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THE ROLE OF COMPUTER APPLICATIONS INNIGERIAN CONSTRUCTION INDUSTRY

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ABSTRACT
In the 21st century, Computer application is seen as a tool that assists companies to perform more efficiently and effectively. The issue is more serious in the construction industry where there are Factors that limit performance such as inadequate training, ineffective use of IT infrastructures, Maintenance inadequacies and less than positive staff perceptions concerning IT implementations by Management. Nigeria is a rapidly developing country and computer application integration has to be efficient to help Accelerate development. This study aims to analyze computer application effectiveness in construction industries in Nigeria. The study reviewed literature related to computer application implementation and its services in the construction industry with the objective of highlighting the important of such application as it relates to the construction industries in Nigeria. The aim is to discover the challenges faced by the professionals by examining the factors affecting the use and adoption of computer in a dynamic world of explosive growth of the information and communication technology (ICT).

Keywords: *Information Technology, Computer, Cad, Nigeria Construction Industry, Construction Tendering*,

INTRODUCTION
It is to be noted that computer use and adoption in the building construction industry has been a subject of interest among the construction industry professionals in general. Rivard et al (2004) carried out case studies on the use of IT in the Canadian construction industry in the summer of 2002. The CIPs 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. Some of the issues related to IT adoption identified in their

study are: efficiency and economy of electronic distribution of documents, difficulty in introducing new technologies on projects due to time lag and tight budgets. Others include: the industry- wide use of CAD system, cost of maintaining trained CAD and IT personnel and the loss of IT benefits to companies that lag behind in adopting IT. In all, the authors believed that the potential benefit in adoption of IT can spread round the industry.

The explosive growth of the information technology (IT) has had unquantifiable impact on business systems and processes .The global acceptance and widespread adoption of ICT has accelerated the dimensions of competition not only among organizations globally but among professions locally. The QSs ability to avail themselves with the emerging opportunities provided by the advent of ICT depends on the adoption of new technologies (Castle, 2002).

Computer has promised to be a reliable tool in all spheres of human Endeavour. Literature has documented the relevance of computer/computing to the industry (Shash and Al- Amir, 1997). Advances were made in various professions when such professions took advantage of technological tools available (Li, 1996 and Pollack-Johnson &Liberatore, 1998). There is quite a lot of development in all areas of computer application to the industry. Of note are the expert systems, artificial intelligence, knowledge-base systems (KBS), artificial neural networking (ANN), robotics and computer aided design (CAD). Wager (1988) examined at the implications of transferring quantities information from CAD systems directly to the quantity surveyor or contractor. Rivard, Froese, Waugh, El-Diraby, Mora, Torrres, Gill and O'Reily (2004) predicted that the evolution of IT will have a profound impact on how organizations in the architectural, engineering and construction (AEC) industry operate. This is already coming to pass. For example, there are pockets of reduction in paper-based operation in quantity surveying offices while electronic led- processes are leading to less dependence on taking- off sheets and other ancillary stationery. Honey (1998) reported that a large proportion of QSs in the United Kingdom have been using computers. In an earlier baseline study, Oyediran and Odusami (2004) examined the state of the art of computing by QSs in Nigeria at the turn of the last century. Their study was limited to Lagos State of Nigeria and can at best be cautiously generalized. Thus an update on the state of the art of computing by the professionals is necessary. The critical roles being

played by the QSs in the procurement chain require that the professionals must not lag behind in the adoption of the computer application tools that promise to improve on their service delivery. Today a large number of software package are available to all the disciplines of the construction industry at every stage of the construction process, they provide support for a broad range of activities such as computer aided design and drafting, building visualization, design appraisal, project management, information storage and retrieval, cost estimations, structural analysis, on-site management etc.

RESEARCH METHOD

This study is ex post facto researches in that it reviewed the works of past scholars from journals and public bulletins with respect to glean the necessary information that will help in espousing the important and needs for computer application to the construction industry in Nigeria as well as identifying the challenges associated with the use of computer application in the industry

THE CONSTRUCTION INDUSTRY IN NIGERIA

Construction contributes some 7% of the GDP in most OECD countries and up to 12 to 14% in Japan and Korea(Gann, 2000), while in developing countries (according to Dharwadker, 1979) investments in construction projects could be as high as 50-60% of national budgets. In Nigeria, the construction industry was the dominant contributor to the nation's GDP in the 1980s, accounting for about 70% of the GDP (Planning Committee on the National Construction Policy, 1989). This made the industry very strategic to Nigeria's development efforts. Unfortunately, however, the industry has been bedeviled by a combination of low demand and consistent low. Productivity and poor performance over the years (Olomolaiye, 1987; Aniekwu, 1995; Okuwoga, 1998;Adeyemi*et al.*; 2005). This has reduced its contribution to the national economy to a mere 1% of the GDP in2002 (AfDB/OECD, 2004).The industry is made up of an organized formal sector and an unorganized informal sector. The formal sector comprises foreign and indigenous companies, which are classified into small, medium and large scale according to their level of capitalization and annual turnover. The few large firms (mostly foreign), which constitute just about 5% of the total number of contractors in the formal sector, control about 95% of the construction market, giving the small firms just about 5% share of the market.

Studies conducted by Oladapo (2007) to investigate the IT situation in the Nigerian construction industry highlights IT penetration, the impact of the industry and setting constraints. In addition, this study identified significant factors influencing the level of IT used, classifying them into those internal to the industry and those external to it. The 136 respondents consisted of contractors, consultants and academic researchers were given a survey to provide data for empirical analysis. Results showed that there are a number of internal factors, the type of business (both contractors, consultants and academics), the perception of senior managers, CEO/senior managers and the head of the executive officer (CEO) and displayed that the benefits of using IT as well as computer literacy are significantly correlated with the level of IT consumption in the industry. However, none of the external factors significantly correlated with the level of IT usage. The main use of ICT is in word processing, Internet communication, cost and scheduling. Five major obstacles of ICT are a lack of sufficient regular power supply, high cost of IT software and hardware, lower job orders for the company, fear of virus infection and high levels of obsolescence of IT software and hardware. In addition, a comparison with results of similar studies in some industries in new industrial countries shows that the proportion of companies using computers is high enough for developing countries like Nigeria. It also highlights the huge gap in access to electricity and other communication infrastructure between developed and developing countries. In this section, some definitions of information technology were discussed. In addition, the author discussed the evolution of IT, Information Systems and their usage in the construction industry. Implementation of IT in the construction industry has also been discussed

THE CURRENT USE OF COMPUTER APPLICATION IN CONSTRUCTION

The construction industry is currently experiencing a paradigm shift from traditional paper-based to digitally based information exchange, which other industries such as aircraft manufacturing and banking have adopted and benefited from long ago (Rivard et al., 2004).This shift has been aided to a large extent by the drastic reduction in computer hardware and software prices and the increased power, usefulness and popularity of computers over the last few years (Rivard et al., 2004). As more and more computers are connected through the Internet to form the worldwide

web, thus allowing firms located on different streets or indifferent cities, provinces, countries, or even continents to readily exchange information, the reach and benefits of ICT to industries and organizations have indeed become global. The use of ICT can impact on the traditional processes of professional organizations in construction and result in change in organizational processes, working methods and culture(Ruikar et al., 2005). In this regard, some benefits of ICT critical to the performance of professional consultants are to reduce the time for data processing and communicating information, and to improve communications for effective decision-making and coordination among construction participants (Peansupap& Walker, 2005) to enhance construction productivity (Liston et al., 2000). This is possible because the Internet-based tools of ICT allow communication between even remote users and enables them to share files, comment on changes and post requests for information (De Lapp et al., 2004).

While some tools of ICT (particularly hardware) are commonly required in Architectural, engineering and quantity surveying practices, others (mostly software) are profession-specific. The common types of software used in all the three professions include word processing, spreadsheet, CAD and Internet software (Goh, 2005). Areas of application of ICT common to the professions are administration, communication, marketing, desktop publishing, presentation and project management (Doherty, 1997; Arif&Karam, 2001). While architects and engineers use CAD mostly for design, drawing and presentation (Rivard, 2000;Arif&Karam, 2001; De Lapp et al., 2004), quantity surveyors use it for measurement, preparation of bills of quantities, estimating and presentation. The engineering analysis software for specific branches of engineering includes Microstran, and MathCad (Doherty, 1997). With 3D modeling capacity in modern structural design software, designing complex structures is now facilitated where previously this was almost impossible (Walker &Hampson, 2003). For quantity surveying, there are WinQS32, QS Plus2001, QsCAD, CATO, and Master bill among others (Willis et al., 1994; Adetola, 1998; Murray et al., 2001), which not only speed up but also enhance the accuracy of quantity surveying functions from approximate Estimating to final accounts. A detailed description of many of the available software for architects, engineers and quantity surveyors can be found in Murray et al. (2001).

In addition to these applications of ICT to what may be termed the traditional domains of the architectural, engineering and quantity surveying professions, there are some emerging new areas of ICT innovations. They include knowledge management (KM), electronic document management (EDM) and e-business. ICT facilitates the transfer of knowledge and information between project teams, enabling the development of new knowledge for innovation (Gann, 2000). The development of an EDM system for project management can save considerable time and cost for document transfer (Tam, 1999); while e-business provides an efficient infrastructure for remote consulting services to consultants who desire to provide their services through the Internet (Mangini&Pelli, 2003). Details of the applications of KM can be found in Egbu et al. (2001) and Egbu & Botterill (2002), those of EDM in Tam (1999,Björk (2002), Sulankivi et al. (2002), and Bäckblom et al. (2003) and those for e-business in Issa et al. (2003), Mangini&Pelli (2003) and Rivard et al. (2004).

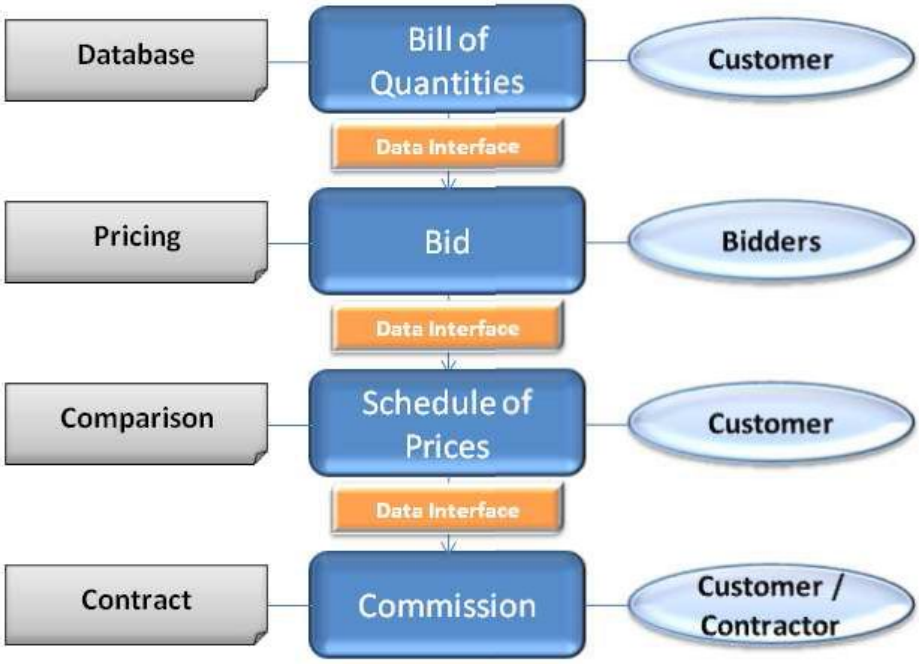
Computer Aided Drafting (CAD): The origins of Computer Aided Design (CAD) lie in the aircraft industry in the 1960s. In the 1980s, these systems also made their break-through in architecture. Specialized Computer Aided Architectural Design (CAAD) software programmer started to improve the drawing process in 2D. In the 1990s, tools emerged which provided the possibility of 3D drawing and subsequently, object-oriented design systems were developed The major output of any architectural and engineering team is drawings and these drawings are now mostly generated on computers. Like any other CAD software, construction oriented CAD are based on the same principles but may differ to some extent in their designing and application methods. CAD systems provide drawing entities with powerful construction, editing and database techniques to produce drawings and models of what buildings will look like when finished (Dace (2007).They are based on the foundation of drawing primitives(2D/3D lines, arcs, curves, 3D surfaces, text etc.).Its data can also be read and stored in by other applications software and hardware for analyzing the output information. For example, a CAD system could be used to generate 2Ddrawing, and can be linked to another or same software as the case maybe and generate the 3D model. It can be stored for future references, printed, projected, edited modified, etc any number of times. A common requirement in architectural and engineering design is to produce a drawing which is a schematic layout of components, and which accurately reflects the relative

sizes and relationships of these components (Eastman *et al.* (2008). The speed and ease with which a drawing can be prepared and modified using a computer have a tremendous advantage over hand-based drawing and techniques. For example in an architectural CAD, walls, beams, Columns, slabs etc are common tools in the application and these can simply beaded on by simply clicking and dropping or drawing along a surface. The drawing can also be shared by a number of designers over a computer network who could all be specialists in particular design areas such as, landscape, structural and mechanical designers and these people can be Located at different geographical points. Drawings can also be linked into databases that could hold material specifications; material costs etc., this helps in providing an ample examination from design through to construction phases. There is virtually no limit to the kind of drawings and models that can be prepared using a CAD system if it can be done manually using the hand (Howard (1998).Most CAD models can be enhanced for further understanding and presentation by the use of advanced rendering animation techniques (by adding material specifications, light sources and camera motion paths to the model) to produce realistic images and interactive motion such as flythrough and walkthroughs.

Spread Sheets and Word Processors: Spreadsheet, word programs and micro computer shave transformed information processing in construction organizations. They are used to solve problems and get round the long delays encountered in dealing with the traditional manual way of getting office works done(Sun and Howard(2004). Spreadsheets like Microsoft excel, word and PowerPoint are very important office tools as they stand for the every day to day running of worksheets. They are frequently used for financial information and presentations as they can be used to create and edit charts, graphs and tables. They are a very important ICT tool in the construction industry as they are designed to perform general computation tasks using spatial relationships. Most documentation, letters, calculations and presentations are been done on spread sheets and they are usually compatible to the CAD software and firms may independently operate small-group ICT innovation such as planning and scheduling applications using spread sheets and word processors.

Computers in Construction Tendering: Traditionally, invitations to tender, specifications, bills of quantities and other contract documents

have been drawn up independently and exchanged in paper form. Today, collaborative and comprehensive software tools can support the complete process of tendering, communication is almost exclusively electronic and documents are exchanged on web sites, by email and on portable data storage devices, such as DVDs, CD-ROMs and memory cards. The first comprehensive software tools that supported tendering procedures were introduced as early as the 1970's. Starting with punch card systems, the development of these tools led to new forms of data exchange. Since then, with the possibilities provided by the internet, spatial barriers have also been broken down. Computers can exchange tender information anywhere worldwide in real-time and digital signatures can ensure that they are binding.



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Software tools support this process from the beginning with the preparation of the bill of quantities. Since databases will already store design information from a building model on the one hand, and predefined specifications on the other, quantities can be calculated and tender documents generated. During the construction process new measurements can be filed and included, with the result that every item, as well as the total volume, is updated automatically. Digitally transferring

the bill of quantities in a structured form to the tenderers' calculation software saves time and money. On the basis of this information, the tenderer is able to calculate a price. Their tender is passed back to the client, again digitally, and all the tenders received can be compared electronically. As a result, a schedule of prices can be created by the client's software allowing bids to be evaluated against a range of criteria. Before the contract is awarded, modifications resulting from tender negotiations or changes in conditions, contingency items, cancelled items or price changes can all be included in the final contract documents. A digital version of the bill of quantities can also support the calculation and agreement of variations during the construction phase.

Information Technology: The construction industry is one of the most information-intensive industries, as a major construction process requires extensive exchange of data and information between the project's participants on a regular basis. In the construction industry, employees must adopt new forms of technology to achieve the time, cost, and quality goals of a construction project. During the construction phases and the lifecycle of a building, the construction industry depends on large amounts of information. It's important that the information provided to the construction site enables task control, data integration, material and resource control, and communication between the company and the suppliers. Here are some of the most accommodating forms of information technology for the construction industry:

- **Cloud Computing:** Cloud computing has a strong appeal in the construction industry, with many benefits due to the constant change of workers and setup of new job site locations. Often, construction workers require access to company data to provide timely decision-making and reporting ability while working in the field. Construction companies benefit from the cloud's ability to offer increased freedom and easy access to information at any time, from any location, such as job sites, customer locations, and satellite offices.
- **Project Management Software**; Project management software allows contractors to manage complicated business processes with planning, organizing, and managing the various resource pools available. Construction companies are required to deliver projects on time and according to budget. With project management software, the construction industry has the ability to execute

projects more efficiently, while delivering high quality results and increasing their overall business profitability.

- **Mobile Device Management**: In the construction industry, employees use mobile devices as their main line of communication during a project. Whether it's emails, texts, or phone calls, the smart phone has become the construction industries primary tool of communication. With the ever-growing amount of mobile devices and applications, mobile device management is increasingly important. With mobile device management software, the construction industry can optimize the functionality of mobile devices, while protecting the configuration settings and data for mobile devices in a network; thus lowering the overall business security risks and support costs.

Constraints to the Use of computers and ICT in Nigerian Construction Industry

The survey carried out by (Adebayo A. Oladapo, 2006) where questionnaires' was administered the respondents were asked to express their opinions on the impact of 13 factors as obstacles to the use of ICT in the Nigerian construction industry on a scale ranging from "Very weak" to "Very strong". Table 1 shows the analysis of their responses using the importance index. The top three constraints to the use of ICT in the Nigerian construction industry are inadequate/erratic power supply, high cost of computer hardware and software and lack of sufficient jobs. It is not surprising that inadequate/erratic power supply is way ahead on the list of obstacles as electricity supply in Nigeria has been unreliable, leading to high production costs for companies, which are forced to procure and run their own power generating facilities (AfDB/OECD, 2004). Respondents seem to have overcome their initial widespread fear of the replacement of humans by computers as the fear of mass job losses in the industry (ranked 10). And the fear of ICT making professionals redundant (ranked 12) is no longer given prominence.

TABLE 1: Ranking of the Constraints to the Use of ICT

CONTRAINT	IMPORTANT INDEX	RANK
Inadequate/erratic power supply	87.1	*1*
High cost of hardware and software	67.3	2
Lack of sufficient jobs	66.6	3
Fear of virus attacks	63.2	4
High rate of obsolescence of hardware/software	62.9	5
Inadequate ICT content of construction education	61.5	6
High cost of employing computer professionals	58.6	7
Lack of appreciation of ICT by firm's management	53.5	8
Security/privacy fears	53.1	9
Low return on investment	50.4	10
Fear of mass job losses in the industry	50.4	10
Fear of personnel abuse	49.7	11
Fear of ICT making professionals redundant	35.7	12

The Current Level of Computer Use and Future Prospects

According to (Adebayo A. Oladapo 2006) A majority of the organizations surveyed (98.5%) use computers. Most of them (59.7%) have been using the computer for 1-10 years, while only 38.8% have been using it for over 10 years and 1.55 for less than 1 year. Some common uses of the computer are word processing (74.3%), Internet communications (66.9%), costing (51.5%), scheduling (50.0%), accounting (44.1%) and design (33.8%).Fig. 7 shows the various uses of the computer among contractors, academics and architectural, engineering and quantity surveying consultants. The results indicate that quantity surveyors (85.72%) use the computer the most and contractors and architects (66.7%) the least for word processing. For design, architects (83.3%) use the computer most, followed by engineers (50.05%); and quantity surveyors (4.8%) the least. Quantity surveyors (90.5%) lead the pack in

costing, while contractors lead in accounting (66.7%) and scheduling (66.7%). These results are not surprising because traditionally design is a core function of architects and engineers, while quantity surveyors rarely engage in design. On the other hand, cost management is the core function of quantity surveyors just as work scheduling is a core function of contractors. Academics rank second in both word processing and Internet use as research and publications are among their core functions. This seems to suggest that the professions tend to computerize more their core functions and activities.

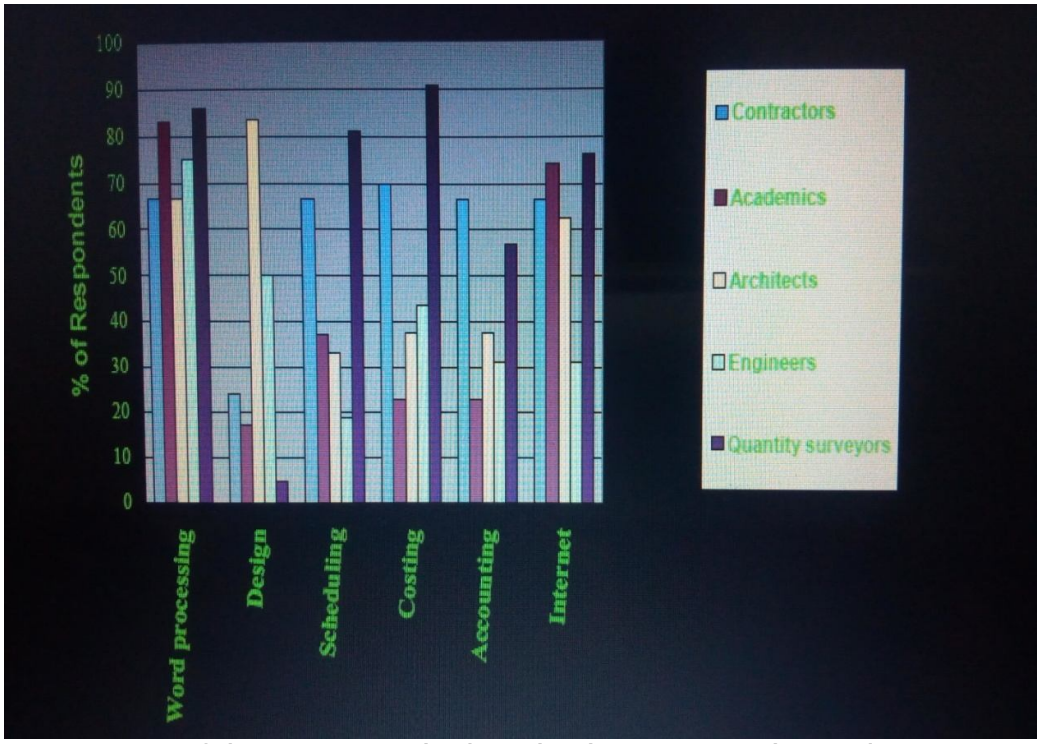

FIG 2: Uses of the Computer in the Nigerian Construction Industry

CONCLUSION

The review of literature concluded that many studies have been conducted to assess the correlation and impact of computer application and related services to companies' performance. There are few issues that are left unanswered, for example, the different degrees of IT between large and SMEs, the areas that IT benefit the most, the ways that IT can be utilized fully and the ways to overcome the hurdles identified in the previous studies. The purpose of reviewing literature is to gain

comprehension of the factors that contribute to the performance of a construction industry. The literature showed the relevant of terms and detailed discussion of important aspects that gave some empirical background, which will help in carrying out additional study. The results and conclusions of the previous studies(***Olukayode S. Oyediran and Koleola T. Odusami 2005)*** in their study of computer usage by quantity surveyors made the following conclusion About 89% of the quantity surveyors have been using computer for PCMS while, about 83% responded that their organizations have been using computers for their services. There has been some tremendous growth in the number of QSs and firms who are beginning to use computers from 1996 to date. Branded and clones (new ones) are the commonest computer hardware. There is the existence of both original and copied versions of the various types of software in use. CatPro, Master Bill and QS Bill are the three most used software. As expected cost was found out to be the most important factor in the acquisition of the software. In terms of regularity of usage communication-based software ranks the highest, followed by general-purpose software, then quantity surveying software and lastly by other industry related software. Almost all the respondents are performing word processing functions using computers. Spreadsheet functions consisting of estimating and job costing, cash flow preparation, scheduling, resource leveling, and material schedule and programmer of works are being carried out using computer by about 44% of the respondents while about 45% wish to perform spreadsheet functions with computer. The QSs indicated high level of proficiency in using Microsoft excel and Microsoft word. They appear to be moderately proficient in the computer based communication media – the E-mail and the Internet facilities. There is indication of fair proficiency in presentation packages such as Microsoft PowerPoint. The proficiency level of QSs in quantity surveying packages was found to be low.

The three main impacts of computer application in construction industry are in making jobs easier for the professions, facilitating decision-making and savings in operating costs. These findings accord with the literature which indicates that with the availability of 3D modeling software, for example, complex designs which were previously almost impossible are now done with ease IT improves communication to enhance decision making which ultimately yields time and cost savings in the industry.

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