and model rendering can be created or generated in a much shorter period of time than by the old traditional way of manual drafting. The knowledge and application of the Structural CAD programs helps to reduce the weight, size and materials of structural components, improve durability and compare design alternatives to best meet specific structural requirements.

5. Conclusion and Recommendation

From the discussion above, it was clear that the respondent knew about general CAD software programs especially AutoCAD, but majority (64.8%) of them did not know about the Structural CAD software programs. The shocking revelation from the survey was that some of the respondents did not know at all about the Structural CAD software programs. It is a great lost to the country if at the higher level of education, students are not introduced to the modern trends in the design and construction industry.

It is therefore not out of place that majority of the respondents did not use the Structural CAD software programs. However, it was revealed that most of the respondents opined the Structural CAD software programs are very important in the construction industry, for design and analysis of buildings and structures which using the manual means may result in delays and errors.

It is therefore recommended that Universities in Ghana offering civil engineering and related programs should introduce courses for the study of Structural CAD software programs to equip their graduates with the skills and abilities to use these software programs so as to be fit in the design and construction industry after their studies. Additionally, government and the universities authorities should sponsor some of the lecturers to go to Europe where the CAD programs are well known and used to learn the skills and application of the software so that they can come back and impart the skills and knowledge to the students in the universities.

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