A SURVEY OF THE IMPACTS OF INFORMATION COMMUNICATION TECHNOLOGY (ICT) ON ARCHITECTURAL PRACTICE IN NIGERIA

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ABSTRACT

The positive impacts of Information Communication Technology (ICT) on the professional services of the main actors in the construction industry cannot be over-emphasized. The future and development of a good architectural master piece depends on decisions made on several levels and by different professionals in the industry. The paper conducted a survey of the impacts of ICT on architectural practice in Nigeria. It also provides an insight into the current usage of ICT in some architectural firms. The data for the study was derived from both quantitative and qualitative methods of data collection. The quantitative method utilized a structured questionnaire survey while the qualitative method was through interview. Findings however revealed that the core architectural function has been largely computerized while data and document management are gradually being computerized. It also shows that a higher percentage of the respondents are aware and do make use of the ICT gadgets available at their disposal. The paper concluded that effective communication with a good managerial skills and mastering ICT is needed for a contemporary architectural practice in Nigeria.

Keywords: Information Communication Technology, Architectural Practice, Nigeria.

INTRODUCTION

The architect is defined in the British Standard Institution Glossary (1993) as the '*person who designs buildings and super intends the execution of building works*'. This reflects a simplistic view of the role of the architect. However, the role expands to involve not only technical activities but other areas of competency including organizational politics, business strategy, consulting and leadership, and technology. The architects have been chosen in particular as they play a key role in the design process and have a wide responsibility of the design and building. The architects have traditionally specialized on several domain areas of knowledge. Such areas have been urban planning, project planning, office planning, public buildings, housing and during the recent years also information technology related issues, such as integrated design data management, 3Dvisualization and building information modeling (Penttila, 2006).

Architecture is concerned with the designing of buildings and spaces. It is one of the professions that are very well founded in the construction industry in the UK as an example, since the early 19th century (Huru, 1992). Architecture has been described as the 'mother profession' and is best known in the family of design professions, it is worth of studying as it is probably the oldest established design profession and

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performs as a model for design in other professions (Schön, 1983). The architect was traditionally the master builder and the presence of architects, as has been documented, goes back to the third millennium before Christ; graphic conventions of architectural practice appeared even earlier (Kostof, 1977). The architect was in charge of the project from the early days of conception to the very last day of execution and was accountable in case of failure. The role of the architect turned out to be directed on the general concept of structures and managing the relationship between the client and contractor, who builds the building (Lewis, 1998). Furthermore, the boundaries of architecture are constantly shifting and there are many variations among architectural practices (Schön, 1983).

The architectural and designing working methods have changed drastically during the last few decades caused by CAD, design integration, project document management, collaborative team-work through the web and email (Kalay 2004). Design communication is currently considered to be an inevitable skill sector of a modern architect. The changes within the architectural profession and even more so in the construction process have recently been particularly economical. According to Penttila (2006), design guidelines, formal contracts and assignments with the clients are currently rather demanding in contemporary practice. The changes in architectural profession have concerned very profoundly the tools which architects use and also the working methods. CAD-systems have become the main tool for the architects during the 1990's and working without CAD is hardly possible any more. Product data modelling or Building Information Modelling (BIM) has also been developed to be an integrated future framework for the Architecture, Engineering and Construction (AEC) field information management.

The architectural profession revolves round building design, project management, construction and consultancy. In order to manage a construction project properly, accurate and up-to-date information is required at all times so that no delays and failures can be encountered. Hence, all project participants must be up to speed with the changes that are happening within the project (Aigbavboa *et al*, 2013). According to Lang *et al.*, (2005) traditional boundaries between different professions have been crossed as new needs and technologies emerged. In addition, professional identities and established work procedures are being challenged as a result of introducing innovative information and communication technologies (Eriksson-Zetterquist *et al.*, 2009).

Communication is the activity of conveying information through the exchange of ideas, feelings, intentions, attitudes, expectations, perceptions or commands. Communication in architectural practice helps the architect to better understand the client and other professionals in the building industry as well as to build trust; respect and create environments where creative ideas, problem solving, affection and caring can flourish. The professional service of the architects requires effective communication from the inception (brief) to the completion (handing over) of the structure. Also, there is need for effective communication between the client and the architect throughout the construction process. For communication to be effective, it requires a sender, a medium and a recipient.

Fig. 1: Communication between the Client and the Architect
Source: Researchers archive

The brief which represents the requirement of the client serves as the medium of communication between the client and the architect. The brief represents the client's mind, taste and intention concerning the proposed structure.

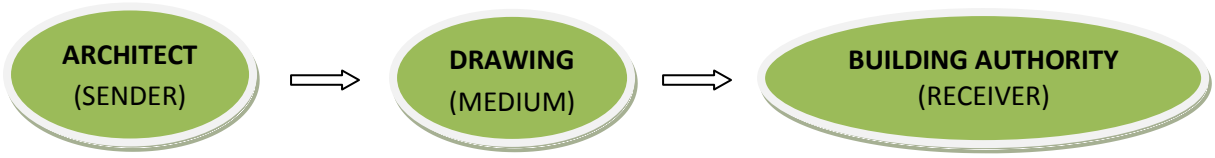

Fig. 2: Communication between the Architect and the Planning Authority
Source: Researchers archive

Before the commencement of any building project, there is need for the approval of the building plan by the planning authority. Hence, the working drawing prepared by the architect represents the medium through which the architect communicates with the building or planning authority.

Fig. 3: Communication between the Client and the Contractor
Source: Researchers archive

The client appoints a suitable contractor for the construction project after a tendering process. The tendering process serves as the medium of communication between the client and the contractors before the award of the contract to the successful contractor while the contract documents serve as the medium of communication between the client and the successful contractor after the award of the contract.

Due to the hierarchal and fragmented nature of construction works, a close coordination among a large number of specialized but interdependent organizations and individuals to achieve the cost, time and quality of goals of a construction project is required (Toole, 2003). In Nigeria, majority of construction information exchange are still based on traditional means of communication such as face-to-face meetings (site meetings) and the exchange of paper documents (Working Drawings, Architect's certificate, Architect's instruction, Specifications etc.) This slow pace of adapting to change is one of the reasons while the construction industry has for many years suffered from the difficult-to-access, out-of-date and incomplete information (Shoesmith, 1995).

This study is therefore a survey of the impacts of Information Communication Technology on architectural practice in Nigeria. Against this backdrop, this paper presents an empirical analysis of the impact the adaption and use of ICT has had on the professional responsibilities of the Nigerian architects. The specific objectives of the study are: to determine the level of compliance with ICT; to identify the factors that determine the use of ICT by the architects; to identify the benefits of ICT; and to determine the commonly used ICT tools among the architects. The paper starts in the next section with a review of some theoretical background. Then it explains the research setting and methods of data collection and analysis before conclusions were drawn and recommendations made.

LITERATURE REVIEW

Penttilä (2006) identified three different periods of time where a hypothetical framework of changes within the architectural practice was created. The periods include:

1. Early 1980's (1980-85) which were the last days of hand drawing (designs drawn on paper using pencil and ink) and the era before Computer Aided Designs (CAD). During these periods, communication was done in weekly face-to-face design meetings and with telephones (land lines and not mobile phones).

2. Mid 1990's (1993-98). This was the period of the expansion of architectural CAD and the era of appearing digital drawing. There was a shift from hand drawing to CAD-drawing during these periods. Also, paper prints of CAD-drawings became prominent among the project teams and were distributed with traditional mail and couriers. After the invention of World Wide Web (www) in 1993, web-based communication started to expand, but it had not achieved very large volume yet in mid 1990's.

3. Beginning of the 2000's (2000-05). These periods brought about the rise of integrated and pervasive web supported digital design; two dimensional (2D) drawing became the main design method; three dimensional (3D) modeling was used in visualization; the advent of building information modeling (BIM) and the importance of communication. During this time, drawings were produced with enhanced CAD systems with extended drawing automation.

> Drawings were distributed to project teams with email and more and more via project document banks. Web dramatically changed the communication environment. Not only email, but also various collaborative working and communicating platforms transferred design work to virtual.

The essence and importance of architectural CAD in all respects, data management, digital drawing, visualization and modelling, as well as numerous web-based collaboration techniques are well documented within the research community, such as in Cumincad index database (Cerovsek & Martens 2004). ICT-based changes concerning the construction sector have also been documented, for instance in several local and national surveys and barometers during the last 10-15 years (Rivard 2000). The surveys have mainly pointed out and measured noticed changes within various fields of ICT. Examples such as the volume of construction field computing, the use of CAD within professional or the distribution and content in web-based communication. Rabee (2007) was of the opinion that since the late 1980s, architecture and architectural education have witnessed an important transformation with the introduction of computers and information and communication technology (ICT) in which they have become pervasive in all aspects of practice and education. The pervasiveness of information and communication technology in architectural education and practice has been manifested in the growing proportion and importance of IT related courses in the curricula of architectural schools (Rabee, 2007). Modern information and communication technology and digital tools have been adapted in the architectural education and practice since the 1990's. Computer Aided Design (CAD) has been adapted into architecture and became the major working environment (Rabee, 2007).

Most of the recent changes concerning pragmatic architectural practice have been caused principally by digital information and communication technologies (ICT). These changes are widely present in the whole AEC field (architecture, engineering & construction), and even wider in the whole western society, where almost all kinds of official activities have been gradually transformed into digital (Penttilä, 2006). A well-documented result of AEC-field ICT is, that information and communication technology has in general been adopted and also gained a significant role in design & construction during the 1990's (Howard, Kiviniemi, Samuelson 2002).

RESEARCH METHODS

The data for the study was derived from both quantitative and qualitative methods of data collection. The quantitative method utilized a structured questionnaire survey which was used to determine the views of the architects on the impacts of ICT on their professional roles. The questionnaire survey was administered among 60 architects. The participants were located in different areas as they were selected randomly. Bulks of the participants were located in Lagos and Abuja while others were in Abeokuta, Ibadan and Akure. The research instruments used for this research are the architecture students of The Polytechnic Ibadan, Saki Campus.

The qualitative method was through interview. According to Bryman (1988) and Silverman (2006), interviews help to see from the perspective of the people being studied, to provide clues to other layers of reality, to understand the process in a wider context, and finally to avoid premature theories and concepts. Both Registered

and not registered members of the Nigerian Institute of Architects (NIA) and final year students in some selected schools of architecture were interviewed.

Out of the sixty (60) questionnaires distributed, only forty-two (42) were returned as most of the architects approached were busy with one project or the other. This represented a response rate of 70%. The data presentation and analysis made use of frequency distributions and percentages of all the respondents. The responses to the items on the questionnaire were obtained on a 5-point scale ranging from 1 to 5. "Strongly Agree" responses were scored 5, "Agree" were scored 4 and "Indifferent" were scored 3, "Disagree" were scored 2 while "Strongly disagree" were scored 1. To be able to rank the factors perceived by the respondents to impact the various aspects of the study, it was necessary to highlight the relative importance of the factors (Kangwa & Olubodun, 2003). Therefore, Relative Significance Index, RSI (also known as Index of Relative Importance, IRI or Relative Importance Index, RII) was used for ranking the factors.

Bakhary (2005) gave an equation that could be useful for determining relative Importance Index (RSI) in prevalence data as:

$$RSI = \frac{\sum \mu}{AN}$$

Where μ is the weighting given to each factor by respondents;
A is the highest weight (i.e. 5 in this case);
N is the total number of respondents.

For this research, the RSI was computed using the formula below:

$$RSI = \frac{5a + 4b + 3c + 2d + 1e}{JN}$$

Where
a = number of respondents who responded "Strongly agree".
b = number of respondents who responded "Agree".
c = number of respondents who responded "Indifferent".
d = number of respondents who responded "Disagree".
e = number of respondents who responded "Strongly disagree".
N = sample size = 42.
J = number of response categories = 5.

FINDINGS AND DISCUSSION

The results of the survey presented below are analyzed using the forty-two (42) returned questionnaires with respect to the respondents' profile, level of awareness of ICT tools, factors determining the use of ICT, benefits accrued to ICT, uses of ICT and the commonly used ICT tools.

Table 1: Sex

S/N	Sex	Frequency	Percentage
1.	Male	36	85.7
2.	Female	6	14.3

Source: Authors' Field Survey, 2014.

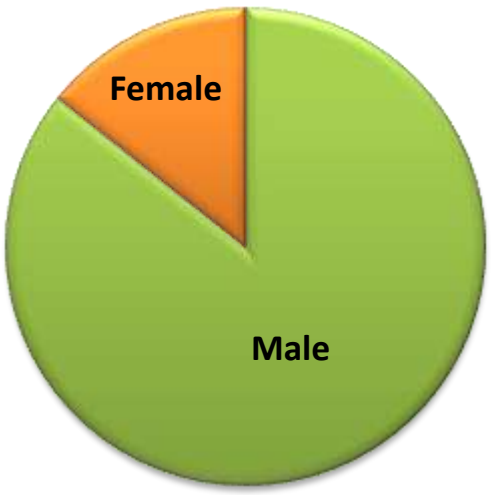

Fig. 4: Pie Chart Showing the Sex of the Respondents

With reference to the data collected as shown in Table 1, 85.7% of the respondents were male, while 14.3% were females. This shows that, architectural practice is Nigeria is dominated by the males.

Table 2: Age

S/N	Age bracket	Frequency	Percentage
1.	20 – 29 years	4	9.5
2.	30 – 39 years	7	16.7
3.	40 – 49 years	18	42.9
4.	50 – 59 years	11	26.2
5.	60 and Above	2	4.8

Source: Authors' Field Survey, 2014.

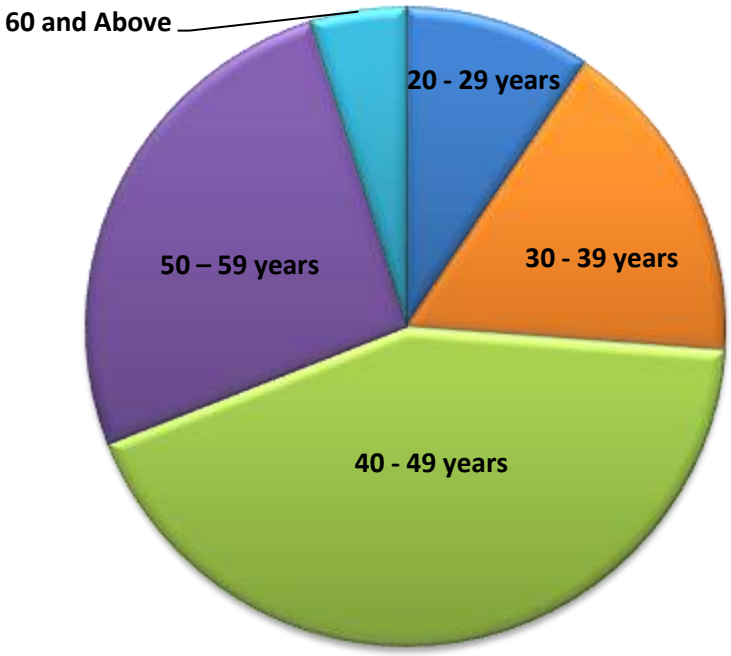

Fig. 5: Pie Chart Showing the Age Bracket of the Respondents

Table 2 shows that, majority of the respondents were between the ages of 40- 49 years which shows that the profession is dominated by this age group. 26.2% of the respondents' falls in the age bracket of 50 – 59 years; 16.7% were between 30-39 years, 9.5% falls between 20 – 29 years while just 4.8% were 60 years and above.

Table 3: Qualification

S/N	Qualification	Frequency	Percentage
1.	Higher National Diploma (HND)	8	19
2.	B.Sc./B.Tech.	22	52.4
3.	M.Sc./M.Tech.	10	23.8
4.	Doctor of Philosophy (Ph.D)	2	4.8

Source: Authors' Field Survey, 2014.

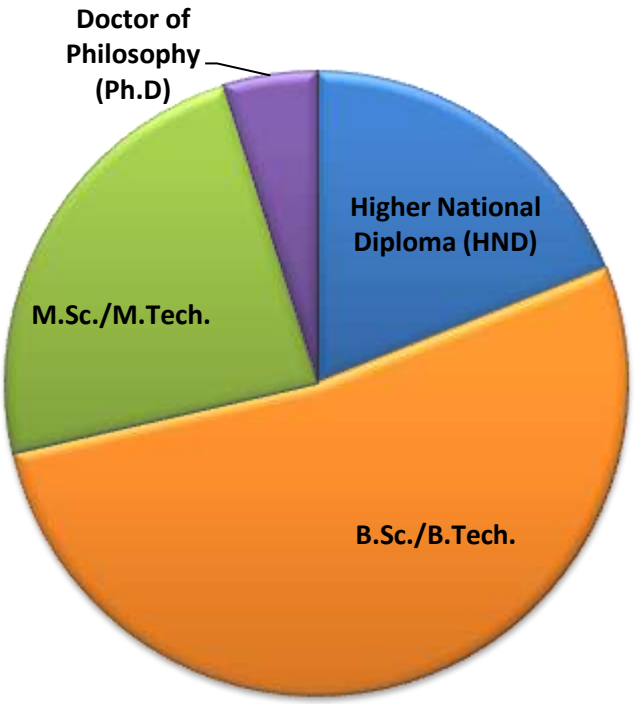

Fig. 6: Pie Chart Showing the Qualification of the Respondents

Table 3 reveals that 52.4% of the respondents hold a Bachelor of Science Degree or a Bachelor of Technology Degree in Architecture. 23.8% are Masters Degree holders, 19% holds a Higher National Diploma (HND) degree in Architecture while 4.8% are Ph.D holders who are more into consultancy.

Table 4: Years of Experience

S/N	Years	Frequency	Percentage
1.	1 – 10 years	11	26.2
2.	11 – 20 years	16	38.1
3.	21 – 30 years	11	26.2
4.	31 and Above	4	9.5

Source: Authors' Field Survey, 2014.

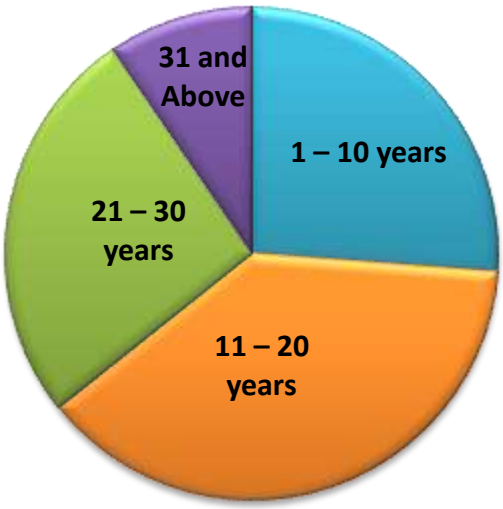

Fig. 7: Pie Chart Showing the Years of Experience of the Respondents

Table 4 shows the years of experience of the respondents. It was deduced that, 38.1% of the respondents have been practicing for 11- 20 years now, 26.2% for 21 – 30 years and between 1- 10 years while 9.5% have been practicing for 31years and above.

Table 5: Size of firm

S/N	Size	Frequency	Percentage
1.	Small	29	69
2.	Medium	11	26.2
3.	Large	2	4.8

Source: Authors' Field Survey, 2014.

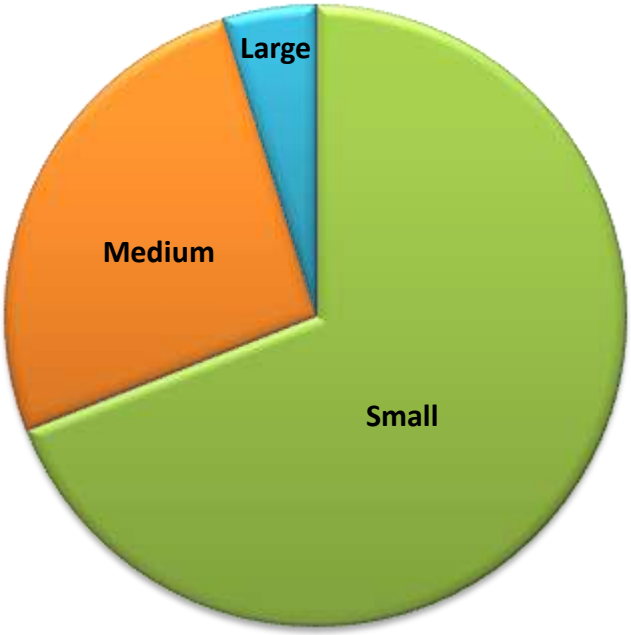

Fig. 8: Pie Chart Showing the Size of the Firm of the Respondents

With reference to the data on table 5, 69% of the respondents work with small firms which are mostly a one-man business or a privately owned architectural firm. 26.2% works with a medium sized firm while 4.8% works with a large sized architectural firm.

Table 6: Level of Registration with NIA

S/N	Level of Registration	Frequency	Percentage
1.	Graduate Member	2	4.8
2.	Associate Member	6	14.3
3.	Member (MNIA/FNIA)	8	19
4.	Not Registered	26	61.9

Source: Authors' Field Survey, 2014.

Table 6 reveals that 61.9% of the respondents are yet to be registered with the professional body (NIA). 4.8% are graduate members, 14.3% are associate members while 19% are either member or a fellow of the Nigerian Institute of Architects.

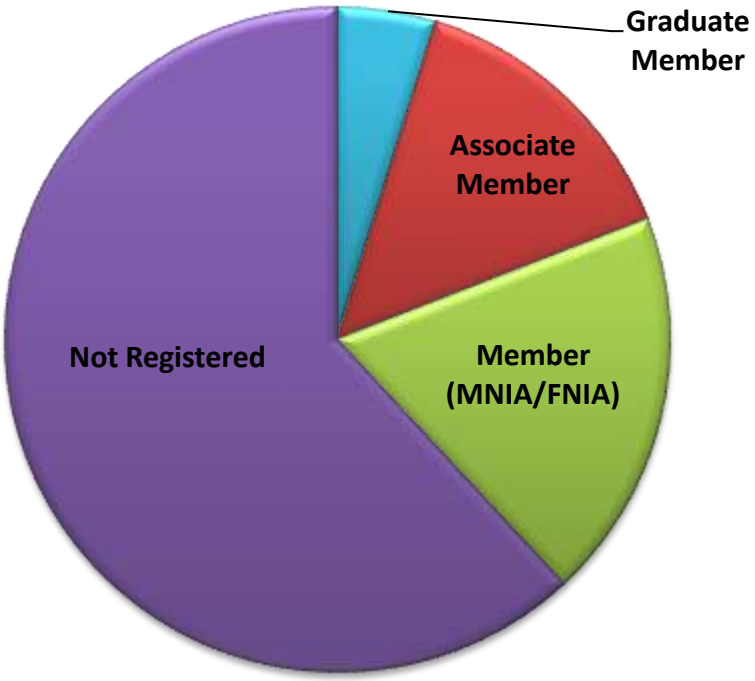

Fig. 9: Pie Chart Showing the Level of Registration the Respondents

Table 7: Level of Awareness of ICT tools

S/N	Level of Awareness	Frequency	Percentage
1.	High	38	90.5
2.	Average	4	9.5
3.	Low	0	0

Source: Authors' Field Survey, 2014.

The level of awareness of the several ICT tools that are available and known to the respondents was presented in table 7 above. It shows that majority (90.5%) of the respondents are aware of the ICT tools and do make use of them. Only 9.5% of the respondents do have an average knowledge of the ICT tools in terms of usage but they are aware of them. None of the respondents claimed not to have heard or become aware of the ICT tools.

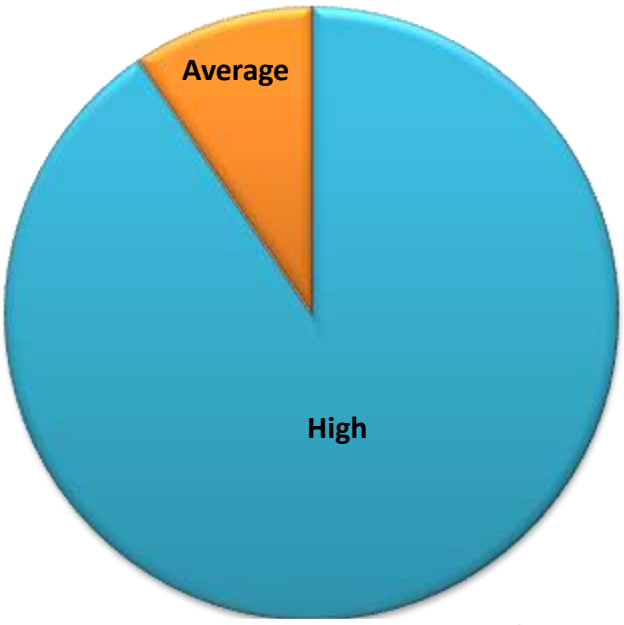

Fig. 10: Pie Chart Showing the Level of Awareness of the ICT Tools

Table 8: Factors determining the use of ICT

Factors	R.S.I	Rank
Changing trends	0.77	1
Level of competition	0.75	2
Construction industry demands	0.73	3
Client demands	0.68	4

Source: Authors' Field Survey, 2014.

Findings as shown in table 8 revealed that, changing trends in the construction industry is the significant factor responsible for the adoption of the use of ICT by the architectural firms. This suggests that, most architects are making use of the various opportunities which ICT offers. The level of competition with RSI = 0.75 was next to changing trends while construction industry demands and client demands followed respectively.

Table 9: Benefits of ICT

Benefits	R.S.I	Rank
Makes Professionals jobs easier	0.91	1
Facilitates decision making	0.54	2
Reduces degree of difficulty	0.52	3
Saves time	0.50	4
Improves public image of the users	0.41	5
Savings in operation costs	0.37	6
Reduces mistakes in documents	0.35	7
Gives users competitive advantage	0.32	8
Improves document presentation	0.31	9
Reduces construction errors	0.31	9
Enhance productivity	0.30	10

Source: Authors' Field Survey, 2014.

Table 9 presents the benefits of using ICT tools according to the findings of the survey. It shows that, majority of the respondents agreed that ICT tools makes their professional jobs easier. This may be as a result of the fact that, it proffers solution to the problem of inefficiency that is accrued to the construction industry. The other benefits include; "facilitates decision making" with RSI = 0.54, R = 2; "reduces degree of difficulty" with RSI = 0.52, R = 3; "saves time" with RSI = 0.50, R = 4; "improves public image of the users" with RSI = 0.41, R = 5; "savings in operation costs" with RSI = 0.37, R = 6; "reduces mistakes in documents" with RSI = 0.35, R = 7; "gives users competitive advantage" with RSI = 0.32, R = 8; "improves document presentation" and "reduces construction errors" both having same RSI = 0.31, R = 9 while the last on the list is that, enhances productivity with RSI = 0.30, R= 10. The findings clearly shows that, the first four benefits (i.e. makes professional jobs easier, facilitates decision making, reduces degree of difficulty and saves time) are of utmost importance to any architectural practice in Nigeria.

Table 10: Uses of ICT

Uses	R.S.I	Rank
Communication	0.81	1
Architectural designs	0.76	2
Word processing	0.74	3
Presentation	0.67	4

Source: Authors' Field Survey, 2014.

Table 10 reveals the uses of ICT to the respondents which are mainly architects. It shows that, majority of the respondents uses ICT tools for the purpose of communication (RSI = 0.81) which contributes to the effective running of the architectural firms. Architectural design which is the core function of any architect takes the second position with RSI = 0.76 while "word processing" and "presentation" follows with RSI = 0.74 & 0.67 respectively.

Table 11: Commonly used ICT tools for Communication

S/N	ICT tool	Frequency	Percentage
1.	Internet	14	33.3
2.	Phone calls	21	50
3.	Voice mails	2	4.8
4.	Video call	5	11.9

Source: Authors' Field Survey, 2014.

Findings as shown in table 11 reveal the commonly used ICT tools for communication by the respondents. Half (50%) of the respondents do make use of phone calls for communication; 33.3% uses the internet (emails); 11.9% uses video

calls (Skype, Tango etc.) especially in a situation where the client is abroad while 4.8% uses voice mails as the medium of communication.

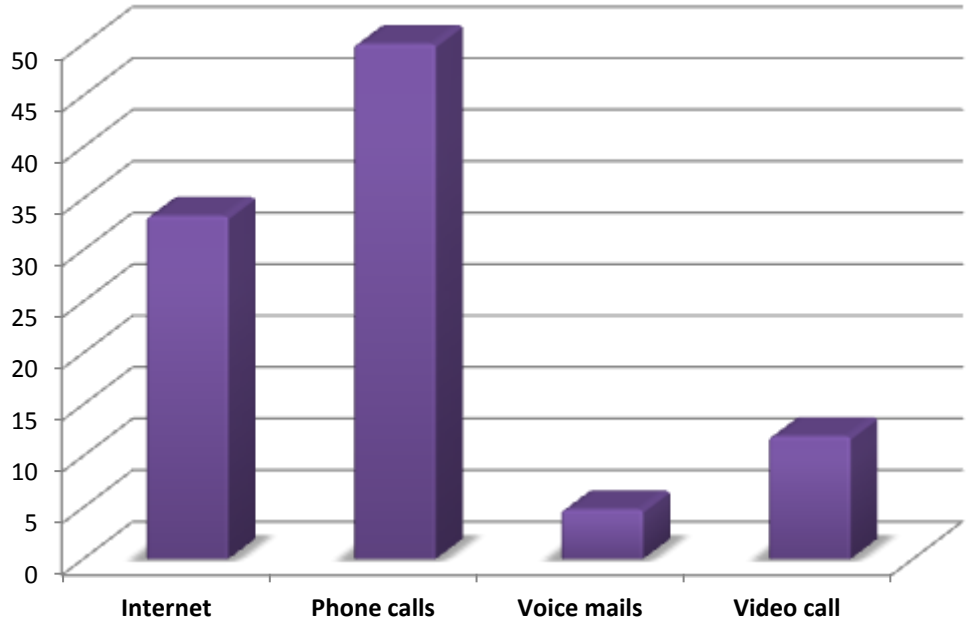

Fig. 11: Bar Chart Showing the Commonly used ICT Tools for Communication

Table 12: Commonly used software for Architectural designs

S/N	Software	Frequency	Percentage
1.	AutoCAD	15	35.7
2.	ArchiCAD	8	19.1
3.	Revit Architecture	11	26.2
4.	Google Sketchup	3	7.1
5.	Studio Max	5	11.9

Source: Authors' Field Survey, 2014.

Table 12 reveals the commonly used software for architectural designs by the architects. 35.7% of the respondents uses AutoCAD; 19.1% uses ArchiCAD; 26.2% uses Revit Architecture; 7.1% uses Google Sketch-up while 11.9% uses Studio Max. The result shows that, AutoCAD is still the commonly use software for architectural designs.

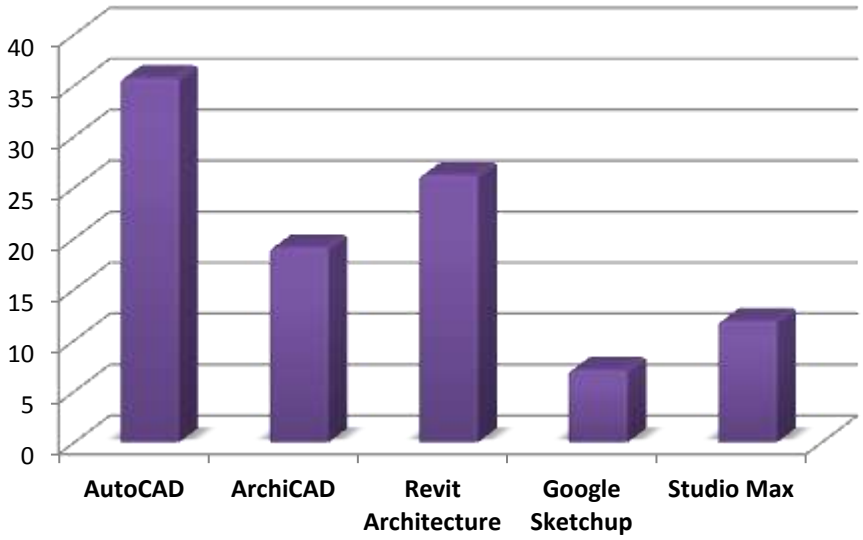

Fig. 12: Bar Chart Showing the Commonly used Software for Architectural Designs

Table 13: Commonly used ICT tools for Word Processing

S/N	Software	Frequency	Percentage
1.	Microsoft Word	26	61.9
2.	Microsoft Excel	13	31
3.	Word Perfect	3	7.1

Source: Authors' Field Survey, 2014.

Findings from table 13 reveal that majority (61.9%) of the respondents use Microsoft Word (Ms Word) software for word processing while 31% and 7.1% of the respondents uses Microsoft Excel and Word Perfect software respectively.

Table 14: Commonly used ICT tools for Presentation

S/N	Software	Frequency	Percentage
1.	Microsoft PowerPoint	31	73.8
2.	Macromedia Dreamweaver	10	23.8
3.	Adobe PageMaker	1	2.4

Source: Authors' Field Survey, 2014.

Table 14 reveals that, 73.8% of the respondents do make use of Microsoft PowerPoint for presentations which is as a result of the flexibility of the software which makes it very easy to use. 23.8% uses Macromedia Dreamweaver which is

more advanced than Microsoft PowerPoint while only 2.4% uses Adobe PageMaker due to its complexity nature.

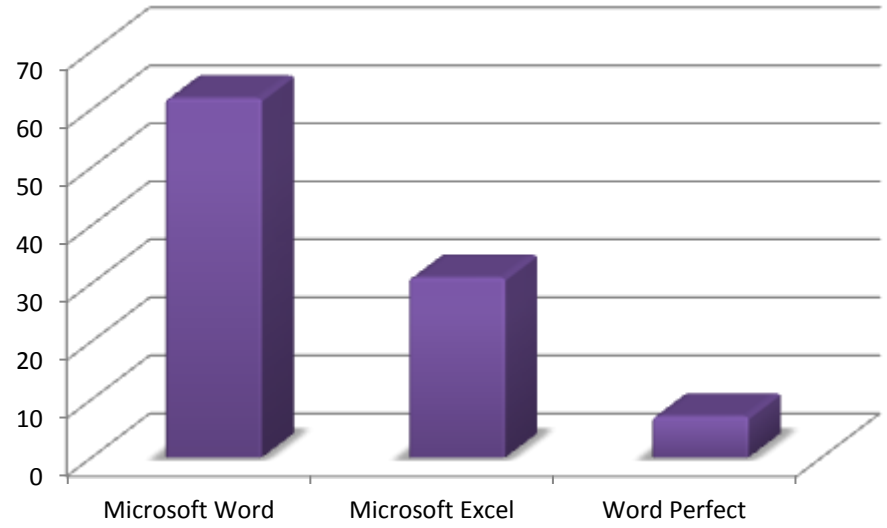

Fig. 13: Bar Chart Showing the Commonly used ICT tool for Word Processing

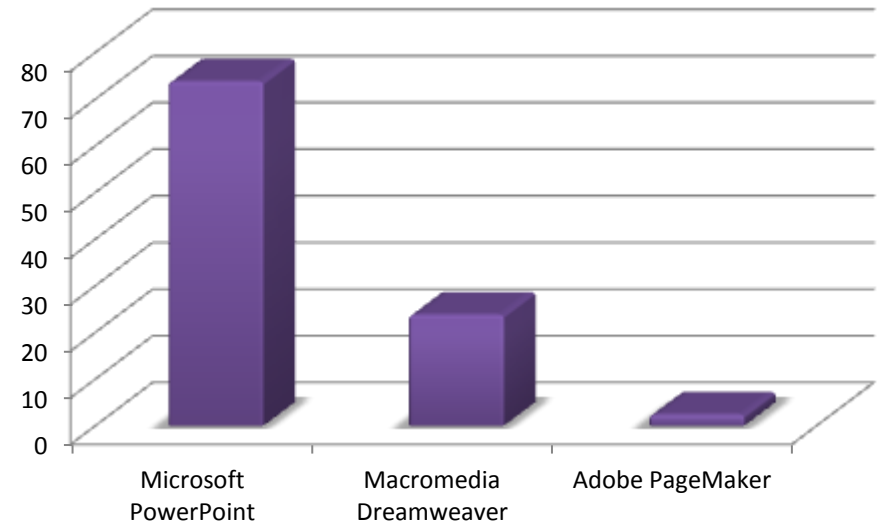

Fig. 14: Bar Chart showing the Commonly used ICT Tool for Presentations

CONCLUSION

Information Technology Communication has been widely accepted and acknowledged as a probable tool for development in most countries of the world. The construction industry being one of the core areas of development in Nigeria need to embrace ICT innovations for its growth. ICT as a veritable tool gained popularity among professionals in the construction industry especially in the architectural practice. This study was carried out to assess the impact of ICT on

Architectural practice in Nigeria with the architect being a key player in the construction industry.

The paper looked at the definition of an architect, architecture, architectural practice and communication. The medium of communication between the client and the architect; the architect and the building authority and that of the client and the contractor was briefly discussed. The transition periods from paper drawing to the use of computer aided designs (CAD) and computer print outs was reviewed. The result of a structured questionnaire survey of some architects and architectural firms were presented in the paper.

The results indicate a high level of awareness and usage of ICT tools by the architects. It also shows that, there is gender imbalance in the profession as majority of the respondents is male. The main factor that determines the adoption of ICT is the changing trend in the construction industry. The level of use of specialized software (such as AutoCAD, ArchiCAD, Revit Architecture etc.) for architectural designs is relatively high among the young architects while some of old ones employ the young ones to handle the software. Telephone calls and internet usage (i.e. emails) were used by the architects for communication which according to them enhanced decision making.

ICT according to the findings of this study makes professional jobs easier, facilitates decision making, play a vital role in decision making, reduces degree of difficulty and also saves time; there is need for all professionals in the building industry to adopt it and make good use of it. This research can be further extended to analyze the need for Nigerian School of Architecture to include specialized software training in the curriculum.

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