



## ASSESSMENT OF INFORMATION TECHNOLOGY ADOPTION IN PROJECT INFORMATION EXCHANGE IN NIGERIAN CONSTRUCTION INDUSTRY

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### ABSTRACT

Information Technology (IT) has been applied by various industries with significant improvement in the practice and strategic standing of the industries. Its successful application is evident in manufacturing, petroleum, banking, aerospace and military industries. However, despite this evidential benefit as a result of IT adoption, delayed receipt of project information and/or loss of the project data/information are still prevalent in the Nigerian construction industry. To reduce these inefficiencies in the data management of the industry, this study investigates the medium of project information exchange and examine the order of IT adoption in the Nigerian Construction industry. A quantitative approach using questionnaire survey was employed. Structured questionnaires were distributed among quantity surveyors in contracting, consulting and public sector. The resultant data was analyzed using descriptive statistical tool. The results revealed the dominance of the paper-based medium over the use of IT tools in information acquisition and dissemination in the construction industry. About three-quarter of drawings, specifications and schedules were acquired through printed copy (paper based), and only about one-tenth of these information were acquired through email and disk/flash. While about four-fifth of the bills of quantities, claims and final account documents/information were being disseminated through the traditional paper-based printed copy, and less than one-tenth of these information are being disseminated through email and disk/flash. The order of IT adoption and use in information acquisition in the Nigerian Construction industry was found to be paper based medium, then followed by online medium, email and others (mobile) came third and fourth respectively, while disk/flash and came fifth and sixth in ranking. Furthermore, in contrast to the order of IT adoption and use in information acquisition in the Nigerian Construction industry, paper-based and disk/flash medium came first and second in order of information dissemination. Emails and online medium came 3rd and 4th in place, while fax and others (such as mobile phone), came 5th and 6th in adoption and use. Thus, for construction professionals in developing countries to reap the benefit of IT, it must go beyond the use of paper based medium to the use of IT tools for the acquisition and dissemination of information in the industry.

## **1.0 Introduction**

The world is undergoing profound and rapid changes due to the development of information super highway. The digital revolution in Information and Communication Technologies (ICT) has created a platform for a free flow of information, ideas and knowledge across the globe (Shafique and Mahmood, 2008). This development has provided the potential for bringing significant changes in the use of data, and information in the construction industry (Datti, 2017).

The main project participants in a typical construction project in Nigeria are the client, his team of professional advisers (consultants), the main contractor, subcontractors and suppliers. The team of consultants is traditionally made up of architects, engineers and quantity surveyors. The consultants produce the documents/information (drawings, bills of quantities, specifications, equipment schedule) which at some point will be required by all the project participants during the project lifetime.

Project information exchange between the various project stakeholders has traditionally been based mainly on such paper documents as architectural and engineering drawings, specifications, bills of quantities and material schedules (Luiten et al., 1998). Duyshart (1997) noted much of this to involve duplication, continual translation and transcription from one medium or form to another, as well as the loss of information. Thus the practice is far from being satisfactory, as about two thirds of construction problems are blamed on inadequate communication and exchange of information and data (Cornick, 1990). The use of ICT not only minimizes such problems but also helps to improve the process (Oladapo, 2007; Ferry et al., 1999). This explains the current paradigm shift being experienced in the construction industry 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). As more and more computers are connected through the internet to form the worldwide web, thus allowing firms located on different streets or in different cities, provinces, countries, or even continents to readily exchange information, the reach and benefits of ICT to industries and organizations have indeed become global.

Smith (2003) asserted that the preparation of bills of quantities in the traditional paper based mode is tedious and time consuming and typically accounts for approximately 80% of the total time spent in preparing tenders, budgeting estimates and cost plans. Removing much of the drudgery, albeit the traditional 'bread and butter', of the profession will provide practitioners with more time to focus on developing sophisticated cost management systems and a wider range of value added services (Smith, 2003). Microelectronics coupled with computing and telecommunications is revolutionizing the handling and storing of information. Microelectronics has made it possible to store, retrieve, rearrange and disseminate large amounts of information almost instantly. A combination of computing and telecommunication has made it possible to communicate over great distances and with a large number of people (Fryer, 1990). For instance a drawing can be revised on a computer in Lagos and accurately reproduced on paper in Kano, only second later. As information flows increasingly become electronic quantity surveying computing facilities, software and data bases will need to develop in a compatible manner. It is inevitable that documentation and data will be increasingly automated to the point where measurement and other technical processes will require minimal human intervention (Smith, 2003).

Even where contract information is not presented to the contractor in electronic format, computer software has now made it possible to use scanning devices to allow the rapid transfer

of information from bills of quantities, without the need for rekeying of information avoiding the tedium and possible errors in transformation that might occur (Ashworth, 2002). The entire cost database systems of estimation are now stored on computer, so that outputs and current prices can easily and routinely be updated and then applied to the individual items in the bills of quantities allowing the estimator more time for analysis and evaluation of the project (Ashworth, 2002).

The widespread everyday use of plain paper facsimiles modems and e-mail has resulted in instantaneous communication that has never previously been possible or expected. It could be argued that this has resulted in compression of time scales and deadlines that are not necessarily always to the advantage of those charged with providing professional advice. At a basic level, the widespread use of common computer software, such as spreadsheets, has relieved much of the laborious and mundane nature of data manipulation in everyday situations, for example, the preparation and presentation of valuations (Ferry, 1999).

Additionally, Rivard et al. (2004) carried out studies on the use of IT in the Canadian construction industry and reported that many of them were at the cutting edge in their use of IT for construction operation and processes. However, despite this evidential benefit as a result of IT adoption, delayed receipt of project information and/or loss of the project data/information are still prevalent in the Nigerian construction industry. For example, Anigbogu and Anunike (2014) and Bamisile (2004) asserted that details of working drawings and many important specifications are frequently omitted, Anigbogu and Anunike (2014) revealed alarming rate of inconsistencies between contract drawings, bill of quantities and contract drawings and significant increase in incomplete information for construction purposes that reach an alarming rate of 73% in some instances. While Ogunbayo (2013) showed that communication breakdown was the number one cause of conflict in the Nigerian construction industry and suggested that the best tactics in reducing conflict is to improve communication channels. Kululanga et al., (2001) identified four sources of conflict in construction which are errors, defects and omissions in contract documents, underestimating the real cost of the project in the beginning. However, it is against these negative practices that the study investigates the mechanism of project information exchange and examines the order of IT adoption in the Nigerian Construction industry with a view to reducing inefficiencies in data management in the industry.

## **2.0 Materials and Methods**

This paper investigated the mechanism of project information and examine the order of IT adoption in the Nigerian Construction industry. Two methods seem adequate for this purpose: survey research and observation research. The survey research method was chosen for this study, been a much economical and convenient method of collecting data. It tends to be less time demanding upon its subsequent administration and provided more untied up time for use in other aspect of the research endeavours (Kolo, 2005). The target population for the survey research was Quantity surveyors in contracting, consulting and public sector organization. Information about the respondents' qualifications and experiences were generated and analyzed graphically. More importantly, data on the mode of acquisition of information and dissemination by the respondents were generated from the questionnaire. Collecting information from the whole of the population would undoubtedly result in a true representation of the population but an attempt at such is prohibitively expensive and practically impossible within the confines of resource constraints. Hence, the need to select appropriate sampling technique. De Vaus (1991)

identified two types of sampling method for a survey research: probability and non-probability samples. He advised that the probability samples are preferred "because they are more likely to produce representative samples and enable estimates of the sample's accuracy". Hence, the choice of the probability sample type for the purpose of this study.

## **2.1 Survey Techniques/Methods**

Basically, data can be collected by observation, in-depth interview, content analysis, and/or through questionnaire amongst other known techniques. The questionnaire technique was found to be very suitable for the needs of this survey for been quick, allowing wide geographic coverage and allowing ample time for the respondents to check fact and give accurate answers (Fellows and Liu, 2008). Additionally, Denscombe (2010) asserted questionnaires to be economical, in the sense that they can supply a considerable amount of research data for a relatively low cost in terms of materials, money and time and relatively easy to arrange. Of the three methods of administration identified by (De Vaus 1991) viz: face-to-face, telephone and mail, the face-to-face method was adopted. This is due to the fact that the method allows quick dispatch, assurance of delivery and efficient response rate in terms of general and specialized samples. A total of 190 sets of questionnaires were distributed amongst various quantity surveying consulting firms in a random manner. An appreciable 70% were returned duly filled. These duly filled and returned sets were carefully sorted, presented and analysed using descriptive statistical tool.

## **3.0 Results and Discussion**

Upon sorting and collating the questionnaires, they were studied to bring out likely patterns of the responses gathered. An appropriate tool for presenting such patterns is the Chart. For the purpose of this research, two types of charts were used – the bar charts and the pie charts. Presented below are the percentage distributions of the patterns of responses gathered during the field survey.

### **3.1 Information about the respondents**

Figure 1 above shows the level of educational attainment of the respondents. It indicates that majority of the respondents (38.10%) were 'PGD holders' while 28.70% of them had a first degree. Added to their educational attainment, 38% of the respondents are 'Associate members' of their respective professional bodies, with 19% of them being 'Fellows' as shown on Figure 2. Thus, the aforementioned revelations suggest that the responses gathered were from a sample of qualified and experienced personal as further depicted in Figure 3 which further affirm to the reliability of the data source and its confidence level. This implies that the results presented in the figure are reliable for the study considering the respondents' qualifications and experiences obtained in the construction industry.

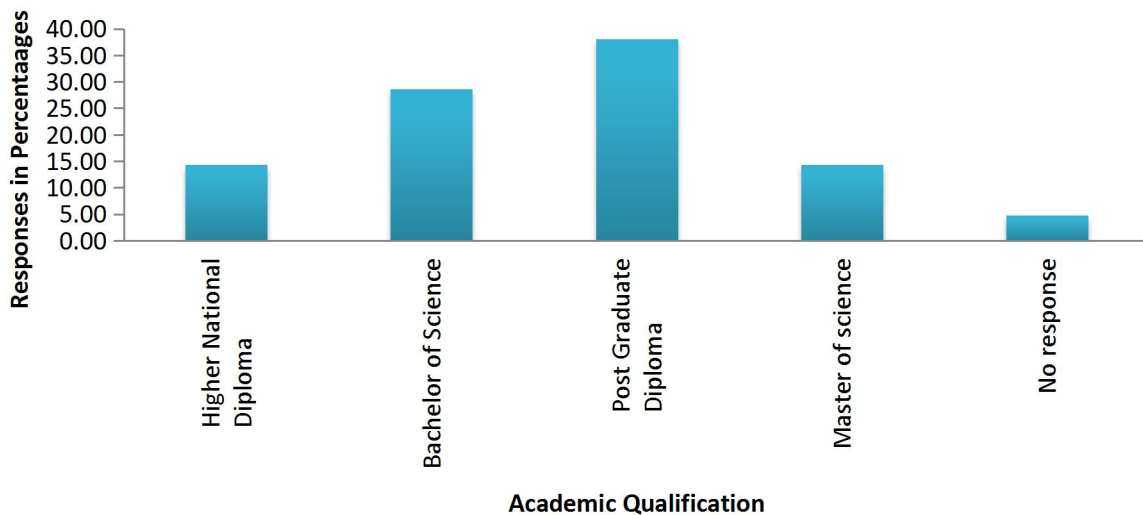


Figure 1: Respondents' Academic Qualification

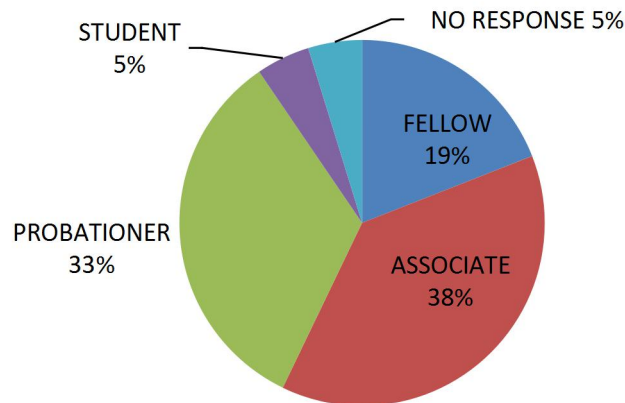


Figure 2: Respondents Professional Attainment

As much as 43% of the respondents did acquire over '16' years of working experience with about 33% of them having between '5 to 10' years as indicated in Figure 3. In furtherance 5% of the respondents have experiences ranging between '11 to 15' years, while only 19% of the respondents have less than 5 years of experience. This indicates that responses were gathered from qualified and experienced personnel which further attest to the reliability of the result.

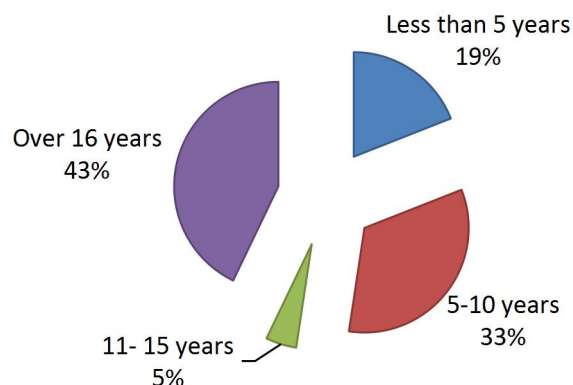


Figure 3: Respondents Working Experience

Figure 4 shows the respondents' profiles by job environment. Majority of the respondents worked in consulting organization. Almost one-third of the respondents work in contracting organization job environment and about one-third work in public bodies (Government, Ministries, Agencies and Parastatals). Thus, the aforementioned revelations suggest that the responses gathered were from a fairly balance sample of personnel across the job environment with the unique characteristics of each section fairly captured and true representation of the population reflected in the result. This is in line with the objectivity of the study as the opinions of the respondents across the various job environments have been captured and reflected in the result.

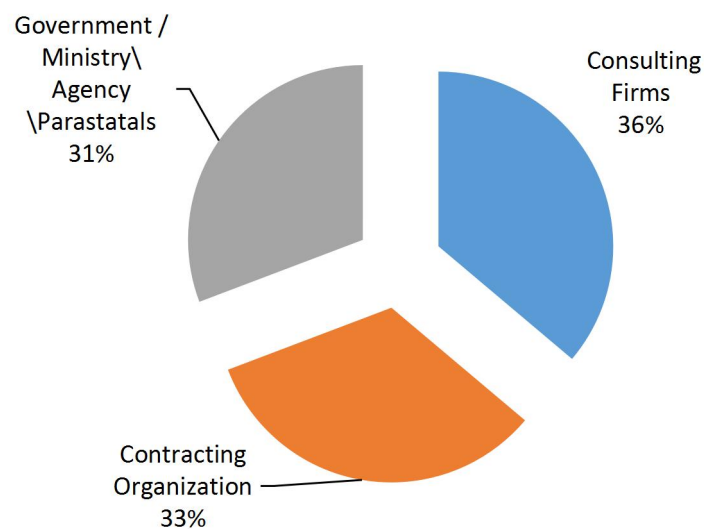


Figure 4: Respondents Current Career/Job Environment

Figure 5 display means of acquiring information by the respondents. Majority of the respondents acquired information through traditional paper-based (printed copy). About three-quarter of the drawings, specifications and schedules documents/information are being acquired through printed copy (paper based). While only about one-tenth of these information are acquired through email and disk/flash. The least acquired information through the traditional paper based copy are building cost indices, government regulations and tender price indices, with only one-third of these information being acquired through the printed copy form. This supports the findings of (Oladapo, (2007 and Oyediran and Odusami, 2005) of the dominance of paper-based medium in project information exchange in Nigeria. However, the reduction in paper-based operation in quantity surveying offices as reported by (Rivard, 2004) has not been observed. It is interesting to notes that about half of the respondents that were asked about government regulations, building cost indices and tender prices do not respond to these questions. This low-response is partly due to non-availability of building cost and tender price indices information in the public domain of the Nigerian construction industry, and also for the fact that government regulations on the industry is been carried out weakly with less information been provided, hence, the higher non-response rate by the respondents. This support the findings of (Anigbogu and Anunike, 2014) that regulatory framework is weak and that there are few existing national standards relating to building construction, many of which are not known (Bamisile, 2004 and Anny et al., 2015). Though there were attempts by the Nigerian institute of Quantity Surveyors to generate the databases for these indices, but till now, this has not come to fruition. Acquisition of information through online medium by the respondents also put a strong show by coming second after the traditional paper-based medium as illustrated in Figure 5. The top three data

that are acquired through online medium are professional publications, 25%; standard/guides, 20% and manufacturer's catalogue, 19%. As compared to drawings, specification and schedules which can be referred to as component part of the contract documents, there has been some significant growth of online medium for project information exchange for non-contract related information. For instance, the online medium adoption increased from one-tenth for acquiring drawings and other contract related documents to one-fifth for standard/guides and manufacturer's catalogue and to a maximum adoption of one-quarter for professional publications. This might be due to the rising contention of the legality of contracts online or by email which makes legal responsibilities in an environment that the contract is not paper-based unclear (O'Brien, 2000). Despite wide availability and penetration of internet and email in the industry as reported by (Datti, 2017; Oyediran and Odusami, 2005; Deng, et al. 2001, Rivard, 2000), their adoption in project exchange seems to be quite low. Additionally, the significant increase in usage of online medium for non-contract related information such as professional publications, standard/guides and manufacturer's catalogue might be due to the recognition of the potential improvements to be gained through the adoption of IT tools in project information exchange as predicted by many among whom is Oyediran and Odusami (2005). Buttressing the above point for non-contract related information, while email is not as prevalent as online medium, but its adoption is increasing from one document to another as illustrated in the figure 5.

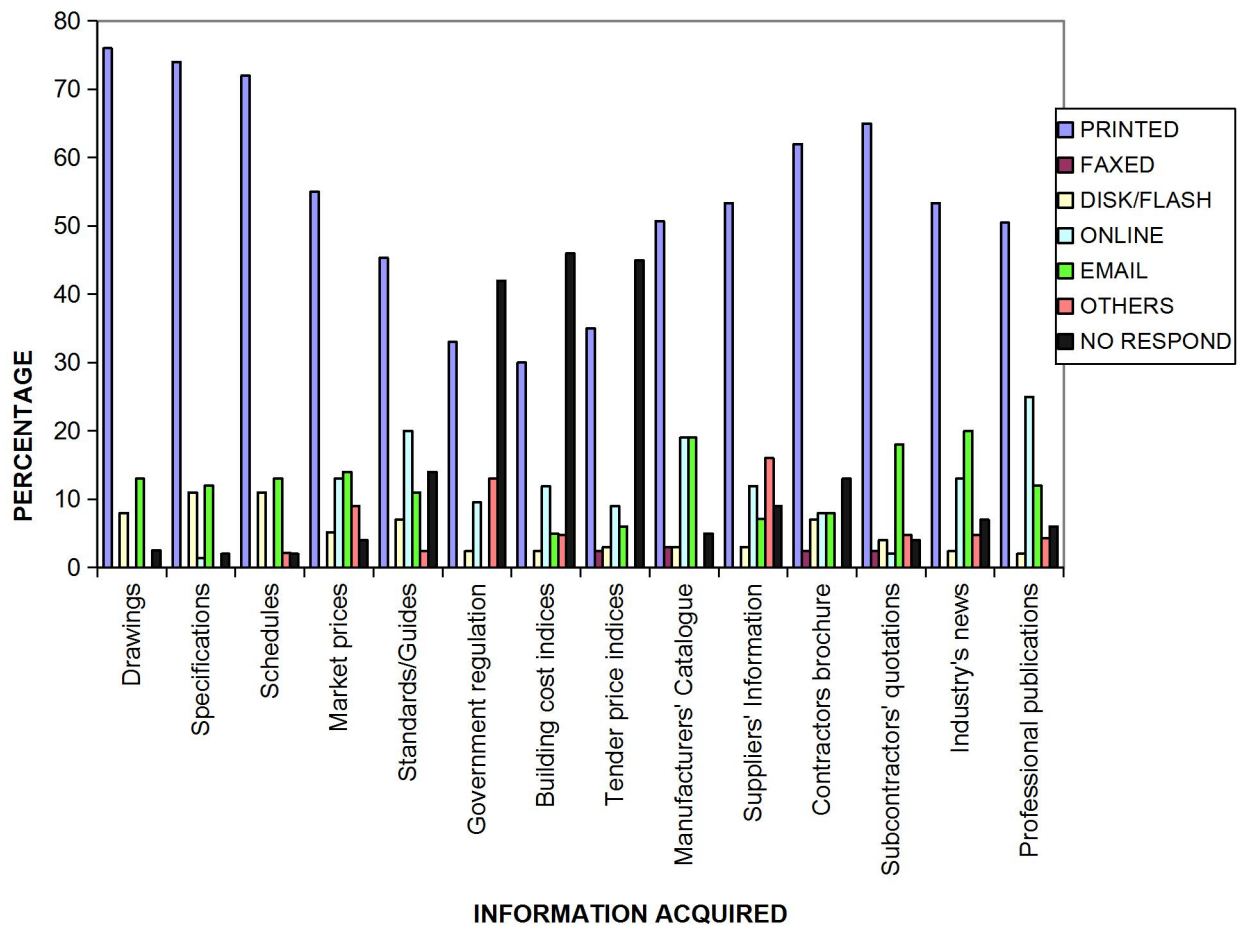


Figure 5: Mode of Acquisition of Information

Additionally, disk/flash and fax comes 5th and 6th respectively in order of hierarchy of adoption for information acquisition by the respondents. Thus, the above result illustrates the dominance of traditional means of information acquisition over the use of IT tools and it also demonstrates the order of preference of each medium over the other in information acquisition in Nigerian construction industry. This peculiar trend is depicted graphically in Figure 6 in order of preference and adoption.



Figure 6: IT ladder and trend in Information Acquisition in the Nigerian Construction Industry

### 3.2 Mode of Dissemination of Information

The distribution of responses with respect to the mode of dissemination of information by QSs is shown in Figure 7. Majority of the respondents disseminates information through printed copy (paper based). About four-fifth of the Bills of Quantities, Claims and final account documents/information were being disseminated through the traditional paper-based printed copy. While less than one-tenth of these information are being disseminated through email and disk/flash. This might be due to the complicated nature of information exchange in the industry where amendment of drawings and bills are common which requires to be in hardcopy with signature affixed to it and acknowledgement of the receipt by the parties is expected to be in writing. Hence, sending messages the in an electronic form cannot complete these endorsement procedures. The least disseminated information through the traditional paper based copy are feasibility reports and financial statements, with about half of these information being disseminated through the printed copy form. Despite being the least information been disseminated through paper-based medium, more than half of these documents are being disseminated over the paper-based medium. This equally shows the dominance of traditional paper-based medium over the use of IT tools, which support the findings of (Oladapo, 2007). Additionally, the dominance of paper-based medium in information dissemination seems to be slightly higher than dominance of paper-based medium in acquiring information.

Furthermore, in contrast to the response by the respondents on the second most preferred medium for information acquisition after the paper-based medium, the second most preferred medium for information dissemination is disk/flash. Emails and online medium come 3rd and 4th in place in terms of usage in information dissemination. While, fax and others (such as mobile) comes 5th and 6th in preference as shown in Figure 7. This go against the findings of Oladapo (2007) and Oyediran and Odusami (2005) that reported widespread use of basic IT tools for accounting, word processing, spreadsheets and e-mail. Thus, the order of preference by the respondents for information dissemination in descending order can be graphically illustrated as follows:



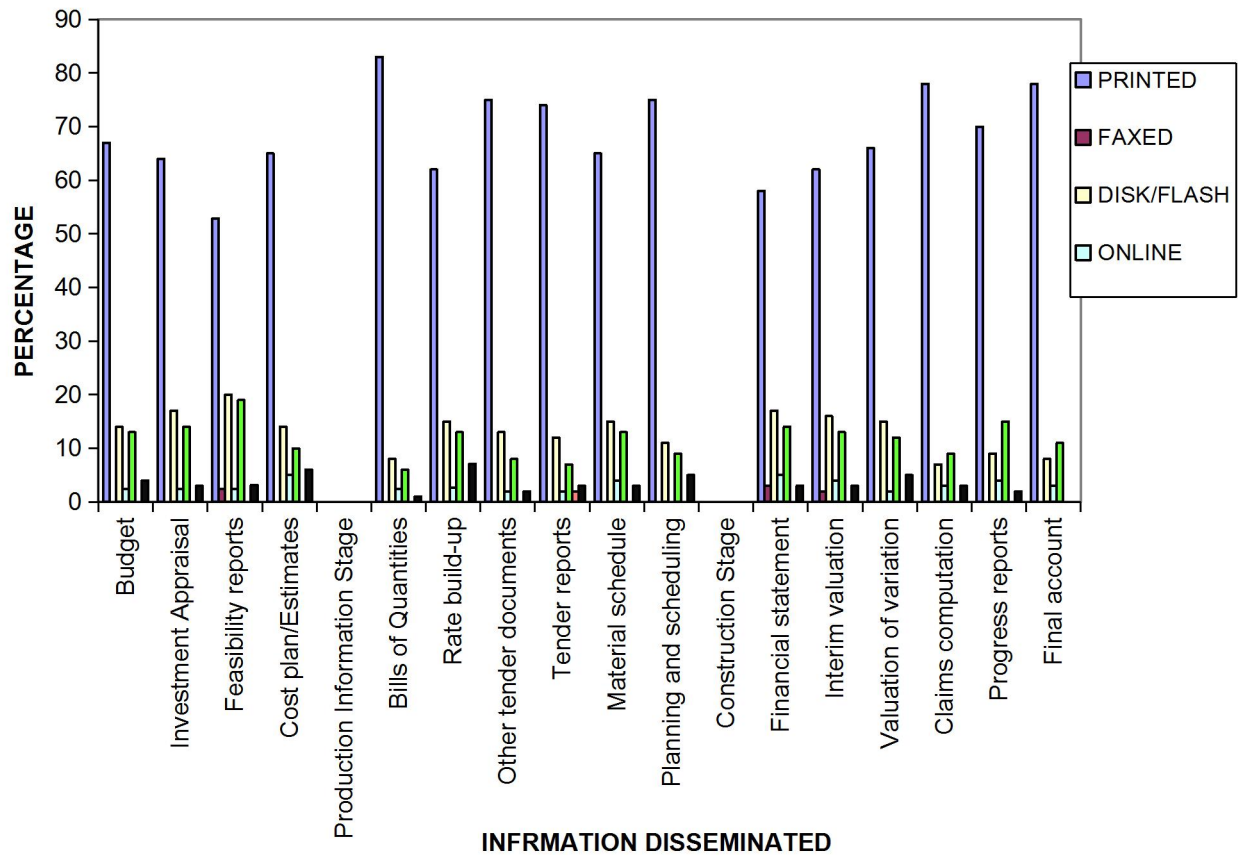


Figure 7: Mode of Information Dissemination by the Respondents

Figure 8 displays the IT ladder and trend in information dissemination in the Nigerian construction industry. This can be seen in their preference for open, sophisticated and easily verifiable IT tools after paper based medium in acquiring than in disseminating information. For instance, in acquiring information, online medium comes in higher preference order than emails, and email comes in higher preference order than others (mobiles) and it continues down to fax, which is in the lowest preference order. This might be due to the benefit that online and email medium provides effective information transfer (Deng et al., 2001), so messages can not only reach the recipients more speedily and accurately, but also can be traceable on the event of dispute than flash and mobiles in the long run. However, in disseminating information the respondents show higher preference in the use of disk/flash which is less verifiable in the event of dispute, than email and online medium. Additionally, the risk of data loss due to virus and other problems is high in disk/flash than with other mediums.

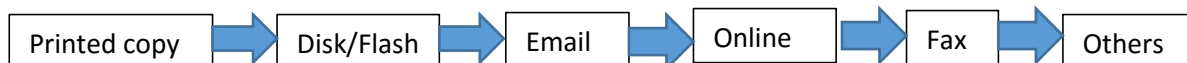


Figure 8: IT ladder and trend in Information Dissemination in the Nigerian Construction Industry

#### 4.0 Conclusion

The study investigated the medium of project information exchange and examined the order of IT adoptions in the Nigerian Construction industry. The results revealed the dominance of the paper-based medium over the use of IT tools in information acquisition and dissemination in the construction sector. About three-quarter of drawings, specifications and schedules were

acquired through printed copy (paper based), and only about one-tenth of these information were acquired through email and disk/flash. While about four-fifth of the bills of quantities, claims and final account documents/information were being disseminated through the traditional paper-based printed copy, and less than one-tenth of these information are being disseminated through email and disk/flash. The order of IT adoption and use in information acquisition in the Nigerian Construction industry is paper based medium, then followed by online medium, email and others (mobile) came third and fourth respectively, while disk/flash and came fifth and sixth in ranking. Furthermore, in contrast to the order of IT adoption and use in information acquisition in the industry, paper-based and disk/flash medium come first and second in order of information dissemination. Emails and online medium came 3rd and 4th in place in order of adoption in information dissemination. While fax and others (such as mobile phone), come 5th and 6th in adoption and use. Finally, findings indicate that respondents in information acquisition show more diligence and sophistication in the use of the IT tools. This can be seen in their preference for open, traceable and easily verifiable IT tools in acquiring than in disseminating information. Thus for construction professionals in developing countries to reap the benefit of IT, it must go beyond the use of paper based medium to the use of IT tools for the acquisition and dissemination of information in the industry.

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