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Impact of ICT on Performance of Building Construction Companies using Selected Standard Estate in Southwestern Nigeria

Akomolafe M.A.[1], Oluwagbemi E.B[2]., and Akomolafe A. A.[3]
1.Department of Building Technology, Osun State Polytechnic, P.M.B 301, IREE Osun State
2.Department of Estate Management, Osun State Polytechnic, P.M.B 301, IREE Osun State
3.Department of Statistics, Federal University of Technology Akure, Nigeria

Abstract
Information and communication technologies became a part of management tools in modern companies. Construction industry and its participants deal with a serious requirement for processing the huge amount of information on construction projects including design, construction, time and cost parameters, economic efficiency and sustainability. To fulfil this requirement, companies have to use appropriate ICT tools. This research examine the impact of ICT exploitation on performance of construction companies, the impact of BIM tools, ERP systems and controlling system on cost and profit indicators were measured on the sample of 85 companies using questionnaire from building construction industry in Nigeria. Data obtained from these sector were analysed using statistical software package. The study confirmed that ICT has a significant impact on the performance of building construction companies in Nigeria.
Keyword: Construction industry, Information Communication Technology, Management Tools, Questionaire and Enterprise Resource Planning System
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1. INTRODUCTION

Today large building and construction companies use ICT to the same extent as companies in other industries in order to co-ordinate and manage their internal information flows. However, in construction projects, the use of ICT for intra- and inter-organizational coordination and information exchange in the planning-, design- and production processes has been limited even if it is claimed to be a recognized potential. Information and Communication Technology (ICT) is a wide-ranging term that includes all technologies for the manipulation and communication of information. For instance, the internet is widely used for electronic mail (e-mail) and electronic commerce (e-commerce) including electronic invoicing, payments and receipt of materials process [1]. Apart from that, more sophisticated solutions of ICT based technologies are emerging such as wireless communication, bar-coding and Radio Frequency Identification (RFID) for tagging technologies. Thus, an appropriate implementation of ICT could facilitate more effective and productive information processes. Generally, building construction industry in Nigeria has lagged behind other industries in embracing ICT. It was found that although the professionals are quick to assimilate computerisation into their construction processes, the contractors and builders are still far from the adoption of ICT [2]. In the international construction industry, Turkey and other countries faced similar challenges in the area of communication and loss of information [3]. Accordingly, the implementation and practice of ICT in construction industry will strongly ease unnecessary lost and increase productivity in any projects. Thus, there is clearly a need to explore on the existing ICT implementation of the contractors while studying the availability for ICT to be implemented. Other than that, current constraints that are hindering the acceptance of ICT in the construction processes will also be identified. The performance of construction companies depends on several factors. A lot of competition, pressure to reduce costs and wide availability are the merits of the need to address the issue of performance of companies in selected sectors [1]. This opens up a number of questions on how to increase performance of companies and what factors affect it. In the last decade, it is often solved the issue of the impact of innovation in information and communication technologies on the performance of companies is very necessary to monitor the impact of these advanced technologies on the performance of building construction companies.

EVOLUTION OF INFORMATION AND COMMUNICATION TECHNOLOGY IN NIGERIA

Information has always played a very important role in human existence. However, in the mid 20th century, the role of information increased immeasurably as a result of social progress and the vigorous development in science and technology. In addition as Transtnikov(2012) cited by [5] has pointed out, rapid expansion of a mass of diversified information is occurring, which has received the name “informant explosion”. As a result, the need has arisen for a scientific approach to information and elucidation of its most characteristic properties which led to two principal changes in interpretation of the concept of information. Firstly, it was broadened to include

information exchange not only between man and man but also between machine and machine, as well as the exchange of signals in the animal and plant worlds. The pace of change brought by new technology has had a significant effect on the people‟s live, work and play worldwide, new and emerging technologies challenges the traditional process of teaching and learning, and the way education is managed. Easy worldwide communication provides access to a vast array of data, challenging assimilation and assessment skills. Rapid communication plus increased access to IT in the home, at work and in educational establishment could mean that learning becomes a truly lifelong activity, that is, an activity in which the pace of technological changes force constant evaluation of the learning process itself. Communication can be described as the process of transmitting and receiving ideas, information and messages.

2. LITERATURE REVIEW

Performance of companies includes good values in cost reducing and increasing of production [6]. Santos and Brito define success factors for corporate performance as profitability, market value, employee and customer satisfaction, social and environmental performance. Taruté and Gatautis said about corporate performance that it includes financial performance and strategic performance [8]. Other authors and researchers have done a series of studies and researches on the factors affecting corporate performance. The construction sector in Nigeria accounts for 3-8% of Gross Domestic Product (GDP), about 5% of the labour force, 40-70% of the gross fixed capital formation and about 12% of industrial sector production [7]. Construction contributes up to 7% of the GDP in most OECD countries and up to 12-14% in Japan and Korea (Gann, 2012) cited by [5], while in developing countries (according to Dharwadker, 2009) and cited by [5] said that investments in construction project 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 1980‟s, 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 be divided by a combination of low demand and consistently low productivity and poor performance over the years. 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 [5]. Following the ranking of Nigeria very low among 51 African countries and 153rd among 178 countries in the world by the international telecommunication union (ITU, 2013), very little was known about the impact of the technology on the industry and the prospects for its widespread penetration of the industry. This is because very few reports existed prior to these rankings of research in ICT in developing countries, Nigeria (Pamulu and Bhuta, 2014) cited by [5]. The use of ICT in construction industry has been making jobs easier, facilitating decision making and saving operational costs among others.

Ayatse carried out a case study of cement factoring companies in Nigeria, where the impact of ICT on corporate performance was examined, based on its findings, it was discovered that ICT have greatly improved corporate performance of cement manufacturing industries in Nigeria positively. There is a large series of studies dedicated to the topic of ICT implementation impact on performance of construction industry. When assessing the impact of information and communication technologies on business performance, different variables were used. The study conducted by Delina et.al. investigated stock market reaction to the IT investment announcements in Czech Republic, Hungary and Slovakia as a whole region, not studying the differences among these three countries [14]. Other authors include cost reduction as a main tool for corporate performance.

3. METHODOLOGY

Research questions

Based on the evaluation of the current state the research questions conducted in Nigeria were formulated:

- What is the impact of information and communication technology on performance of construction companies in Nigeria?
- What is the impact of BIM tools, ERP systems and controlling system on cost and profit indicators – performance?

Research objectives

Based on the determination of the research questions, the research objectives have been set. Main objective of this research was to analyse the impact of ICT on the performance of construction companies, generally. Another objective of this paper was to examine the impact of the chosen ICT tool as BIM (Building Information Modeling) tools, ERP (Enterprise Resources Planning) systems and mcontrolling system on the performance of construction companies.

Data collection and research sample

Data collection was conducted by questionnairing method. Questionnaire was designed and distributed in both postal and electronic form. In total, 1276 of respondents (construction companies in Slovakia) were interviewed. 85 respondents participated in the questionnaire survey. It represents a return of 6.66%. Research sample is described in more detail based on the table 1 below

Table 1: Research sample based on the design

S/N	ENTERPRISE	% Composition
1	Micro Enterprise	31.76
2	Smaller Enterprise	32.76
3	Medium Enterprise	27.06
4	Large Enterprise	8.24

3.4. Data processing methods and research hypotheses

Achieved data were evaluated based on several statistical methods through software STATISTICA version 12. To analyse the differences between the research groups, the Kruskal-Wallis ANOVA test was used. Also, the "Likert scale ranging" from 1 to 5 on the basis of the fixed values was used where value "1" is a very low performance and value "5" is a very high performance. These data were compared with the cost reducing indicator and profit.

The research hypotheses were set as follows:

H_1: ICT has a significant impact on the performance of construction companies in general.

That means that companies with active use of ICT achieve higher value (more than 0.05). This claim will be confirmed by Kruskal- Wallis test. Other hypotheses are extended from this main hypothesis and they are focused on BIM tools, ERP systems and controlling system.

H_2: Corporate performance of construction companies using BIM is higher than performance of the construction companies who do not use the BIM.

H_3: Corporate performance of construction companies using ERP systems are higher than performance of construction companies who do not use ERP systems.

H_4: Corporate performance of construction companies using controlling system is higher than performance of construction companies who do not use controlling system.

According to Kyakula, valuation of the hypotheses was based on the exploitation level as (Kyakula, 2011):

• Significant (level of use or impact > 0.05) or

• Not significant (level of use or impact ≤ 0.05). Statistical significance was verified by Kruskal-Wallis test.

4. RESULTS AND DISCUSSION

The perception of increasing of corporate performance is mainly linked with the increased profitability. This means cost reducing and increasing the profit. These data were provided and included in the research. Impact of the ICT in performance of construction companies in Nigeria has to reflect cost reducing and profit increasing. On the other hand, investments into ICT in generally were rapidly increased. It was reason for examined the level of investment in ICT was researched. For presenting the results, two groups of survey sample were created, namely: companies investing in ICT companies and companies without investments in ICT.

Hypothesis 1: ***ICT has a significant impact on performance of construction companies in general.***

This hypothesis means that companies that invest to ICT have higher corporate performance than construction companies without investment to the ICT. That means cost reducing and profit increasing for this companies. This value was interpreted to the Likert scale from 1 to 5. Results were confirmed by Kruskal- Wallis test.

Table 2: Kruskal- Wallis test for statistical significance of research groups (hypothesis 1)

Construction Group	**Kruskal-Wallis ANOVA based on ranking, Variable – investments to the ICT p=0.0265**		
	Code	**Number of valid responses**	**Performance rate**
Companies with investments to the ICT	**1**	**57**	**4.13**
Companies without investments to the ICT	**2**	**28**	**1.87**

Based on these results we can say that the ICT impact on performance of construction companies is relevant. This statement is confirmed by Kruskal-Wallis test (see table 2). Hypothesis 1 was accepted at the significance level $\alpha = 0.05$. Kruskal-Wallis test was value p=0.0265.

Next hypothesis discusses some of ICT tools as BIM, ERP systems and controlling systems in construction companies in Slovakia. All ICT has an important tool for everyday management activities in construction companies. It is very interesting comparison of corporate performance results in companies that using this tools

with companies without using these tools.

Hypothesis 2: ***Corporate performance of construction companies using BIM is higher than performance of construction companies who do not use the BIM.***

BIM tool presents an easy way for design of construction projects in all parameters together. It is a good tool for cost planning, project documentation and designing, time planning activities and other parameters of construction project in the phase of design and implementation too. Results of performance rate for companies used this tool as in Table 3.

Table 3: Kruskal - Wallis test for statistical significance of research groups (hypothesis 2)

Construction Group	**Kruskal-Wallis ANOVA based on ranking, Variable – used the BIM tool p=0.0398**		
	Code	**Number of valid responses**	**Performance rate**
Companies using BIM tool	**1**	**21**	**3.89**
Companies not using BIM tool	**2**	**64**	**1.96**

Based on these results it can be said that the BIM impact on performance of construction companies is significant. This statement is confirmed by Kruskal-Wallis test (see table 3). Hypothesis 2 was accepted at the significance level $\alpha = 0.05$. Kruskal-Wallis test achieved value $p = 0.0398$. Corporate performance of companies using the BIM tool is higher than companies that not using the BIM tool

Hypothesis 3: ***Corporate performance of construction companies using ERP systems is higher than performance of construction companies who do not use ERP systems***.

ERP systems are a very good tool for overall financial planning. This tool allows cost planning, controlling processes, accounting and other financial activities. Results of performance rate for companies using ERP system as in Table 4.

Table 4: Kruskal - Wallis test for statistical significance of research groups (hypothesis 3)

Construction Group	**Kruskal-Wallis ANOVA based on ranking, Variable – used the ERP system p=0.0494**		
	Code	**Number of valid responses**	**Performance rate**
Companies using ERP system	**1**	**32**	**3.85**
Companies not using ERP system	**2**	**53**	**1.67**

Based on these results it can be can said that the ERP system impact on performance of construction companies is significant. This statement is confirmed by Kruskal-Wallis test (see table 4). Hypothesis 3 was accepted at the significance level $\alpha = 0.05$. Kruskal-Wallis test achieved value $p = 0.0494$. Corporate performance of companies using the ERP system is higher than companies not using the ERP system too. In spite of the high cost of the ERP systems implementation, this tool has an impact on overall performance of construction companies.

Hypothesis 4: ***Corporate performance of construction companies using controlling system is higher than performance of construction companies who do not use controlling system.***

Last of the investigated ICT are controlling systems in construction companies in Slovakia.

Controlling systems probably impact on financial performance. It is tool for cost planning, checking and cost management. More results are described in Table 5.

Table 5: Kruskal - Wallis test for statistical significance of research groups (hypothesis 3)

Construction Group	**Kruskal-Wallis ANOVA based on ranking, Variable – used the Controlling system p=0.0237**		
	Code	**Number of valid responses**	**Performance rate**
Companies using **Controlling system**	**1**	**32**	**4.17**
Companies not using **Controlling system**	**2**	**53**	**1.53**

Based on these results controlling system impact on performance of construction companies was confirmed. Hypothesis 4 was accepted at the significance level $\alpha = 0.05$. Kruskal-Wallis test achieved value $p = 0.0237$. Corporate performance of companies using controlling system is higher than companies that do not use the controlling system.

Generally, ICT has a significant impact on the performance of construction companies in Nigeria. Adoption of ICT should be one of the main objectives for construction company managers. Table 6 shows the confirmation of all the hypotheses.

TABLE 6: Summary of the test and final result of the hypotheses

	Final result of the tested Hypotheses		
	Hyphotheses	**p**	**Result**
Hyphotesis 1	ICT has a significant impact on performance of construction companies in general.	**0.0265**	**accepted**
Hyphotesis 2	Corporate performance of construction companies using BIM is higher than performance of construction companies who do not use the BIM.	**0.0398**	**accepted**
Hyphotesis 3	Corporate performance of construction companies using ERP systems is higher than performance of construction companies who do not use ERP systems	**0.0494**	**accepted**
Hyphotesis 4	Corporate performance of construction companies using controlling system is higher than performance of construction companies who do not use controlling system.	**0.0237**	**accepted**

5. Conclusions

Performance of companies depends on numerous factors. In many situations, it is perceived through the financial results (cost reducing, profitability, return of investment and so on). This research has shown the impact of ICT on the performance of 85 Nigerian construction companies. Construction companies in Nigeria that have been using ICT more actively achieved a higher performance rate than construction companies that do not use ICT. Very similar results were obtained for chosen types ICT solutions. Controlling system is an effective tool and performance rate is higher than 4 out of scale. This is a significant impact on performance of companies. ERP system and the use of BIM tool has a significant impact on performance, too. This research confirmed the trend and has shown, that ICT has a real impact on performance of companies in building construction industry of Nigeria. For future research, it is necessary to gain more specific information on communication technology and its impact on performance of construction companies.

6. Recommendation

With the above mentioned findings and conclusion, the research carried out on ICT approach within the axis of south-western part of Nigeria (i.e. Lagos, Ogun, Oyo, Osun, Ondo and Ekiti-state), the following are made in order to promote the use of ICT in the construction industry in Nigeria. Efforts should be made by professional bodies to establish the use of ICT in Nigerian building construction industry, basic application of ICT like word processing, design, detailing and costing should be known to improve technical business applications like e-business, electronic data management, and teleporting should be part of training for all the site personnel. The building construction industries and professional teams should be optimistic about the future use of ICT such as communication facilities like e-tendering and teleporting, anti-virus applications should be available and installed on the computers to avoid virus attack and adequate awareness and enlightenment programme on application packages used in building construction project to the construction workers by the professional bodies.

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