EARNED VALUE MANAGEMENT AWARENESS AND UTILIZATION IN CONSTRUCTION PROJECTS IN NIGERIA

BY

NSIKAK E. UDO,
ITORO E. UDO
DEPARTMENT OF QUANTITY SURVEYING
AKWA IBOM STATE POLYTECHNIC

&

AKWAOWO DIANABASI
DEPARTMENT OF ARCHITECTURE
AKWA IBOM STATE POLYTECHNIC

ABSTRACT

The aim of the study is to investigate the levels of awareness and utilization of earned value management (EVM) in construction projects. The objectives are to analyze the level of awareness of EVM of construction professionals and to examine the extent of utilization of EVM in the delivery of construction projects in Nigeria. Structured questionnaire was used to collect information from construction professionals who undertook EVM recently. Snowballing sampling technique was used in selecting One Hundred and Fifty (150) respondents and only Eighty Four (84) responses from the two geo-political zones (south – south & north central) were found fit for data analysis. This study used percentage and parametric test of ANOVA to test two hypotheses @ 5% level of significance. Result showed that EVM concept is known to respondents but not fully embraced by them. The level of awareness is still low (69%) while employing some informal methods of EVM in the practice; about 26% of the respondents were not quite familiar with the practice. From F-test @ 5% level of significance ftab < fcal at 3.46 and 25.10 respectively affirming the significance of EVM in projects implementation while area of practice has no impact on EVM since ftab>fcal at 7.26 and 5.22 respectively. The study has proposed measures to improve quality performance through inspections and valuations methods. Policies should be enacted for use of EVM for all funded construction projects. The study concludes that organizations have not fully embraced EVM but only on very few projects. Recommendations were made to upgrade curricula of postgraduate courses in construction related fields to include EVM; while professional bodies are to create awareness and enlighten their members through seminars, workshops and conferences, on the use of EVM for projects.

KEYWORDS: Earned Value Management, utilization, technical performance Applicability, Performance baseline.

INTRODUCTION

The genesis of Earned value management was in industrial manufacturing at the turn of the 20th century, but the idea took root in the United States Department of Defense (DOD) in 1967. The original concept was called Program Evaluation and Review Technique and the cost activities in the project (PERT/COST) was considered overly burdensome (not very adaptable) by contractors who were mandated to use it (Boar, 2000).

In IMCOs and early IMDOs, some managers in both government and industries employed **COST/SCHEDULED CONTROL SYSTEM CRITERIA (C/SCSC)**. C/SCSC was often considered a financial control tool that could be delegated to analytical specialists. In the late IMDOs and early IMMOs, Earned value management **(EVM)** emerged as a project management methodology to be understood and used by managers and executives **(Onyeador, IIOOX)**.

The primary professional associated for **EVM**, called **P**erformance **M**anagement **A**ssociation **(PMA)** merged with the project **M**anagement institute **(PMI)** in IMMM to become **PMI**'s first college the college of **P**erformance **M**anagement. Efforts to simplify and generalize **EVM** gained momentum in the early IIOOOs [**PMI**, IIOOV], the **U**nited **S**tates **O**ffice **M**anagement **A**gencies, and all publicly traded companies **(Postula, IIOOC)**.

EVM as a project management method requires integrated baseline of cost, scope and schedule against which performance can be measured for the duration of the project **(PMI, IIOOV)**. Despite **EVM** principles being generally accepted as effective in project management which can be implemented in any project ranging from aerospace, construction, information technology, healthcare, etc; there have not been found a broad practitioners base in both private and public sector construction industries **(Locke and Latham, IIOIII)**.

In **N**igeria, the acronym **EVM** to a large extent is not really known in the medium industry. Although the oil and gas sector uses the technique for jobs earned, small fractions of practitioners and owners of projects have adopted or invented project controls method using **EVM** principles based on their own experience, risk exposure and control needs. The paper seeks to know the awareness level, level of application on the part of contractions as well as the effectiveness of the system in construction projects in **N**igeria.

THEORETICAL FRAMEWORK

This paper is based on the theory of **G**oal setting proposed by **E**dwin **L**ocke in IMLD with the focus on the area of performance measurement. **G**oal refers to future valued outcome while in measuring performance, basic principles like charity, challenge, commitment, feedback and task complexity allow goal setting to perform better **(Locke + Latham IIOIIII)**.

In case of the construction activity, the charity is the cost performance index **(CPI)** being the ratio of the value of work achieved to date, to the actual cost of achieving those results. **C**hallenge in construction relates to scheduled variance (compares the value of work achieved to date with the planned value). **F**eedback relates to scheduled performance index **(SPI)** which identifies time efficiency to date while task complexity acts as an indicator to predict cost at completion **(Candido, IIOIV)**.

EVM APPLICATIONS IN ENGINEERING/CONSTRUCTION PROJECTS

EVM allows the performance and progress of projects to be assessed at a single point in time, usually repeated on a regular basis such as weekly or monthly. **P**rojects are composed of many activities with differing durations and start times. **T**herefore at any point during the project some activities have been completed, some are underway, and some have not been commenced **(Fleming, IIOIO)**.

Building construction

EVM principles are commonly used to determine contractors' monthly payments. In large building projects a "cost loaded schedule" is issued to forecast the monthly payments. The field program report outlines activities and compares the budget spending plan to the actual costs spent. The determination of Earned value (Progress) is based more on an expert's judgment often recommended by the quantity surveyor and certified by the Architect than on formal quantitative monitoring (Brenza + Hildreth, 2006).

At preconstruction phase, the architect typically takes the lead on the overall design. The architect also represents the owner during the construction phase to inspect the quality of and determine the progress of work. However, engineers, interior designers and other consultants are hired and managed by the architect. Construction is typically performed either by General Contractor (GC) or by a Construction Management firm (CM) which renders the contract separate from the architect's.

Work breakdown structure (WBS) such as Master Format is useful at this stage in organizing and communicating design data and dividing the work among trade subcontractors and complementing it with critical path method (CPM) schedule (Demarco, 2011). During construction phase it is common practice to hire a construction manager to coordinate with the architect, engineer and other consultants and to supervise the trade subcontractors on the client's behalf. A Guaranteed Maximum Price (GMP) agreement is a popular way to shift some of the budget over men risk exposure to the Construction Manager. However, GMP agreements typically do not cover scope changes (SC) and scheduled delays. A fixed price General contract (GC) model may be more suitable when the design is substantially completed for construction.

In his review, Anbari (2003) noted that it is not common in the building construction industry that a construction Manager agrees on a payment schedule that is tied to project milestones or completion of discreet units of project or WBS. As a result of this, the industry does not benefit as much as other industries do from applying EVM.

TRANSPORTATION/ROAD INFRASTRUCTURE

This requires large and risky investments highly owned and operated by government agencies. The permitting phase (preconstruction) is followed by the engineering phase consisting primarily of civil and traffic engineering activities. The progress is measured by the linear length of the road designed. Where required or feasible, valleys and mountains are crossed by bridges and tunnels which require specialized and focused engineering efforts handled as separate projects with their teams, schedules and budgets. According to Brienza + Hidreth (2006), the construction phase witnesses earthmoving, compacting, and pavement as the major construction activities. This is managed by tracking the actual cost and schedule against the planned. In order to avoid both cost over run, and delays due to inherent risk in project commodity tracking which employ project management, system software has been made available for this purpose.

Road construction activities can lend themselves to quantity tracking and EVM applications if the accuracy of actual quantity measurement is improved and administrative costs are controlled. Surveying large sites is costly and not always produced accurate results. Dealing with earthwork quantities can be misleading when taking account of the compaction ratios, shrinkages, swells, types of soil, and fill materials. However, technologies such as monitoring earthmoving equipment with Global positioning system (GPS) can improve the effectiveness of quantity tracking and program reporting (Alshibani, 2009).

Possible Setbacks and Benefits of EVM Technique in Measuring Performance of building Projects.

Fleming+ Koppelman (2000) found that the difficulty embedded in applying **EVM** is about an adequate work breakdown structure (**WBS**). If the work is subdivided into small packages, it will represent a high cost of control and a lot of paperwork. Conversely, a badly stratified subdivision may represent an inaccuracy of data real cost and deadlines.

Aside from the practice of certifying progress by an expert without formal quantity tracking or **WBS**, monitoring can cause cost increase and delays. For example, on a scale of 100% cost on work scope, the different between5% and 10% of monthly progress of a trade may look insignificant. However, an innocent 1% of over reporting per month over a 10month period can add up to 10%. If the trade subcontractor uses its monthly payments to pay off its bills and payroll for that month, then it will arguably not have enough money in bank to build the final 10% of the scope in month 10. As a result, the owner will pay the extra 10% in order to rescue his project (Brienza+Hildreth, 2006).

In another development, Candido (2014) found that **EVM** inspires participants on the project to pay more attention to costs and progress and to discuss the cost element with more intensity and optimize the costs resulting in a project that was finished on time and on budget.

In his opinion, Kerzner (1999) stated that managing costs using **EVM** is referred to as "managing with open eyes'' because the manager clearly sees what was planned, what was performed and the actual costs.

The adoption of strong governance and control frameworks based on **EVM** principles can help contractors grow their business by involving larger and more complex projects with more sophisticated construction client. It would allow them to bear a higher level of risk, consistently allowing them to increase their fees and profitability (Bower, 2000).

Sustainable Approaches for measuring Earned Value

Webb (20003) outlined a number of alternatives for measuring the earned value of an activity on a project as follows:

0/00 Approach: This is the most common milestone based method, although seen as harsh, as no value is achieved until its completion regardless of progress. Domitrova (2005) opined that this approach is applied to a project that involves work packages with small duration. It indicates that no value is earned until task is completed.

x0/x0 Approach: This **EVM** technique recognizes x0% when the task is started and x0% when completed.

2x/cx Approach: This is similar to the x0/x0 approach, only with the better percentage ratio for long duration work packages.

Percentage completed Approach: It allows for a subjective percentage of completed units weighing and results in percentage of completion. The significance is that the project is well planned.

In the implementation of earned value system, Fleming and Koppelman (1996) outlined vital routes which when followed, could capture the critical essence of earned value concept and enhance the management of all projects as follows;

- Project work scope to be defined using work breakdown structure (**WBS**).
- Introduced Control Account Plans (**CAPs**) from work scope, schedule and resources
- Formally schedule **CAPs**
- Assigned each **CAPs** to an executive to oversee their performance.
- A baseline that summarizes **CAPs** must be established.
- Periodically, measure performance against schedule
- Periodically, measure cost efficiency against cost incurred.
- Periodically, forecast final cost based on performance
- Managing remaining works.
- Managing baseline changes.

Conceptual framework

Blue and Deltek (2005) opined that earned value management (EVN) is a project management technique that seeks to measure forward progress in a objective manner. EVM is a set of business practices focusing on a combination of processes, people and tools for enterprise project planning and control. It is an industrial standard way of integrating the scope, schedule and cost in a baseline against which accomplishment can be measured; measured project progress, forecast its completion date and final cost, provide schedule and budget variance along the way (Christensen, 1997).

By putting a monetary value on a project status, earned value enables companies to measure "projects health'' throughout the lifecycle of a project. Thus it can be described as the sum of the budget for completed works.

EVM is touted as having a unique ability to combine measurement of technical performance (under / over budget) within a single integrated method as well as providing early warnings of performance problems (Altken, 2000).

In his analysis, Domitriva (2001) summed up that earned valued (EV) for a completed activity is equal to the total budget for those activities. For activities not yet started EV is zero.

For activities in progress the method is to multiply the budget by a "percentage complete" to get the EV.

The essence of EVM is to establish the task level and as work progresses, the budget for each task is earned. This would provide a metric to measure what was spent and the budgeted amount of the work completed or earned valued.

Empirical framework

The level of Applicability of EVM technique in Construction Projects.

Many studies about the applicability of EVM have been made. In his curiosity, Thamhain (1996) surveys with 500 professionals who engaged in 150 projects executed at Fortune 1000 companies. In his findings only 16% of people engaged in projects made use of EVM. He observed that EVM was more useful than Critical Path Method (CPM), quality function deployment (QFD), and crashing.

In another development, Christensen (1996) observed that the implementation of earned value (EV) requires a cultural change, which demands time and efforts. He stresses that policies and knowledge must be taught by the organization in order to quicken the work of those involved.

In the same vein, Wideman (1996) observes that a project of great importance requires planning and control with professionals capable of collecting the information and making the analysis of Added value, turning its applicability justifiable.

In their work, Terrel etal (2000) observed that earned value Analysis (EVA) would only be effectively implemented, if the information about the resources is clearly defined. A failure in obtaining these data will create inaccurate performance baseline (PMB), distant from the real scenario.

RESEARCH METHODOLOGY

The study population was mainly Architects, Quantity surveyors, Builders, Engineers in both medium and heavy industries. The study employed snowballing sampling technique since there are no professional bodies or associations from which sampling frames can be drawn. The study was conducted in two geopolitical zones. (North-Central and South-South) Nigeria. Different construction organizations were contacted to find out whether they have been involved in EVM practices or not, whereby questionnaires were sent to them for evaluations. A total of 190 copies of questionnaires were distributed within these two regions and 87 responded accurately and were found (92%) suitable for the analysis.

Descriptive statistical tools such as tables and percentages were used alongside a parametric test ANOVA for testing the level of significance of hypothesis. F-test was used in taking decisions on significance of implementing EVM as well as significance of area of practice being the two hypotheses tested.

RESULTS AND DISCUSSION

Table 1 Result of awareness of respondent on the use of EVM

Item	QUESTION RESPONSE	FREQUENCY	%TAGE
(A)	Are you aware of yes	XD	LM%
	The concept of EVM before No	V	X%
	Completing this not quite familiar	IIII	IIL%
	questionnaire	DV	I00%
(B)	IS EVM practice by yes	VX	XV%
	Your organization; very rare	IIII	IIIC%
	No	D	M%
(C)		DV	I00%
	What is your level very sound	VD	XC%
	Of understanding of fair	IIIO	IIIL%
(D)	EVM application to poor	L	C%
	Projects	DV	I00%
	To what extent have highest	IIIO	IIIL%
	You applied EVM high	IIIII	IIID%
	Software tools low	IIII	IIL%
	In your organization	DV	I00%

Following table I, the awareness of respondents on EVM is LM% affirming that greater number were aware that such practice existed although IIL% were not quite familiar with it. These awareness confirms that most professionals were aware based on training and professional exposure.

About IIIC% of the respondent stated that they do not quite often practice EVM although, XV% have been practicing. These results shows that with the evolution of EVM over the years in developed and developing countries still, EVM is not widely accepted and used in most of our projects in Nigeria.

Further, about IIIL% and IIID% respondent proved that they are used to EVM software tools in their practices on highest and high level respectively. About IIIO% has low utilization and such there is greater need for concept to be widespread amongst construction organization and firms in Nigeria.

Table 2: Two way ANOVA: value Vs question, responses

Source	DF	SS	MS	F	P
Question	III	ILDCV.C	XLIIV.MI	II X.IO	0.000
Response	III	IIM.V	M.DO	0.OV	0.MDD
Error	VI	MIDC.M	IIIIV.OM		
Total	VC	IILOMIL II			

S=IV.MC, R-sq=LV.CX%, R.sq (adj) =XM.LIII%

In testing hypothesis I

H_o: EVM is not significant in the implementation of projects in Nigeria. Decision Rule: Reject the null hypothesis if $f_{cal} \geq f_{tab;}$ otherwise accept it

From the analysis above $F_{III,\ VI}$ AT 0.0X level of significance =III.VL i.e. f_{tab}=III.VL and f_{cal} =IIX.IO

Based on the decision rule H_o is rejected and H_I is accepted that EVM is significant in the implementation and delivery of projects in Nigeria.

Table 3 Area of Practice vs dominant capital

Source	DF	SS	MS	F	P
Area of Practice	III	LD.LLC	IIII.DDDM	V.ID	0.OLV
Dominant capital	II	XC.ILC	IID.XDIIIIII	X.IIII	0.OVM
Error	L	IIIII.DIIIIII	X.VCIIII		
Total	II	IXD.LLC			

S= 2.339, R-sq=79.311, R-sqadj=62.06%

From Table III

$F_{II,\ b}$= C.IIL f_{tab} AT 0.0X(level of significance) from statistical table;f_{cal}= X.IIII

Decision: $f_{cab} \geq f_{tab,}$ Ho is accepted; that area of practice has no significant impact on the use of EVM in project implementation. This implies that EVM can be applicable in all aspect of construction project.

Implications of the study

The implication of this study for policy makers in government and practitioners is that the use of EVM should be made compulsory on all funded construction projects. That the awareness of EVM is low proves the it has not been widespread among construction professionals and its actual practice is minimal.

It is suggested that competent value managers must be employed for EVM studies in Nigeria.

Conclusion

It can be concluded that EVM is known to construction professionals in Nigeria but they have not fully embraced it in delivery if construction projects. EVM has only been practiced on very few projects and only informal method have been practiced in Nigeria. This means that most public projects undertaken before now may have suffered with unnecessary cost with no "value for money "spent on such project.

Recommendations

Thus, the study recommends that curricula of postgraduate course in construction must include EVM and government at all levels must make compulsory the application of EVM in project execution. Also, professional bodies need to spread the awareness on the use of EVM through its seminars, workshop + conferences to their members for improving the performances of future construction projects in Nigeria.

REFERENCES

Alshibarri, A. (2008). Tracking and controlling of Earthmoving operations using spatial Technologies. Cost Engineering, Ap. 12-1111

Altken, W. (2000). Planning and Controlling Project, scitech Educational Broadstair, Kent, UK.

Anbari, F.T. (2003)Earned value Project management. Method Extension. Project management journal (11v), 11-1111

Blue, C. + Deltek, F. (2006). Earned value Readiness guide, U.S + UK www.bluecanopy.com

Boar, P. F. (2003). Risk Adjustment Valuation of R + D Projects, Research Technology Management, Industrial Research inst. Inc.

Bower, D. C. (2006). New Directions in project performance and progress Evaluation. School of construction, property and project management. Melbourne: RMIT University

Brienza, R. M. + Hiddreth, J. C. (2006). Tracking project commodities for progress control TR 0c-0m. Blacksburg, AV: Virginia Tech.

Candido, L. F. (2010). Critical Analysis on Earned value management Technique in Building construction, Oslo press U.S.A

Christensen, M. D. S. (1MM9). The costs and Benefits of the Earned value management process. Acquisiton Review Quarterly, 11C11 - 11D1.

Christensen, D. S. (1MMv). Using performance indices to Evaluatethe Estimate At Completion; South Utah University.

Demarco, A. T. (2011). Earned value Based performance Monitoring of Facility construction projects. Journal of facility management (1), 1M-90

Donitriva, M., (2001). Earned Value Project Management; A model for project performance valuation. In Ericson AB. Masterthesis, Gotebory University.

Fleming, Q.W. (2010). Earned value project management (3rdEdition), Newton square, PMI

Fleming, Q.W. + Koppelman, J. M. (1MM9). Earned value Project management. A powerful tool for software projects. Of defence software engineering: Pp 10-111

Kerzner, H. (1MM9). Project Management: A system Approach to planning scheduling and controlling (9thEdn), Hoboken, U.S. A, John Wiley + Sons

Locke, E. + Latham, N. (2011). New Development in Goal setting and Task performance. Newyork, Routledge.

Onyeador, S. O. (2002). Earned value project management; A powerful Technique for procurement/Management of project. A workshop paper, DannicsEnugu, Nigeria.

Postula, D. (2006). Skills and knowledge of cost engineering; AACE international publication, xth Edition, Pp 1-11.

Project Management institute (2002). A collide to the project management Body of knowledge (PMBOK(R)Guide; 3rd Edition.

Terrel, M. S. + Mekel, S. (1000). Evaluating project performance tools. Paper presented at 11M^th Annual project Management institute seminars and symposium, long Beach.

Thamhain, H. J. (1MMD). Integrating project management tolls with the project feam. Proceedings of the 11M^thAnnual FMI seminars and symposiums. Long Beach; PML.

Webb, A. (1000) Using Earned value: A Project Managers Guide.