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The Impact of Information Technology on Nigerian Construction Industry

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Abstract*— in recent years, the construction industry in Nigeria seems to be using the internet as much as other industries. However, what is the actual level of internet usage in construction industry and what are the perceived benefits and disadvantages experienced by the users. The main use of the internet is only for emails and information search. Use of the internet for online bidding and e-meetings are almost negligible, despite the advantages of time and cost savings as well as increased in efficiency. The results presented here are from 16 different construction companies' sites for the year 2004 and another 16 sites for the year 2009. Most of the sites were for residential buildings (65%) and those construction companies responsible were medium-sized (between 21 to 50 employees on each site). Despite interest in IT use, most of the companies in this survey (56%) had still not used IT to help or facilitate the site management process. However, these companies realized that IT mechanisms could offer advantages and they were trying to incorporate IT into the construction site management routine. Most of them already had IT devices on the construction site; i.e. a computer with Internet access, a digital camera, and hand-held computers. According to the survey, communication by telephone was between 94% (2004) to 100% (2009)! The responsible site engineer contacted and dealt with the information flow between the company office and the construction site directly, and by himself. Only a third of the companies used e-mail communication in 2004 and 50% in 2009. The purpose of this report is to study the existing technologies for information exchange in order to devise methods such that these technologies may be used efficiently in the Nigerian construction industry.

***Keyword* — Information Technology, Product information, Product model, Supplier Management.**

I. INTRODUCTION

Information technology has grown significantly in the last few years. Today, the Internet is one of the main forms of information technology and is used for accessing, exchanging and communicating information throughout the world. The present information flow system used in the construction industry has several inefficiencies. Errors and misunderstandings occur due to the interpretation and re-entry of data between many of the parties involved in a construction project. This can sometimes lead to extended project completion times and higher costs. An improved information system allowing for better communication and teamwork may be the answer for solving these inefficiencies and the Internet may be the key. The Internet can be used as a central medium and will allow for information to be stored and exchanged in a single place accessible to all parties involved in a project. A major construction process demands heavy exchange of data and information between project participants on a daily basis. This makes the construction industry one of the most information-intensive industries, and requires close coordination among a large number of specialized but interdependent organizations and individuals to achieve the cost, time and quality goals of a construction project. Surveys on the use of Information technology in the construction industries of various countries in different parts of the world have been carried out in recent times. (Samuelson, 2002). They include surveys conducted in Canada in 1999, South Africa in 2000, Sweden in 2000, Denmark in 2001, Malaysia in 2001 and Turkey in 2001. Some of these surveys were based on modified versions of the Information technology Barometer survey instrument, which was originally developed for the Swedish construction industry in 1997. (Samuelson, 1998) While most of these surveys have been carried out in highly developed European countries and Asian "Tiger" economies, only the South African survey represents an emerging economy in Africa. This study attempts to bridge some of this gap by examining the state of Information technology use of the construction industry of Nigeria the second largest economy in Africa. The explosive growth of the information technology (IT) has had unquantifiable impact on business systems and processes .The global acceptance and widespread adoption of IT has accelerated the dimensions of competition not only among organizations globally but among professions locally. The Builder ability to avail themselves with the emerging opportunities provided by the advent of IT depends on the adoption of new technologies. 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). Kong. (2005) examined at the implications of transferring quantities information from CAD systems directly to the contractor. Shelly, Gary, Cashman, Thomas, Vermaat, Misty, and Walker, Tim (1999), predicted that the evolution of IT will have a profound impact on how organizations in the architectural, engineering and construction (AEC) industry operate.

II. LITERATURE REVIEW

The Construction Industry depends on the use of large amounts of information during the construction phases and for the entire life-cycle of a building. In this context, it is very important that the information is provided to the construction sites in a manner that enables data integration, task control, communication between the company and the suppliers, and material and resource control. This kind of information constitutes the necessary support to allow the engineer to

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carry out the execution phase within the appropriate budget and without any delays. Therefore, the use of information systems that are capable of improving information integration and communication are fundamental, thus helping the decision-making processes 'in situ'. Kong (2005) proposed an interoperable construction products catalogue model, which enables interoperability of Web-based construction products catalogues through Web-services technologies. Shailesh and Godfried (2003) have analysed search methods dividing them as follows:

(a) Not-standardization driven approach: User finds web site either through information broker web site or by conduction a web search using popular search engines;
(b) Product information standardization at source side: Product information brokers require independent manufacturer/supplier to provide product information in standardized formats (e.g. bcXML);
(c) Product information standardization on broker side: Independent manufacturer/supplier uses information broker to disseminate product information.

The approach suggested by Shailesh and Godfried (2003) might be especially suitable for building products that can be dealt with as functional units such as windows or outdoor wall elements. However, the approach is difficult to be applied for other products such as heat insulation products, roofing etc. The significance of product information increases, because it is needed in service-life design, life-cycle assessments, simulation, requirements verification, formulation of as-built information and within care and maintenance. It is also notable that the contents and type of this data can vary for different product groups. It is not possible for designers or maintenance personnel to define the detailed, product-specific information, but it must be created and provided by manufacturers. Manufacturers have already formulated and published detailed information on technical and environmental performance, but the existing data are not in a coherent and automatically usable format. There is a need to start to produce standards for the content, structure and format of the product information. The format must be computer interpretable, and the content must respond to the needs of different situations and analyses tools. One example of the work in this area is LifePlan research project (Häkkinen 2004). The project introduced methods how to use product-specific service-life information in service-life design and within care and maintenance of buildings. LifePlan project created a framework for a database where manufacturers are able to store all product specific service life information. Adelman, C. (2000), described the framework for product model based design, construction and maintenance process. The project studied building projects as examples, which tested potentials of product models with regard to different information management cases. The best experiences were received with bill of quantities and cost accounting. Bill of quantities is an obvious example of potential advantages. Because the current and widely used design software products are already based on product models - although they have their own internal model - and because the representation of geometry of building objects is already included, the inclusion of data that is related to geometrical data is one of the easiest tasks. Earl 1989, have described the use of IT as a strategic weapon. Betts 1992 develops the concept, applying a five level framework of:

(1) National construction industry,
(2) Professional institution,
(3) Construction enterprise,
(4) Construction project and
(5) Construction product.

Issues surrounding the use of electronic communications affect all five levels in different ways and it would seem from the work that the strategic and technological co-ordination of all five levels is essential for the successful use of IT for a national industry, a factor that rose to prominence from the work of Webster Frank, and Robins, Kevin. (2001).

III. METHODOLOGY

The results presented here are from 16 different construction companies' sites for the year 2011 and another 16 sites for the year 2012. Most of the sites were for residential buildings (65%) and those construction companies responsible were medium-sized (between 21 to 50 employees on each site). Data was analysed by [SPSS]. 40 questionnaires were administered while 33 were collected, 82.5% was collected which is very fair in term of data collected. The results were presented below.

IV. RESULTS AND ANALYSIS

The research question on the proportion of staff that has computer training were analysed using the frequency distribution method and the result obtained is presented in table 1.

Table: 1 Proportion of Staff That Has Computer Training

	Frequency	Percent %
26 – 50	12	36.4
11 -25	11	33.3
51 – 75	6	18.2
1 – 10	4	12.1
Total	33	100.0

From table 1 it is shown that the number of staff that has computer training in the range of 26-50 has 36.4% and the staff between the ranges of 11-25 has 33.3% while 18.2% of the staff that has that has computer training is in the range of 51-75.

The table below shows that the 78.8% stand-alone without connecting with Internet while 21.2% are on networking

Table 2: Hardware Profile

	Frequency	Percent
Stand alone	26	78.8
Networking	7	21.2
Total	33	100.0

The table below shows the number of personal computer owned.

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Table 3: Number of Personal Computer Owned

	Frequency	Percent
1 – 5	14	42.4
6 - 10	9	27.3
11 - 20	9	27.3
21 - 50	1	3.0
Total	33	100.0

From above table 3, it is shown that the number of computer owned in the range of 1 – 5 has 42.4%, while number of computer owned between the range of 6 – 10 is 27.7%, also 27.7% number of computer owned are in the range of 11 – 20. This section shows the software utilization by the firm.

Table 4: Type of application software used in the industry

Software Application	Mean	Mean item score [MIS]	Ranks
Design Drawing (auto card)	4.21	0.018	1
General administration	4.06	0.017	2
Bill of Quantities	3.65	0.015	3
Tender preparation & bidding	3.64	0.015	3
Specification Writing	3.39	0.014	4
Microsoft Project Management	3.33	0.014	4
Engineering Analysis	3.30	0.014	4
Technical Calculations	3.28	0.014	4
Scheduling & Resource Planning	3.19	0.013	5
Costing / Budgeting	3.18	0.013	5
Material Control & Purchasing	2.97	0.012	6
Office Supplies Purchasing	2.75	0.011	7
Document Tracking & management	2.12	0.011	7
Economic & Risk Analysis	2.36	0.010	8

Table above shows the software utilization by the firm The drawing (auto card) has the highest rank, general administration and bill of quantities software rank as 2nd and 3rd. The table shows that office supplies purchasing, document tracking & management, economic and risk analysis software rank at very low range Table 5 shows the barrier caused by information technology, rapid changes in technology has the highest mean of 3.03, poor leadership (2.94), The table also shows that integration / capability problem has mean of 2.67, inadequate training is very low in the rank having 2.45 and fear / mistrust of technology 2.42 as mean. This section shows the effectiveness benefits from information technology. The table above shows the effectiveness benefits from information technology. The highest mean is 4.15 according to the rank is quicker response on current project, followed by ease capturing of meaningful information. While the mean on overcoming obsolescence is 3.61 which is the lowest rank What Is the Purpose of the Information Technology (I T). The table below shows that is purposely for communicating with central office which has mean of 4.45, followed by 4.13 as the mean for others (browsing, making enquiries, and publishing, typing, getting information). How do you communicate between the company office and the construction site?

Table 5: Barrier caused by information technology

Barriers / Obstacles	Mean	Mean item score [MIS]	Ranks
Rapid changes in technology	3.03	0.016	1
Poorleadership	2.94	0.016	1
High cost	2.68	0.014	2
Integration / capability problem	2.67	0.014	2
Poor management	2.64	0.014	2
Poor teamwork	2.64	0.014	2
Software problem	2.61	0.014	2
Reliability / breakdown problem	2.55	0.013	3
Lack of knowledge / awareness of IT	2.55	0.013	3
Lack of available funding	2.55	0.013	3
Security not guaranteed	2.52	0.013	3
Hardware problem	2.45	0.013	3
Inadequate training	2.45	0.013	3
Fear / mistrust of technology	2.42	0.013	3

Table .6: Effectiveness Benefits

Effectiveness Benefits	*Mea*	Mean item score [MIS]	Ranks
Quicker response on current project	4.15	0.019	1
Ease of capture of meaningful information	4.03	0.019	1
Faster delivery of service	4.00	0.019	2
Motivate to work better	3.94	0.019	2
General knowledge about construction	3.91	0.018	2
Time saving in project	3.88	0.018	2
Ability to handle more enquiries	3.88	0.018	2
Getting to know progress of project	3.64	0.018	3
Cost saving in project	3.70	0.018	3
Capturing lessons learnt from previous project	3.64	0.018	3
Overcoming obsolescence	3.61	0.018	3
		0.018	
		0.017	
		0.017	
		0.017	
		0.017	
		0.017	

Table 7: Purpose of the Information Technology (I T).

Purpose	Mean	Mean item score [MIS]	Ranks
Communication with central office	4.45	0.027	1
Others	4.13	0.025	2
Time schedule control	4.12	0.025	2
Communication with suppliers	4.09	0.025	2
Construction planning	4.06	0.025	2
Supplies control	3.85	0.023	3
	3.79	0.023	3
	3.76	0.023	3

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Human resource control Costs			

Table 8: Communication Process

Communication process	Mean	Mean item score [MIS]	Ranks
Telephone	4.91	0.052	1
Face to face meeting	4.12	0.044	2
Through the engineer	3.73	0.040	3
E-mail	2.42	0.026	4
Web portal	1.82	0.019	5
Fax	1.55	0.016	6

The table above shows the result obtained, that the use of telephone has the highest mean of 4.91, followed by meeting, which has 4.12 as the mean. According to the result Communication through engineer still serve as the major way to communicate between the office and the construction site. Describe the usage of information technology in your company? The table below shows that is frequently use by having the mean of 3.97 which rank as no 1.

Table 9: Usage of Information Technology

	Mean	Mean item score [MIS]	Ranks
Frequently used	3.97	0.059	1
Most frequently used	3.70	0.055	2
Averagely used	2.78	0.041	3
Sparsely used	1.78	0.026	4
Not used at all	1.13	0.016	5

V. DISCUSSION OF FINDINGS

Through this research it was realized that the proportion of staff that has computer training was within the 26%-50% which is an average category and that the percentage of staff that have computer is 69.7%. With this result, information technology in construction industry is well oriented. The research also shows that, most companies in the Nigerian construction industry are not using networking, they mostly use stand-alone computer without connecting to networks,78.8 percent of the respondent are using stand-alone computer while 21.2 percent are using networking in their firm. The software utilization by the industry, shows that the industry commonly use design drawing software (auto card), general administration and bill of quantities software according to the percentage on how often they are used. In the ranking, tender preparation & bidding software, specification writing software and Microsoft project management software is next in the ranking. The survey shows that office supplies purchasing, document tracking & management, economic and risk analysis software are not commonly used. There are very low barrier caused by information technology, according to the research, rapid changes in technology, poor leadership, high cost are not barrier to usage of information technology in Nigeria construction industry. The survey also shows that integration / capability problem, poor management, poor teamwork is not obstacles in their respective firm. Respondent stipulated that hardware problem, inadequate training and fear / mistrust of technology are still giving them some minor problem, but with time all this will be solved due to the developing stage of the Nigerian construction industry. From the research, the main benefit of information technology to the industry is that information technology has impacted positively on productivity of business activities. Respondent believes that productivity of business administration has increased as a result of quicker response on current project, easy capture on meaningful information, faster delivery of service has increased, compare to before in the Nigerian construction industry, as a result of the use of information technology in the construction industry. According to the respondents, the use of information technology has motivated workers to work better and time saving in project including ability to handle more enquiries. Although the survey shows that information technology still have low benefit in capturing lesson learnt from previous project also to overcome obsolescence. The introduction of information technology is purposely for communicating with central office, (others) browsing, making enquiries, publishing, typing, getting information etc, and time schedule control of project . The construction industry office communicate with the construction site, the survey make it clear that telephone is commonly used to communicate, respondents also show that face to face meeting and through the engineer are also in use. The use of e-mail, web portal and fax are still not in good use compared to the level of information technology in the industry. The survey showed that only few firms have a web site and that more firms are planning to launch a web site in the next two years. Access to e-mail is not available to all employees as indicated in the survey. The survey shows that information technology is frequently used in most firms. The companies that are not using information technology are very few according to the survey report.

VI. CONCLUSION

This paper reports the findings of the information technology survey in the construction industry in Nigeria. The study collects data from construction firms. These firms were interviewed during the period of November 2011 and August 2012. The participating firms are involved in the construction of buildings, roads and bridges, water and sewage projects. Among the top software utilized by the industry are Design Drawing (auto card), General administration, Bill of Quantities, Tender preparation & bidding. AutoCAD dominates the production of engineering drawings with most firms utilizing the software almost 80% of the time. Only 15% of firms have a website, 50% are planning to have a website in the next two years. Demands from customers are one of the top motivators for new information technology investment. Information technology has a positive impact on the productivity of business activities. Over 80% of respondents believed that the introduction of information technology has improved the productivity of design and project management. Two-thirds

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of the respondents agree that the productivity of general administration has improved as a result of information technology introduction. Almost all respondents indicated that IT has improved the quality of documents and increased the speed of work. The perceived benefits for information technology adoption according to the respondents are quicker response on current project, Ease of capture of meaningful information, faster delivery of service, better financial control, better communications, flexibility to satisfy customers, possibility of sharing common information, easier to use lots of data, and Possibility of telecommuting. The main obstacles for information technology use are inadequate training, Hardware problem and Fear / mistrust of technology required from staff. The study benchmarks current information technology usage, availability, and perceived impact in the construction, architecture and engineering, and consulting industry in Nigeria. Such benchmarking is of prime importance to both construction education and practice to understand current trends, forecast future directions, and conduct international comparisons.

VII. RECOMMENDATION

The construction industry still has a significant gap to bridge to reach best practice in the use of information technology to support supplier management. Fundamental changes are required in technology information management culture and procurement forms to allow an advanced use of information technology to support electronic communication and trading at all levels. The technological infrastructure to manage the transition is readily available and waits to be harnessed. The inevitability of electronic trading faces the construction industry as a strategic weapon to the competitive advantage of the industry, a competitive advantage that is essential to maintain, not only in the marketplace for construction services, but against other industries. The choice for investment decisions of the future may be the choice between highways or information super-highways.

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