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## APPLICATION SOFTWARE USED IN BUILDING PROJECT DELIVERY IN NIGERIA

O. J. AMEH and M. B. OLUFOWOBI

Department of Building,  
University of Lagos, Nigeria

### ABSTRACT

*The study aimed at exploring the types of application software used in building project delivery in Nigeria. A survey research design was employed. Forty one construction professionals from building and civil engineering consultancy firms were sampled using Judgment sampling technique. Data were analyzed using descriptive statistics. AutoCAD top the list of preferred 2D and 3D architectural design software, Staad Pro top the of dominant structural analysis/design software, Microsoft Excel and Microsoft project was the most used cost estimating and project management software respectively. Ability to handle complex projects, timely completion of operation (speed) and opportunity to review and amend documents were ranked the highest benefits of computer software. Virus attack leading to data loss was the most significant barrier to the adoption of Information and Communication Technology in the building and civil engineering consultancy firms. The study will serve as a guide to tertiary educational institutions in the review of their curriculum in line with ICT needs of the industry. It also bridges the gap in literature on international construction practice in IT. The study provides insight into construction industry hiring requirements for new graduate, in terms of proficiency in dominant application software both locally and internationally.*

**Keywords:** Application software, construction, consultancy, engineering, project delivery, Nigeria.

### 1.0: INTRODUCTION

As construction projects become more complex, coupled with its multi-organisational and matrix structure, it became imperative to use information technology (IT) for re-engineering of organisational functions and operations as well as for strategic advantage. Studies have shown that the early 1980s was an era when Construction Industry Professionals (CIPs) were awakened to the reality of applying computer into the operations and processes in the industry (Dobson, 1999; Tse and Choy 2005; Kumas, 2004). Mak (2001) opined that the construction industry is slow in utilizing IT to manage projects. The number of studies related to IT in construction for developing countries is scanty comparatively to such studies in developed countries. Expectedly, the professionals in the developed economies showed more readiness and commitment to the adoption of computers in their operations in comparison to those in the developing economies like Nigeria (Oyediran and Odusami, 2005). This perception of low level of IT adoption in the case of the Nigerian construction industry was confirmed in Oni's (2003) study as reported by Oyediran and Odusami (2005). Oni (2003) also

noted the lack of comprehensive IT strategy by practitioners and management of construction organisation. In the case of Nigeria, the late adoption of IT in construction is hinged on lack of necessary physical and information infrastructure, inadequate competent IT personnel among others. It was not until the late 1980s that researchers and practitioners in Nigeria began to draw attention of the industry to the advantages of the use of computers in the construction industry (Ayeni, 1989). Productivity is a serious issue for the construction industry, and because of the large size of the industry, this has a dramatic impact on the economy of nations. Ardit and Moctar, (2000) averred that construction productivity has been on a steady decline over the past two decades. The slow or non adoption of ICT in construction operations particularly in design, estimating, project planning and control of resources in developing countries results in the followings; time consuming, routine design, poor specifications and scheduling for projects and inaccuracies as well as cumulative errors in estimating, costing, structural design and analysis, poor and ineffective planning and control of project resources. Improved use of IT application software in design and production



management of construction operations coupled with the use of the internet offers a new vista of opportunity for reversing the decline in labour productivity in the construction industry. Furthermore, significant saving in costs and time can be achieved if the team members embrace IT application software use both at the design and production management stages.

This study explore the types of application software used by leading engineering and construction consultancy organisations in Nigeria. Furthermore, the study examines the benefits of application software to professionals and the challenges to the use of application software by the Building and Civil Engineering Consultants.

## 2.0: LITERATURE REVIEW

A survey carried out by Thompson (1992), which focussed on identifying the main operating systems and software packages in use in New Zealand building construction industry indicated a predominance (80%+) of "IBM compatible" users and in the CAD field a similar predominance of AutoCAD users. In like manner, Doherty (1997) reported Morgan and Banks' (1996) survey of 1000 Australian employees and managers in a wide range of industries where it was shown that nearly 60% of Australian employees are falling behind rapidly in the basic skills needed for efficient use of the Internet and other desktop personal computer software required in business environment. O'Connor and Yang (2003) averse that there is a statistically significant correlation between the use of IT and project being successful. Rivard, Froese, Waugh, El-Diraby, Mora, Torres, Gill and O'Reilly (2004) carried out case studies on the use of IT in the Canadian construction industry in the summer of 2002. The construction industry professionals interviewed include architects, engineers, general contractors and owners. It was reported that many of them are at the cutting edge in their use of IT for construction operation and processes. Despite the fact that there has been a significant adoption of IT application software by construction industry of developed economies, the issue of independent data information system which does not permit improved collaboration by project team member is a limitation. For example, design application software is independent of software for controlling cost or software for

monitoring project progress. Thus, design information must first be printed and reviewed and thereafter relevant data are manually entered into another program for cost estimation purposes. This fragmentation causes increased effort and time and has greatly reduced the ability of project team members to respond quickly and effectively to change in scope, site conditions, delivery delays.

The 'Construct IT Bridging the Gap' report (Department of Environment, 1995, cited in Sun and Howard, 2004) examined the current use of IT in the construction industry and concluded that 'software applications are available to support most aspects of a construction project. Software, by definition, is the collection of computer programs, procedures and documentation that performs different tasks on a computer system. They have been designed largely as solutions to specific problems (Blundell in Betts, 1999). Ranns and Ranns (2005) observed that there are many computer software packages allowing programming to be done on computer which can also generate progress reports. The use of IT applications software in Architectural, Consulting Engineering, Quantity Surveying (Q.S) and Contracting organisations vary. According to a survey conducted in Hong Kong, Tse and Choy (2005) observed that the architectural firms use IT packages mainly for architectural design, technical drawings and model simulation. The engineering consultants use IT applications mainly in engineering design, structural and geotechnical analyses as well as graphical modeling. Engineering firm also used IT in office management and communication. Studies by Arif and Karam's (2001) in the West Cape Province of South Africa and Riverd's (2004) in Canada supported the fact that Computer Aided Design (CAD) software is widely used by Architectural/Engineering (A/E) professionals. AutoCAD has the largest share of the CAD market (Howard, Kiviniemi and Samuelson, 1998; Dobson, 1999). Other popular CAD packages include Microstation, ArchiCAD, MiniCAD, FastCAD, IntelliCAD, Revit, etc. These CAD programs have largely replaced the traditional drawing board at the production information stage. The basic function of CAD packages is that they allow the user to build up drawings by



manipulating lines, circles, rectangles and texts interactively on the screen. Some architecture-specific CAD systems, such as AutoCAD Architectural Desktop, even provide graphical libraries of commonly used building elements such as doors, windows. The main benefits of CAD seen by professionals according to Tse and Choy (2005) are the improved accuracy and legibility of engineering drawings and the ease of making alterations to designs, leading to consistent quality; a better capability for the coordination of complex operations; the possibility of examining various alternatives at reasonable cost; and thereby improved designer productivity. Photoshop, 3D Studio and Microstation are additional architecture specific application software.

A QS firm mainly uses IT applications to estimate building costs, prepare tender documents, monthly valuations, controlling costs and final account of building works. Brooks (2004) noted that spreadsheet application software frequently used by Quantity Surveyors provide the framework for price list, calculation and cost planning. Spreadsheets are frequently used for financial information because of their ability to recalculate the entire sheet automatically after a change to a single cell is made. Lotus 123, MS Excel, and Quattro Pro, are examples of leading spreadsheets. Sun and Howard (2004) suggested that, there are sophisticated computer software packages, such as Esti-Mate, Manifest and FBS-Estimator, which allow project managers to perform estimation and to keep track of project spending.

Project managers use ICT application software both during the production process and post construction periods. One of the challenges a project manager must face is how to keep track of the many elements of project management, including tasks, milestones, dependency relationships, schedules, people, costs, deliverables and progress toward interim and final goals. Computer systems can assist on-site managers to plan ahead, evaluate different options, adopt and execute the most efficient construction operation. Sun and Howard (2004) suggested that, apart from the wide spread use of planning packages such as Microsoft Project, Primavera, Power Project, etc., to programme and schedule the detailed construction activities, some applications, like Job Master and ICON, are designed to log and track

internal processes during the construction phase.

### 3.0: RESEARCH METHOD

The research is based on a survey design. A non probabilistic sampling technique 'judgment sampling' was adopted in the selection of both Building and Civil Engineering consulting firms. The rationale for adopting this sampling technique was that the sampled firms were generally perceived as top rated consultancy firm in the construction industry in terms of their size, annual turnover and geographical spread nationwide, and are regarded as being in the best position to use IT in their operation. The study population comprises Building and Civil Engineering consultancy firms, made up of architectural firms, civil/structural engineering firms, building/construction project management firms, mechanical and electrical engineering firms located in Lagos, Nigeria. Lagos is located in the south-western part of Nigerian. Being a former federal capital and now the commercial nerve centre of the country, Lagos has an estimated population of about 17 million in 2007 with growth rate of 3.2% and its attendant pressure on infrastructure. Lagos is listed as one of the twenty-five megacities of the world. Majority of building and civil engineering organisations (both consulting and construction) have their head office or at least, their branch offices in Lagos. This makes it possible to sample outstanding Building and Civil Engineering consulting firms that are considered representative of construction consulting organisations in Nigeria to warrant generalization.

The questionnaire consists of three sections. The first section seeks to obtain information on the respondents' profile. The second section seeks to know the degree of use of the different types of computer software application under the respective professional groups, obtain information with regards to the computer literacy level and degree to which the staff are trained for their use; challenges/limitations perceived in the use as well as benefits derived from continuous use of computer software applications. Out of the forty eight questionnaire administered to building and civil engineering consultancy firms. Forty-one questionnaire returned were accepted for analysis after check for completeness and omission including error of multiple answers. Data





collected from the study were analysed using descriptive statistical method with the aid of the statistical package for social sciences software (SPSS 17 software).

#### 4.0: FINDINGS AND DISCUSSION

Table 1 presents the type of consultancy firms sampled. Twelve a piece of architectural and building/construction project management firms representing 29%, 10 (25%) civil/structural engineering firms, three and four of mechanical and electrical engineering firms respectively were sampled. The survey elicits information with respect to the work experience (in years) of the respondents and computer literacy level of members of staff of the sampled consultancy firms. Twenty six of the respondents representing 63.4 % have over five years of working experience. Five (12.2 %) have between 6 and 10 years working experience, 24.4 % have between

11 and 15 years working experience, 17.1% have between 16 and 20 years working experience while very few (4.9%) have over 20 years experience. This implies that the respondents have had adequate experience and were conversant with the firm's operation and hence information provided by them pertaining to the application software used for their practice is reliable. Furthermore, Table 1 shows the computer literacy level of members of staff in the consultancy firms. As shown in Table 1, overwhelming majority (90.2%) affirmed that more than 40% of the members of staff in their organisation are computer literate while very few (9.8%) affirmed that less than 10% of their members of staff are computer literate. These latter group representing 9.8% certainly is less likely to be proficient in the use of computer software applications even though they are computer literate.

**Table 1: General Information on the respondents**

Respondent Information	Frequency	Percent		
<b>Consultancy firms</b>				
Architectural	12	29		
Civil engineering	10	25		
Building/Construction project management	12	29		
Electrical engineering	4	9.7		
Mechanical engineering	3	7.3		
<b>Total</b>	<b>41</b>	<b>100</b>		
<b>Working Experience</b>				
below 5 years	15	36.6		
6 - 10 years	5	12.2		
11 - 15 years	10	24.4		
16 - 20 years	7	17.1		
21 - 25 years	2	4.9		
above 25 years	2	4.9		
<b>Total</b>	<b>41</b>	<b>100.0</b>		
<b>Staff Computer Literacy Level</b>				
below 10%	4	9.8		
40 - 59%	3	7.3		
60 - 69%	4	9.8		
70 - 79%	6	14.6		
80% and above	24	58.5		
<b>Total</b>	<b>41</b>	<b>100.0</b>		



#### 4.1: Means of Internet Access

Internet access makes it possible for the designer(s) to share intelligent 3D models with other project team members using browsers. Internet access also aids in running the computer software in terms of programme update and buying current antivirus software from online

store. All the respondents affirmed that their organisation had at least a means for gaining access to the internet, although some of them had more than one means of internet access. However, broadband connection is the most common means of internet access as indicated in Table 2.

**Table 2: Means of Internet Access**

Means of internet access		N	Mean	Rank	
	Broadband connection	41	2.85	1	
	Dial up connection	41	2.15	2	
	Wireless connections	41	1.93	3	
	Network providers	41	1.44	4	

#### 4.2: Application Software Currently Used in Building and Civil Engineering Project Delivery.

Table 3 shows order of different computer software under their respective application packages. These application packages are grouped into seven categories, Business Information Management, Computer aided design and visualization, Building engineering application, Computer aided cost estimating, planning, schedule, site management, computer aided facilities management and others. As shown in Table 3, other software more preferable to MS-access, film maker and data-base by the consultancy firms under business and information management package. Some of these software include Microsoft word and Adobe reader. Under the computer aided design package, AutoCAD (mean = 3.68 and 3.39) are the most preferable application for 2D drafting and 3D modelling respectively, followed by ArchiCAD. Micro station and data CAD are also used, but less preferred as they ranked 3<sup>rd</sup> and 4<sup>th</sup> for 2D drafting and 6<sup>th</sup> and 7<sup>th</sup> for 3D modelling. However, Revit software. CADDSMAN and Sketch up were also

in contention for preference for 3D modeling (means = 1.83, 1.44 and 1.44 respectively). In the structural analysis and design software package, Staad Pro is the most preferred (mean = 3.5). For computer aided cost estimation, MS excel is the most preferred (mean = 3.61). Lotus, Quattro Pro were sometimes used while super plan, manifest, FBS estimate and Smart software were rarely used as indicated in Table 3. MS Project was overwhelmingly ranked the most preferred for project planning and site management (mean = 3.68) while Graphic information systems and CAD software were commonly employed for facility management (means = 2.74 and 2.15) respectively.

**Table 3: Preference of computer application software in the delivery of building projects.**

Computer software applications	N	Mean	Rank
<b>Business and information management software</b>			
Other(s)	5	3.40	1
MS-access	41	2.22	2
File maker	41	2.07	3
Database	41	1.93	4
<b>Computer Aided Design (CAD) software (2D Drafting)</b>			
AutoCAD	41	3.68	1
Archi CAD	41	1.98	2
Micro station	41	1.27	3
Data CAD	41	1.24	4
Versa CAD	41	1.00	5
<b>(3D modelling)</b>			
AutoCAD	41	3.39	1
Archi CAD	41	1.88	2
Revit	41	1.83	3
CADDSMAN	41	1.44	4
Sketch up	41	1.44	5
Micro station	41	1.37	6
Data CAD	41	1.27	7
<b>Structural analysis and design software</b>			
Staad Pro	40	3.50	1
Microstran	38	1.36	2
Turbo frame	40	1.35	3
Math CAD	41	1.32	4
P-frame	41	1.27	5
Other(s)	2	1.10	6
<b>Computer aided cost estimating software</b>			
MS Excel	41	3.61	1
Lotus	41	1.93	2
Quattro Pro	41	1.68	3
Super plan	41	1.15	4
Manifest	41	1.00	5
FBS estimate	41	1.00	6
Smart	41	1.00	7
Viscalc	41	1.00	8
Esti-mate	38	1.00	9
<b>Planning, Scheduling and site management software</b>			
Microsoft Project	41	3.68	1



#### 4.3: Benefits of Using Computer Software to Practitioners

The various benefits derived from the use of computer software application by building and civil engineering consultancy firms for project delivery are shown in figure 1. Overwhelming number of respondents (92.7%) affirmed of the fact that they had benefitted so far from the use of

computer software for their project delivery. Ability to handle large and complex projects (mean =3.73), timely completion of operation (speed) and opportunity to review and amend documents top the list of benefit of computer software to building and civil engineering consultants.

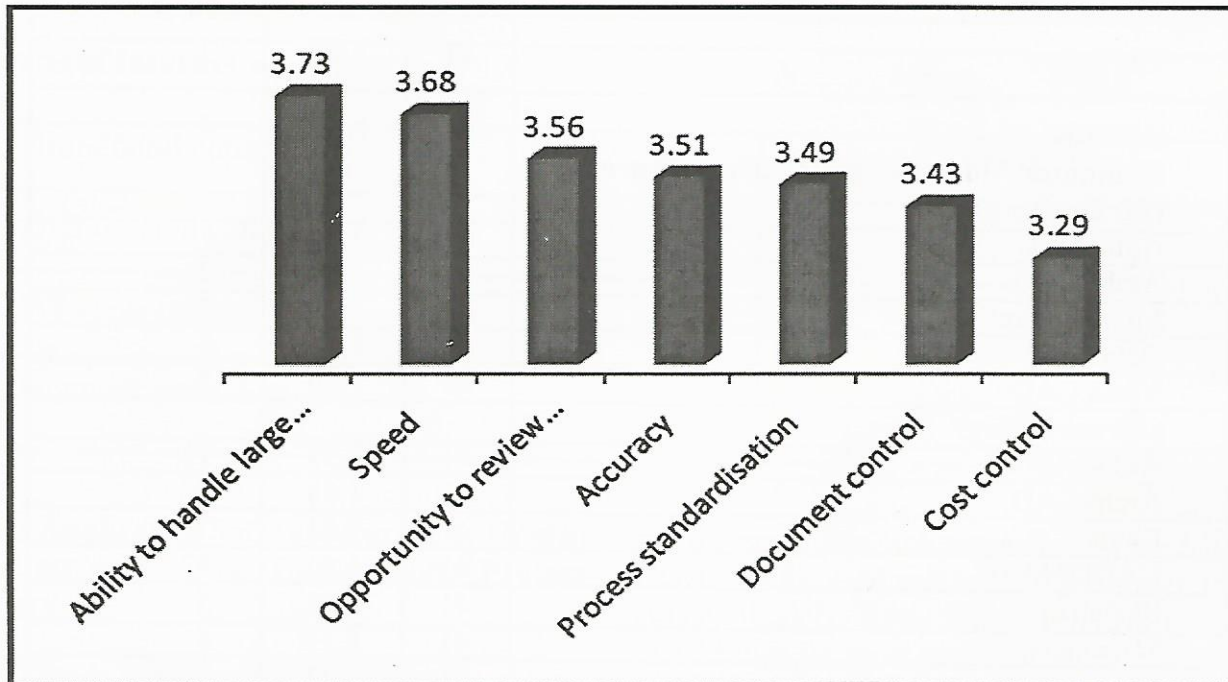


Figure 1 : Benefit of using application software

#### Barriers to Computer Software Usage in Building and Civil Engineering Consultancy Firms.

Figure 2 presents major limitations to computer software usage in building and civil engineering consultancy firms. As shown in figure 2, virus attack resulting in loss of data top the list. Software virus is very common and it can be

detrimental to the progress, profit and reputation of any organization; it can also lead to paralysis of activities within the organization if not dealt with accordingly.



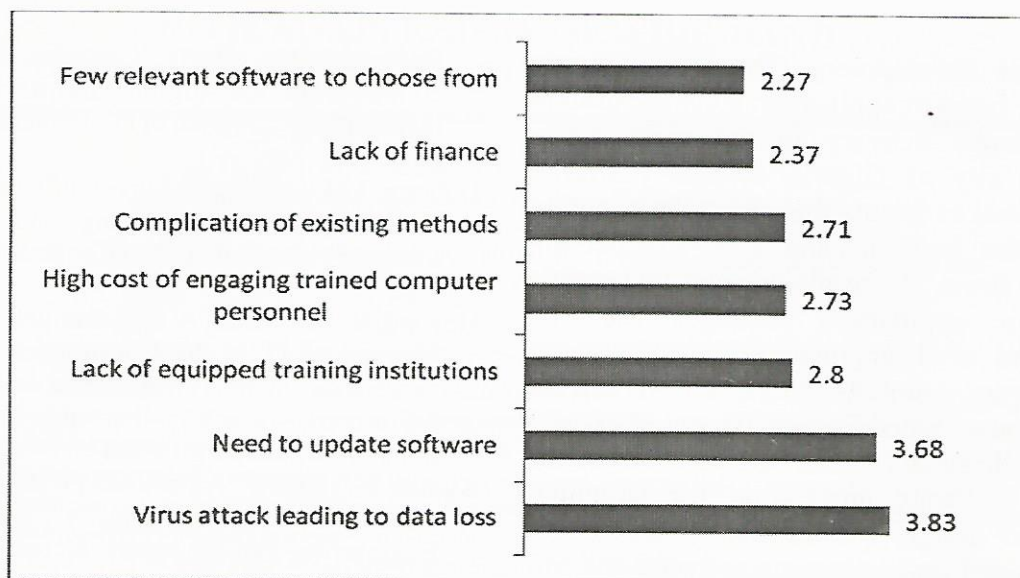


Figure 2: Constraint to the use of application software

#### 4.4: DISCUSSION

The predominance of AutoCAD among the CAD application software in building project delivery in Nigeria stem from the fact that AutoCAD was one of the earliest design software in the Nigerian construction industry. AutoCAD is the only application software used by the Petroleum Trust Fund (PTF) and the Computer Society of Nigeria (CSN) for short term training of staff and students of tertiary institutions in the built environment discipline. This result is similar to Doherty's (1997) survey of computer use by New Zealand building construction industry. According to Doherty's 1997 survey, AutoCAD was the most commonly used CAD for 2D drafting with 67% of users within the construction industry. The result of the current study is also in tandem with Rivard's (2000) survey of architecture, engineering and construction industry in Canada where AutoCAD and AutoCAD Lt was most popular among 65% of all firms surveyed. Similarly, AutoCAD was the most preferred CAD software application, followed by 'Caddie' in a survey of architectural practice in the Western Cape Province of South Africa (Arif and Karam, 2001). Revit and Sketch up software are newly introduced and are strongly contending with CADDSMAN which ranked third most preferred in Doherty (1997) survey. This result for structural analysis and design software package differs from Doherty's (1997) New Zealand survey in which Microstran topped the

group but in conjunction with ROBOT, CAD, FEM and ORION, as reported by two of the consultancy firms since no one design/analysis software does everything. For computer aided cost estimation, MS excel displace Lotus and Quattro pro which were the most preferred software in Doherty's (1997) New Zealand survey. The preference for MS project in these findings correlates with that of Doherty (1997) study. The reasons for the preference of particular application software may not be unconnected with the initial cost of purchase, absence of bug, stability (rare need for upgrading), flexibility, security and audit ability of the application packages. In comparison to findings from Doherty's (1997) survey on computer use in New Zealand building construction industry, the most significant barrier was lack of finance but this reason was insignificant in the current study. This was predictable as computer software is the centre of interest in this study and you can only make use of it when you already own a computer system.

#### 5.0: CONCLUSION

The slow or non adoption of IT software in construction operations of developing countries particularly in design, estimating, project planning and control of resources may account for their



slow rate of development. The current study explores the types of application software used in building project delivery in the most active commercial city of Nigeria. It also examines barriers as well as factors that affect the adoption of IT in the building and civil engineering consultancy firms. The result indicates that among the software application packages used by building and civil engineering consultants in project delivery, AutoCAD and archiCAD top the list of Computer Aided Design 2D and 3D(CAD) software while staad Pro and Microstation are the most used software application for structural analysis and design. MS Excel top the list of Computer aided cost estimating software and MS Project is the most used Planning, Scheduling and site management software. Ability to handle complex projects, timely completion of operation (speed) and opportunity to review and amend documents top the list of benefit of computer software to building and civil engineering consultants. Furthermore, the study revealed virus attack resulting in loss of data as the most significant barrier to the adoption of IT in building and civil engineering consultancy firms. The practical implication of this study is that, it has brought to the fore, dominant IT software used in building project delivery and area where potential graduates in the construction profession need to be proficient. It will also serve as a guide to tertiary educational institutions in the review of their curriculum in line with needs of the industry. The study bridge the gap in literature on international construction practice by comparing application software used in building project delivery in Nigeria with that of developed countries.

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