ASSESSMENT OF FACTORS AFFECTING THE ADOPTION AND USAGE OF SOFTWARE FOR CONSTRUCTION PROJECTS ON UNIVERSITY OF ILORIN TETFUND PROJECTS

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ABSTRACT

Tertiary Education Trust Fund (TETFund) projects always require prudent management to enhance prompt completion within performance parameters. The use of Special Purpose Software (SPS) enhances achieving project objectives faster. This paper therefore aims to assess the use of SPS for TETFund projects by examining factors affecting SPS adoption and efficacy of their usage for monitoring, evaluation and control in University of Ilorin. A cross sectional research design was adopted for the study. Structured questionnaire was used for collecting data. Respondents were purposively selected from 158 firms that are registered with the University. A total of 60 questionnaires were distributed; out of 54 copies retrieved, only 52 were suitable for the analysis and this represents 87% response rate. Findings revealed that cost of procuring and montage of SPS with an average mean of 3.65 and integration with other systems with average mean of 3.56 had the highest effect on the adoption of SPS amongst construction professionals. Features available in the software and internet feature compatibility ranked lowest with average means of 2.1 and 2.0 respectively. Usage of SPS for monitoring and control is low with activity averages of 2.15 and 2.01 respectively, while usage for evaluation is significant with activity average of 3.19. The study concluded that construction professionals used by University of Ilorin averagely uses SPS for evaluation on TETFund projects but usage for monitoring and control is low. The study recommends that construction professionals should employ new technologies to enhance the adoption of SPS for monitoring and control. Client organizations should also mount SPS for monitoring and control to allow for easy integration and information transfer by construction professionals.

Keywords: Construction Project, Control, Evaluation, Monitoring, Software.

INTRODUCTION

Tertiary Education Trust Fund (TETFund) was established in Nigeria as an intervention agency and charged with the responsibilities of managing, disbursing and monitoring the education tax to public tertiary institutions in Nigeria. One of its primary mandates is to administer the fund for physical infrastructure for teaching and learning (TETFund, 2018). It also monitors the projects executed with the funds allocated to the beneficiaries. These projects always require prudent management to enhance prompt completion within performance parameters in order to justify the funds objectives.

Project Monitoring, Evaluation & Control (PME&C) are important activities in order to achieve project delivery within performance parameters. Tengan and Aigbavboa (2016) opined that monitoring and evaluation is a vital process in project delivery which is aimed at ensuring that major objectives and goals are achieved. The use of modern techniques and wide range of Special Purpose Software (SPS) solutions cannot be over emphasized in the management of construction work to enhance project performance. In the study of a specially developed software system for project monitoring, and evaluation, Robert, Nathalie, Xavier, and Pierre-Majorique (2013) established that the level of use of the software, and some of its subsystems, appears to be linked to project performance. The study revealed that the more the software usage time increases, the better the cost performance index (CPI) of the project. In addition, project performance also seems to be related to the intensity of use of four software subsystems: project definition, document control, management and construction activity management.

The construction industry world over and more especially in developing nations are greatly man... and as such requires more human resource to undertake the many activities aimed at achieving ... targets (Tengan and Aigbavboa, 2016). In addition it is stated by Schwalbe (2007) that many people will use basic productivity software such as Microsoft Excel or Word to perform many project management functions, such as determining project scope, time, and cost, etc., rather than using SPS for achieving faster and more detailed results. Construction professionals who implement TETFund projects in University of Ilorin appear to be quite attached to their conventional methods instead of the use of software. Brandon (1990) as cited by Nkado (2002) observing similar attitude ... professionals suggests that their continuing relevance and growth could require enhancing ... knowledge domain so that it can move quickly into new areas of service as opportunities arise. At the same time, they should be prepared to move away from old methods when technology ... competition make them redundant. This tendency can be observed easily in the realm of web-... technologies such as software use, where the rate of adoption of various systems is far from desired level (Acar, Kocak, Sey and Arditi, 2005).

Stair and Rynolds (2008) separated application software into four (4) main categories as: personal application software, workgroup application software, enterprise application software, and application software for information, decision support and specialized purposes. This study is particular ... special purpose software designed for specific operations to enhance the efficiency of its ... This study therefore aims to assess the use of special purpose software (SPS) for TETFund ... examining factors affecting software adoption and software use for monitoring, evaluation and ... in University of Ilorin.

LITERATURE REVIEW

Adoption of Special Purpose Software (SPS) for Construction Projects

The use of ICT based technologies in the preparation and implementation of projects in ... has been evident in the Nigerian construction industry for a long time. Several vendors ... out special purpose software applicable to construction activities and which facilit... production and ensures more accurate project delivery to the market. Hence, the industry ... fresh view of how to use ICT in order to improve productivity of the sector (Sarshar, Ta... and Underwood, 2002). Oyerinde and Odusami (2005) opined that the explosion ... information and communication technology (ICT) has had unquantifiable impact on bus... and processes. The global acceptance and widespread adoption of ICT has accelerated th... of competition not only among organizations globally but among professions locally. F... adoption of Web-based Project Management Systems has considerably improved ... construction and enhanced collaboration between professionals (Becerik, 2004; Z... 2005; Nitithamyong and Skibniewski, 2006). Using special purpose software aids in ... these technologies.

Sargent, Hyland and Sawang (2012) affirms that firms are increasingly utiliz... technologies to better manage geographically dispersed projects, though these tech... changes to existing working practices and processes and are viewed as disruptive b...

organization. Similarly, Masrina, Mahadi and Nor (2017) agrees that the existence of software has shifted the way company, manufacturing, firms and individual people perform and coordinate their ... They further highlighted that the impact of software use on the worldwide economy, environment and society in the context of innovation increase, enhanced productivity and improved social knowledge cannot be denied. Adoption of software for project monitoring and control is therefore necessary to further enhance the project delivery process. Despite the importance of project monitoring and control, the current practices are still time-consuming, costly, and prone to errors (Yang, Park, Vela, and Golparvar-Fard, 2015).

Software are technological inventions that reduces the rigor in monotonous activities of projects and increases the ability to advance or better the overall process of project delivery through speedy and accurate presentation of required results. These technologies over the years have developed to form major propellants in project management methodologies and have improved projects to a near perfection state. For the continuous growth of an industry, technological capabilities must be enhanced. This position is supported by Jegede *et al.* (2012) in the literature on growth and competitiveness of a country. The study and several others have argued that a country needs technological capabilities before it can grow sustainably (Garvin, 1981; Levinthal, 1989; Lall, 1992; Malerba, 1992; Dodgson, 1993; UNCTAD, 1996). Using technological advancement in project delivery process can then be argued to be bedrock in improving project delivery therefore, enhancing a smooth project monitoring, evaluation and control processes with the overall objective of improving project performance.

To a large extent, software application in the project delivery process has attained high prominence in the Nigerian Construction Industry. However, the appropriate or optimum usage may not have been adequately achieved by the construction professionals. This has led to several training and retraining efforts to bring construction professionals to date with software applicable to their areas of expertise (Ibrahim, 2012). Some of the available software used in the industry today includes software for design (architectural, structural, civil, electrical and mechanical); estimating and budgeting; scheduling and planning; and general project management (resource planning, monitoring and control).

Oyediran e and Odusami (2005) identified factors affecting the adoption of ICT amongst professionals in the built environment in Nigeria as; proficiency and knowledge on software, capacity (ability of the software to handle complexity), documentation and on-line help facility, ease of use, features available, installation requirements, integration with other systems and software, internet features, reporting capacity, security, vendor support, accuracy of results and affordability of procuring & mounting software. Similarly, Schwalbe (2007) revealed from relative research that such factors as supporting explicit business objectives, supporting implicit business objectives and providing financial incentives as reasons cited for organizations to invest in information technology projects.

Project Monitoring, Evaluation and Control (PME&C)

In the project delivery process, monitoring and control has always been a follow up process to planning. Chitkara, (2011) opines that the performance goals of a sub-system are stated in terms of parameters to be controlled. Monitoring construction projects is a multi-faceted task. it is the continuous assessment of programmed work to ensure compliance to initial plans and assessing what work has been completed. Idoro (2009) opined that monitoring and control are considered as two of the series of sequential measures that are adopted to make a project successful. The duo of monitoring and control cannot be separated from each other as controlling uses data from monitoring activities to bring actual performance to planned performance. In a study of construction performance monitoring, it is explained that timely and accurate monitoring of onsite construction operations can bring an immediate awareness on project specific issues (Yang *et al.*, 2015). Monitoring is seen to provide construction professionals with information required to readily make project control decisions. Broadly, activities in monitoring involve collecting, recording and reporting information concerning project performance. Hore *et al.* (1997) identified the need to continually monitor the integrity of the project scope and ensure that the planned scope is achieved and not lost in the complex array of construction change orders and environment. Idoro (2009) used four (4) project monitoring activities in evaluation of project monitoring and control in the Nigerian construction industry as site visit, site meeting, interim valuations and financial statement.

Controls are the processes and activities needed to correct deviations from plan. They put in check the triple constraints of time (schedule), cost (budget, expenses, etc.) and performance (specifications, testing results, etc.). In their definition of the project control process, Gido and Clement (2009) explain that project control process involves regularly gathering data on project performance, comparing actual performances to planned performances, and taking corrective actions if actual performance is behind planned performance. This process, they device, must occur regularly throughout the project. Control is considered according to Idoro (2009) as a process distinguishable from monitoring by a number of activities through which schedule slippage in project performance is corrected. Chitkara (2011) opines that an efficient integrated project control system generates information that can improve the productivity of men and materials; economizes the employment of resources; enables understanding of time and cost behavior; provides early warning signals of ensuing dangers; updates resources planning and costing norms; prevent pilferages and frauds; and assists in formulating bonus/incentive schemes for motivating people.

Adeleke (2001) is of the view that all project control activities and process are of three (3) primary forms or mechanisms, which are:

i. Productivity control which is technical in nature and has such direct activities of project scope reviews, performance evaluations (earned value management), project plan reviews and construction programme updating;
ii. Organizational control which is administrative in nature and it looks at work and delegation lines such as aspects of project work structure, unity of command/span of control and human resource control mechanism; and
iii. Profitability control which is economic in nature and it controls activities such as controlling budget lines (cost control) and cash flow control mechanisms which are all aimed at improving profitability of the project.

In similar activity identification, Idoro (2009) citing Kursave (2003) identifies four activities in the control process as: programme updating, plan review, objective review and scope review. Evaluation can be described as the comparison of actual project impacts against the agreed strategic plan. It looks at what you set out to do, at what you have accomplished, and how you accomplished it. Project evaluation measures and quantifies progress against planned parameters. Bamiduro (2000) opines that evaluation is a process which supports a project, by measuring the extent to which the objectives are met, identifies achievements and also identifies areas for improvement. He continued that project evaluation encourages decision to be taken, including changes to objectives and the project methodology. Construction work in progress is evaluated using quantity surveyor's interim valuation of work and final accounts. These measure the value of the work done on interim bases and at completion respectively. Change orders and the effect of price changes in the market are recorded and analyzed during work progress. Majority of the work required in project evaluation is carried out by the quantity surveyor (Ashworth, 2002). Quality evaluation is however carried out by the quality control officer. Evaluation is assessing, as systematically and objectively as possible, a completed project or programme (or a phase of an ongoing project or programme that has been completed), or extent of completion of ongoing works. Evaluations appraise data and information that inform strategic decisions, thus improving the project or programme in the future. Evaluation should help to draw conclusions about five main aspects of intervention ranging from relevance, effectiveness, efficiency, impact and sustainability (Bamiduro, 2000).

RESEARCH METHODS

This study was carried out among construction professionals who have executed TETFund construction projects in University of Ilorin in the last ten (10) years. The research was conducted by an examination of relevant literature followed by the administration of a structured questionnaire on selected professionals. In order to obtain the sample size which represents the entire population of construction professionals employed by consulting and contracting firms that have been used for TETFund projects in University of Ilorin, purposive sampling technique was used for collection of data. The sample size comprises the list of one hundred and fifty - eight (158) registered firms with the Physical Planning Unit of the University of Ilorin. Sixty (60) firms were purposively selected, comprising a homogenous sample because of their involvement in TETFund projects with the University of Ilorin. Creswell (2012) explains that in homogeneous sampling the researcher purposefully samples individuals or sites based on membership in a subgroup that has defining characteristics. The questionnaire used was constructed to elicit responses to determine the more important factors from a total of thirteen (13) identified that affect the adoption of software for construction project monitoring, evaluation and control. Similarly, respondents were requested to evaluate the use of software for twenty one (21) activities attributed to project monitoring, evaluation and control processes

The survey instrument consists of three (3) sections. Section A sought information on the personal profile of the respondents and also evaluates the organizational characteristics of the respondents. Section B elicited information on the factors that affect the adoption of software for construction project delivery while section C measures the usage of software by construction professionals for project monitoring, evaluation and control. Respondents were requested to measure the level of the effect of highlighted factors on a five-point scale. The reliability test for the research instrument adopted for the study was the test-retest method, which allowed the research instrument to be administered at two different times. Joppe (2000) defines reliability as the extent to which results are consistent over time and an accurate representation of the total population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable.

The target populations was construction professionals such as architects, structural engineers, civil engineers, services engineers, and quantity surveyors who have been employed by firms during the execution of TETFund projects at University of Ilorin. University of Ilorin was selected as the study area because the University has over the past ten (10) years consistently delivered TETFund funded projects on an annual basis. Questionnaires were distributed by hand and via email to construction professionals employed by the firms selected. A total of 60 questionnaires were distributed; out of 54 copies retrieved, only 52 which represents 87% response rate were suitable for analysis. Data for the study were analysed with the aid of the Statistical Packages for Social Science (SPSS 20.0). Data measured on nominal scale were analysed using descriptive statistics. The levels of significance of identified factors were determined by the magnitude of their mean scores, with the greatest mean representing the most significant factor.

RESULTS AND DISCUSSIONS

Results from the Study

The results from the data collected are presented in two forms. The demography alongside the nature of organizations the professionals belong to, were analysed in percentages. These were narrated while the decision on the results of the factors relating to the objectives are presented in tabular form and measured based on mean scores.

Respondents Demography and Organisational Characteristics

About 80% of the respondents were male and the other 20% were female. This indicates a good female representation among the sample. The respondents parade a sizable number of experienced professionals judging from the age distribution and working experience. The sample revealed that 25% of the respondents were between 25 – 35 years of age; 52% were between 36 – 45 years of age; and 22% were 46 years of age and above. This however confirms that majority (74%) of the respondents were above 35years of age. Also 21% of the respondents had construction experience between 1 – 5 years; 27% has experiences ranging from 6 – 10 years; while the 52% of the total respondents has over 10 years' experience. This confirms that majority of the respondents have requisite experience to provide information for the study.

Civil/structural engineers, quantity surveyors and architects rank highest amongst the professionals selected with 25%, 27% and 26% respectively. Builders were 17%; mechanical services engineers were 2%; and electrical services engineers were 3%. Quantity surveyors constitute the highest proportion among the total respondents who participated in the survey. Results from their professional affiliations revealed that 23% of the total respondents were graduate or probationer members of their professional bodies; 4% were associate members; 59% were full professional practitioners and 14% were fellows.

Assessment of educational qualifications revealed that a large percentage of the respondents have appropriate degrees as 21% of the respondents possess Higher National Diplomas; 28% of the respondents have a Bachelor of Technology, Science or Engineering degree; 23% have a Post Graduate Diploma degree; while 27% have a Masters of Technology, Science or Engineering degree; and only 1% has PhD. This indicates adequately trained personnel in the distribution as a total of 5[illegible]% of the distribution have post graduate degrees.

41% of the organizations were engaged as contractors in building project funded by TETFund, while 59% were consultants. The study also revealed the frequency distribution of the years of existence of the firms. Majority (60%) of the organizations have existed for more than 10years, 35% of the respondents have existed for 6-10years with the remaining 5% existing for less than 5 years in the construction industry. Findings also showed that 48% of the responding organizations have executed more than three (3) TETFund funded construction projects in the last ten (10) years, while the remaining 52% have less than three (3) TETFund construction projects during the last ten (10) years.

Assessment of Factors affecting the Adoption of Software for TETFund Projects

To achieve this objective, thirteen factors identified from literature were evaluated. The highlighted factors affect the adoption of software for construction project. The effect of the factors was measured on a 5 point Likert scale; nil, low, moderate, high and very high. The scales were weighted as follows: nil = 1, low = 2, moderate = 3, high = 4 and very high = 5. The mean scores of the effect of the factors on the adoption of the software are presented in Table 1.

Table 1: Mean scores of the effect of factors on adoption of software

Factors	1	2	3	4	5	N	Mean	Rank
Affordability of procuring & Mounting Software	4	8	9	12	19	52	3.65	1
Integration with other systems & software	4	11	7	12	18	52	3.56	2
Accuracy of results	5	8	12	11	16	52	3.48	3
Capacity (ability to handle complexity)	7	11	7	13	14	52	3.31	4
Ease of use	12	5	12	11	12	52	3.12	5
Installation requirements	17	0	9	16	10	52	3.04	6
Reporting capacity	10	16	10	7	9	52	2.79	7
Vendor support	13	12	8	12	7	52	2.77	8
Security	7	19	14	10	2	52	2.63	9
Proficiency and knowledge on software	22	7	5	14	4	51	2.44	10
Documentation & online help facilities	20	14	7	6	5	52	2.27	11
Features available	24	6	12	9	1	52	2.17	12
Internet features	18	20	10	0	4	52	2.00	13

Assessment of Use of Software for Monitoring, Evaluation and Control for TETFund Projects

To achieve this objective, activities peculiar to monitoring, evaluation and control were evaluated. Twenty one (21) activities were identified with: monitoring having five (5) activities; evaluation having six (6) activities and; control having ten (10) activities. The use of software was measured on a 5 point Likert scale; never, rarely, sometimes, often and always. The scales were weighted as follows: never = 1, rarely = 2, sometimes = 3, often = 4 and always = 5. Average mean for collective activities attributed to a process is rated on a 3 point scale of low (0 - 2.5), significant (2.6 - 3.9) and high (4 - 5). The mean scores of the effect of the factors on the selection of the planning software are presented in Table 2.

Table 2: Respondents Use of Software for Project Monitoring Evaluation and Control

Activities	1	2	3	4	5	N	Mean
Monitoring:							
Site visit.	22	18	7	5	0	52	1.90
Site meeting.	39	5	3	5	0	52	1.50
Financial statement.	4	5	10	18	15	52	3.67
Project scope integrity monitoring.	30	18	3	1	0	52	1.52
Time progress monitoring charts.	18	15	14	2	3	52	2.17
Overall mean for monitoring activities							**2.15**
Evaluation:							
Interim valuations.	8	12	8	12	12	52	3.15
Final account.	7	16	9	8	12	52	3.04
Work program evaluation (work progress) :- percentage & level of work done)	2	4	6	8	32	52	4.23
Fluctuation analysis report	6	11	4	15	16	52	3.46
Variation evaluation report	5	10	2	13	22	52	3.71
Quality performance evaluation.	38	8	1	3	2	52	1.52
Overall mean for evaluation activities							**3.19**
Control							
Project scope review	18	9	7	13	5	52	2.58
Performance Control (Earned Value Management)	44	2	1	1	4	52	1.44
Project plan review	26	12	13	1	0	52	1.79
Construction Programme updating	3	10	27	5	7	52	3.06
Project objectives review	30	11	3	5	3	52	1.85
Project work structure control	27	12	12	1	0	52	1.75
Unity of command /Span of control	41	1	7	2	1	52	1.48
Cost Control systems	33	14	2	1	2	52	1.56
Cash flow review and updating	5	10	15	19	3	52	3.10
Life cycle costing and review	31	18	1	1	1	52	1.52
Overall mean for control activities							**2.01**

DISCUSSION OF FINDINGS

The study reveals that affordability of procuring and mounting software and the integration [illegible] systems and software has the highest effect on the adoption of Special Purpose Software [illegible] construction project delivery. The price of acquiring software has been found to be a major [illegible] organizations are not ready to invest in software without certainty about the value espec[illegible] competitive market like the construction industry. These findings supports the results of a [illegible] Oyerinde and Odusami (2005) on the adoption of ICT by quantity surveyors that cost rela[illegible] that are considered high includes cost of original software, its hardware and infrastructure [illegible] computerization and cost of support services. The compatibility of any software organization's system or other software is however very essential as it ensures they have [illegible] efficiency in achieving task as a result of adopting the use of particular software. Other factors with relatively high mean score as depicted on Table 1 are accuracy of result, capa[illegible] to handle complexity) and ease of use. The amount to cover for training will be an additional cost to the organization. **Documentation and online help facilities; feature available and; internet features have been found to exert less effect on the adoption of SPS for the management of TETFund projects in University of Ilorin. It is not surprising to note that internet features do not adversely affect the** adoption of SPS as the availability of online help facilities is readily available (Sarshar *et al.*, 2002). Underutilization of online technologies is more evident in the industry. This is so because there are cheap internet facilities available and a number of online help on the use of some software on search sites.

Usage of SPS for monitoring is considered low with an average mean of 2.15. Although it is seen that SPS is significantly used for the presentation of financial statement in monitoring which has a mean of 3.67, all other activities have low mean, justifying that the use of SPS for monitoring activities is low. Similarly, Usage of SPS for controlling activities is low with a mean average of 2.01. Significant activities in control are construction program updating with a mean of 3.06 and cash flow review updating having a mean of 3.10. *This can be attributed to the ease of mounting SPS that can carry out construction program updating and resource schedule activities and they can be procured off the shelf* like the Microsoft Project. Finally, the use of SPS for project evaluation is significant. All activities in evaluation significantly use SPS except for quality performance evaluation which is abysmal at 1.52. Work program evaluation also showed high usage of software by professionals. Interim valuations, final accounts, variation and fluctuation analysis is showing significant usage of SPS. The low adoption of SPS for monitoring and controlling activities supports the recommendation of Tengan and Aigbavboa (2016) that stakeholders should undergo capacity building on strategies and new methods for effective monitoring and evaluation. In addition high uses of SPS for evaluation activities can be attributed to the proliferation of Quantity Surveying Application Software in the Nigerian Construction Industry (Oyerinde and Odusami 2005). Also many firms have developed solutions from basic application software like Microsoft Excel.

CONCLUSIONS AND RECOMMENDATIONS

The construction professionals who participated in the survey cut across all the professional background ranging from architects, civil engineers, service engineers and quantity surveyors. They have requisite experience in the construction industry but adoption of SPS for project monitoring and control is still low and abysmal. This can be attributed to why clients according to Takim and Akintoye (2002) are dissatisfied with the outcome of most construction projects, which is somewhat linked to inadequate planning and implementation amongst other factors. Use of SPS for evaluation is relatively significant but can be improved. The significance recorded should be taken with caution as the study did not investigate the type of software used to ascertain if it was application software designed as SPS or solutions derived from the development of basic application software like MS Excel.

The cost of procuring software coupled with the associated cost of establishing the support infrastructure determines the adoption and the subsequent use of the software by professionals in the built environment. It is however interesting to note that little emphasis is accorded to knowledge and proficiency of professionals in the adoption of software as professionals are expected to be trained in the use of the software after purchase.

Some recommendations have been suggested based on the findings and conclusions made in this study to eliminate the inefficiency associated with poor monitoring and control practices in the Nigerian construction industry. Construction firms and practitioners consider largely the cost of procuring SPS and its associated cost of support infrastructure for its effective use in project monitoring and control amongst other factors, hence funding agencies like the TETFund should consider mounting Web-Based Technologies that can assist construction professionals to use mounted SPS on project management systems that are web-based. This will improve monitoring and control processes.

Organizations should also improve their reputation in the construction industry by acquiring technical competencies and capabilities with the use of modern software as these qualities have become important considerations in assessing competiveness and key indicators of increased productivity in construction projects. Clients and employers should insist on the maximal use of relevant software on all aspects of project development, monitoring, evaluation and control. Finally, construction professionals involved in the construction process should endeavor to explore more software and applications for monitoring, evaluation and control purposes during the entire project delivery process for improved output and better project performance.

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