Effectiveness of Monitoring Systems for Controlling Project Cost in the Construction Industry

Samuel K. Ansah [1] and Emmanuel Bamfo-Agyei [2]

Abstract

The absence of a well established effective system for monitoring and controlling project cost has caused failures to many contractors in the construction industry. Understandably, clients in construction industry have become increasingly dissatisfied. What they see is unpredictability and under-performance. What they receive is too often of late delivery and overpriced. This study therefore was carried out to establish the most effective system for monitoring and controlling project cost in the construction industry. Literature review and interview were the two main methods adopted to retrieve data for the study. The personal interview was conducted among some identified contractors within Cape Coast Metropolis of Central region in Ghana. The analysis used for the study was basically qualitative in nature. It was noted that the commonly used systems for monitoring and controlling project cost are: cost-value reconciliation, detailed spread sheet model and Earned value analysis system (EVAS). It was also indicated that the effectiveness of the monitoring systems in showing deviations of project performance varies considerably from one system to another. Some systems are more effective in indicating the need for control action than others. It was identified that EVAS gives more details indication of the overall project performance than the other systems. Although, EVAS been effective system, it usage in the Ghanaian construction industry is limited. Lack of usage of this effective system (EVAS) was attributed to the lack of technical personnel to apply it.

Keywords: Cost Control, Construction Industry, Ghana, Profit Maximization

Introduction

Effective cost monitoring and controlling has received much attention in the construction industry due to excessive cost escalation and woefully profit margin of some contractors. Government construction client panel bench-marking study carried out in 1999 in UK shows that three quarter of the 66 projects studies on the central government construction projects exceeded 50% of their contract price (BGCS, 1999). In Ghana, both public and private sector clients of the construction industry continue to complain about the industry's performance and its seeming inability to deliver projects on time, within budget and to the expected quality standards. Nicco-Annan (2006) carried out a limited survey of the construction of a few office buildings in Accra – Ghana and found that:

- Cost overruns of between 60% to 180%, not taking inflation into account;
- Time overruns of between 12-24 months
- In a few cases, the buildings are still not usable, because of some major short comings.

The size, complexity and the nature of work undertaken by construction industry can affect the generally performance of a project (Cooke and Williams 2004). It should be realized that as projects grow in size and complexity, the ability to plan, monitor and

[1]Lecturer, Department of Building Technology, Cape Coast Polytechnic, P.O Box AD 50, Cape Coast, Ghana, Tel: +233-(0) 246769673, E-mail: skansah@hotmail.co.uk.

[2]Lecturer, Department of Building Technology, Cape Coast Polytechnic, P.O Box AD 50, Cape Coast, Ghana, Tel: +233-(0) 244026432, E-mail: kwaminabamfoagyei@yahoo.com

control them is a key project management function. Like any other business, builders, contractors and developers have to plan and organise their day-to-day activities in order to manage effectively (Cooke and Williams 2004). Construction project plans are usually drawn to ensure that work is carried out to the desired quality, in the allowed time, and according to budget. Divergences from the plan however, occur and within construction project such occurrences are common (Al-Jibouri, 2003). Such divergences nevertheless are expected because of the nature of the construction work as there are uncertainties associated with it. According to pilcher (1992), not withstanding the complexity nature of the work undertaken by the construction industry, cost and time needs to be effectively monitored and controlled if anticipated profit margin will be realized for the contractor's, and project completed within budgeted cost for the client.

Cost monitoring and controlling systems involves working out a plan of campaign or cost plan for a project and ensuring that it is completed within the predetermined tender price with all things being equal while maintaining good quality product (Al-Jibouri, 2003). According to Cleland, control is the process of monitoring; evaluating and comparing planned result with actual results to determine the status of the project cost, schedule, and technical performance objectives (Cleland, 2002). He defines monitoring as a process of keeping track and to check systematically all the project activities. Different techniques such as activity based ratios, variances and Earned value analysis of cost control system have been develop; with the choices of a particular one adopted depending on many factors such as the project peculiarities, size, complexity and the likes. In spite of all the effort made to control cost, some contractor's still continue to unrealized their expected profit margin at the end of the project completion, due to the fact that many contractors' cost control systems are not continuous. Many authors are of the view that cost control from contractor's perceptive to be effective, the systems should be continuous from the conception stage up to completion stage of the contract; this will ensure that the various operations involved are executed and monitored to prevent unnecessary cost overrun due to irrelevant factors.

The traditional method of project cost monitoring is base on simple parameters using two data sources that is the budget (or planned) spending and the actual spending. The comparison of budget versus actual spending merely tells what was actually spent at any given time. Besides, it does not relate to any current performance trend to forecast future performance. Therefore, because of these limitations, was the introduction of Earned Value Analysis System (EVAS). EVAS gives more details indication of the overall project performance than the other systems. It proves the earn value of completed work and compares it with actual cost and planned cost to determine the project performance and forecast its future trends (Jung and Woo, 2004).

Aim and Objectives of the Study

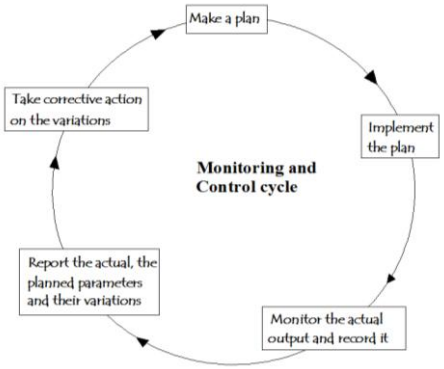
This paper aims to investigate the effectiveness of commonly used monitoring and controlling systems in the construction industry. The specific objectives of this paper are:

- To identify project monitoring systems for controlling cost in the construction industry,
- To determine whether the implemented system have the ability to indicate on-going cost status of each work item.
- To assess monitoring systems characteristics and their effectiveness for assessing performance of projects,

Literature Review

Project Cost Monitoring and Controlling

As project grows in size and complexity, the ability to plan, monitor and control them has become a key project management function. Like any other business, builders, contractors and developers have to plan and organise their day-to-day activities in order to manage effectively. Monitoring and controlling are universal activities indispensable to effective and efficient operation of the control cycle. According to Al-jibouri (2003), within construction, divergences from the original plan will occur; therefore project should have a control cycle as follows with the aim of completing project within acceptable time and budget:



Figuere 1: Control circle

1. Make a plan
2. Implement the plan
3. Monitor the actual output and record it.
4. Report the actual, the planned parameters and their variations.
5. Take corrective action on the variation

During the execution of a project, procedures for project control and record keeping become indispensable tools to managers and other participants in the construction process. These tools service the dual purpose of recording the financial transactions that occur as well as giving managers an indication of the progress and problems associated with a project. The task of project monitoring and control is to give a fair indication of the existence and the extent of problems associated with a project. For monitoring and controlling purposes, the original detailed cost estimate is typically converted to a project budget, and the project budget is used subsequently as a guide for management. Expenses incurred during the course of project are recorded in specific job cost accounts to be compared with original cost estimates in each category. Thus, individual job cost accounts generally represent the basic unit for cost control.

Most of the project budget is consumed during the construction process. Therefore, it is the prime responsibility of the project manager to control the costs associated with the work packages. A project cost can be usually classified into direct, indirect and overhead costs. During the budgeting process, all these costs are sum up to develop a cost baseline. A cost baseline is defined as cumulative time-phased budget that will be used to measure and monitor the current and future project cost performance (PMI PMBOK, 2004). It is graphically represented in the form of S-curve and it is an important cost monitoring tool. It allows the user to see the project cash flows over the period of time and make it possible to forecast the trends of future spending. S-curve defines the amount of construction

spending according to the budget allocation (Neale and Neale, 1989). It is convenient tool for cost management. It can produce different cost scenarios that will make possible for the manager to envisage the cost trends (Kern and Formoso, 2004). Figure 1 shows an example of typical S-curve that is based on accumulative values of cost estimates.

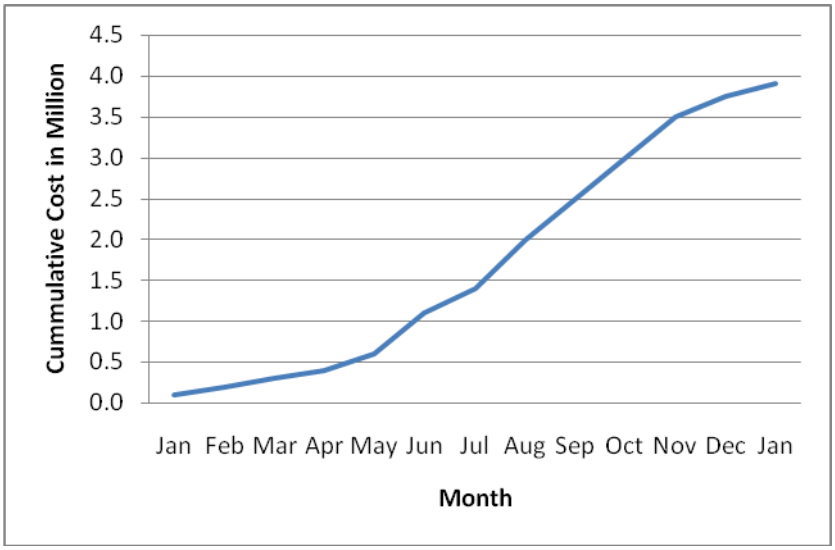


Figure 1: An Example of Initial Project S-curve

In these customary approaches, usually separate and direct monitoring is used for time and cost analysis. Kenley (2003) described the direct monitoring techniques for time and cost management in construction projects. In direct monitoring, there is split up between the time and cost performance indicators. Both of them are measured and reported in isolation with each other by comparing their planned and actual values at stipulated time frames. The direct monitoring does not point out anything about what has actually been produced at the rate, or according to the schedule, originally planned. In other words, it does not relate the time versus cost performance of the project (Kenley, 2003).

An effective project performance control cannot be achieved only by monitoring the actual physical progress with the planned progress and actual spending with the budgeted values (Ahuja et al, 1994). This approach may be deceptive as it does not take in consideration the worth of the work which is completed during a particular period. The cost performance graph as shown in Figure 2 suggests the actual cost against budge. It does not point out any information that how much has been produced against the spent money. This aspect may limit the scope of traditional cost monitoring as it does not address the complete depiction of project current and as well as future progress trends in a true manner. Therefore, because of these limitations, was the introduction of Earned Value Analysis System (EVAS). EVAS gives more details indication of the overall project performance than the other systems. The traditional approach of project performance measurement usually separates the time and cost parameters during the progress reporting. Nevertheless, EVAS integrates time and cost functions and allows the project manager to see a clear insight of project performance with an open eye. It proves the earn value of completed work and compares it with actual cost and planned cost to determine the project performance and forecast its future trends.

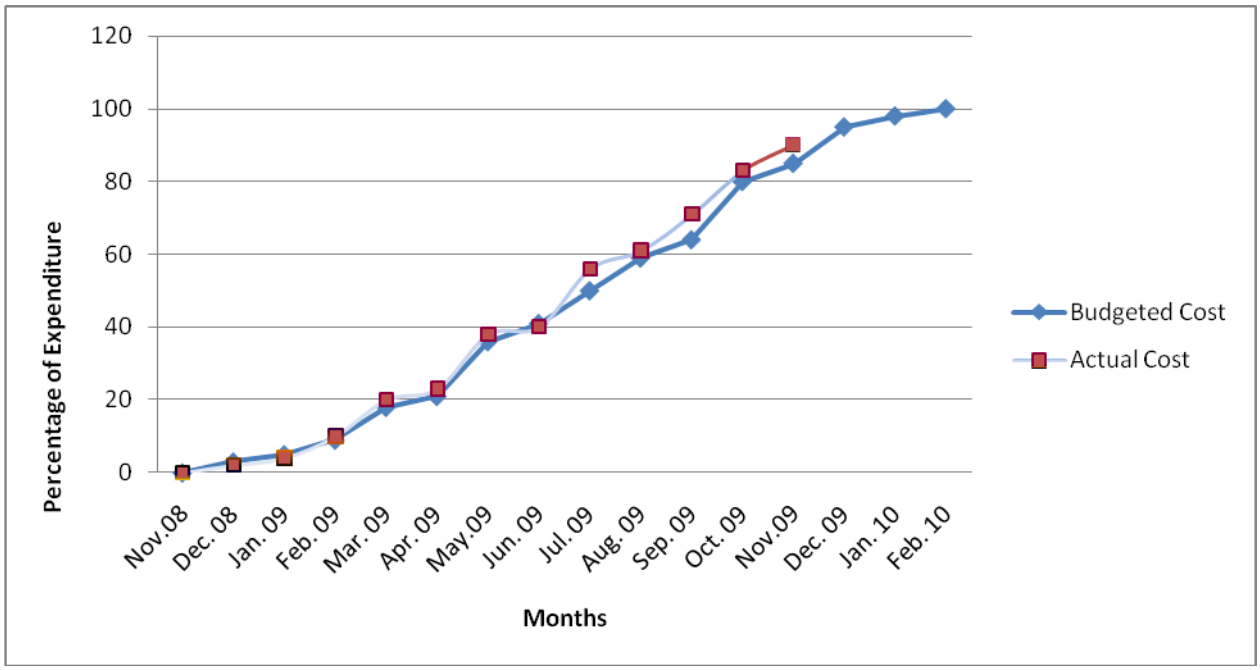


Figure 2: An Illustration of Budgeted vs. Actual Costs

Purpose of Project Cost Monitoring and Controlling

The purpose of project cost monitoring and controlling is to allow the project to be completed within the approved budget. According to Oxley & Poskitt, (1996; pp 164), the primary aim of contractor's cost control system is to:

- Ensure that expected profit is obtained to enable the contractor continue to stay in business and expand.
- Ensure that project is carried out within the approved budget to maintain the planned profit margin
- Arrive at the cost of each operation as planned and carry out a continuous comparison with the target to ascertain the project performance
- Provide cost information to assist in future estimating work.

Project Cost Monitoring and Controlling Systems In Used

Activity Based Ratios

Al-Jibouri (2003) described activity based ratio as financial control technique that employs the ratios between the earnings and expenditures of the activities as measures of performance. The system can also be used to measure the performance of the whole project as well as that of the activities. The three ratios the system relies on for the calculation of performances are:

$$\text{Planned performance} = \frac{\text{Planned Earning}}{\text{Planned Expenditure}}$$

$$\text{Actual Performance} = \frac{\text{Actual Earning}}{\text{Actual Expenditure}}$$

$$\text{Efficiency} = \frac{\text{Actual Performance}}{\text{Planned Performance}}$$

These ratios can be calculated at any time and over any duration for which a plan is available. Both planned and actual work must be evaluated using the same rates for earning and the same rates for expenditure. If the earning rates come from the original estimates, the performance measures calculated above give an evaluation of the performance against the estimate and the efficiency gives a measure of the project performance against the plan. All values should, in theory, be in unity although it is sensible to plan slightly optimistically; it is perhaps advisable to aim for 1.05 for planned performance and efficiency.

The measures used by this technique are both simple to calculate and simple to interpret. They require relatively little data and can be applied at a range of level on a project. They can, for example be prepared for a whole project or a section of it can therefore be used in measuring contributions of individual subcontractors to a project. Based on the above, it can be concluded that the measures used in this method are excellent communication tools and particularly useful for short-term applications. The forecasts made are based solely on the plan and are not statistically reliable.

Variances

In this context, variance is differences between two values (Lockyer and Gordon, 1996). In project measurement and control there are usually differences between two expenditures – the planned and actual, although the incomes or any other values could be used.

The use of variances to measure project performance is perhaps one of the oldest and most commonly used techniques. By considering the current and final state of the actual and the plan, it is possible to build a quite detailed picture of the project. Indeed, because it is possible to produce these figures for the project or for any section of the project, they are commonly used to assess the whole of a project, sections of it or, for example the performance of single subcontractors. Basically by plotting various expenditure curves such as those for the first project budget; the last estimated total cost; latest estimated expenditure; and budget value of work done, two main types of variances, which may indicate an increase in the cost of the project compared with its budgeted expenditure. They do not however identify the causes of this increase.

It is possible to break these two main variances down into more detailed sub-divisions in order to assist in recognising the reasons for the changes in cost. For example the ‘Total Cost Review Variance’ can be broken down into the current ‘Current Budget” and ‘Future Budget’ variances. A current budget variances, for example, means that the incurred cost of work done to date is greater that the planned expenditure. It does not show however, whether the project is behind schedule of if overspending has occurred. Further sub-dividing this variance into two more components as follows can see this:

Performance Variance = Budget value of work done - budget expenditure to date.

Efficiency Variance = Incurred Cost - budget value of work done

The ‘performance variance’ indicates that progress of the project is ahead of schedule if it positive or behind schedule if it negative. The ‘efficiency variance’ on the other hand indicates over-spending if it negative.

An extension of the idea of the method of variances is the earned Value Analysis technique. This technique is relatively popular. However, it requires rather more data and effort to calculate than the other system described so far.

Earned Value Analysis

Earned Value Analysis (EVA) is a project control technique which integrates cost, schedule and technical performance. It proves the earn value of completed work and compares it with actual cost and planned cost to determine the project performance and forecast its future trends. EVA is also described as an integrated, indirect or remote monitoring technique for the complex interaction of time and cost parameters to provide the performance measurement of a whole project (Kenley, 2003). It is an effective and useful project tool that helps the client and as well as contractor to assess the project performance. As discussed in the previous section, the traditional approach of project performance measurement usually separates the time and cost parameters during the progress reporting. Nevertheless, EVA integrates time and cost functions and allows the project manager to see a clear insight of project performance with an open eye.

The concept of Earned Value was evolved in 1967 by US Department of Defence and subsequently developed as a 35 criterion-based approach which is the then call Cost/Schedule Control Systems Criteria (C/SCSC). Initially, it was considered that C/SCSC is a financial control tool which confined its use in project and programme management. However, in 1989, Undersecretary of US Department for Acquisition adopted this criterion for programme management and procurement. In 1996, it was revised by the US industry and renamed it as Earned Value Analysis (EVA). Since then, it has been used as a widely accepted tool by many US government agencies like United States Department of Energy, NASA and US Defence Acquisition Department etc. Beside United States, EVA has also attracted many other governments and public department including industrial sectors like engineering, construction, oil and gas, infrastructure, information technology etc.

In the construction industry, EVA is being used as a time and cost control tool. It has an ability to bring together planning and management functions. During the last decade, many developed countries have imposed EVA technique in their public and private funded construction projects and achieved remarkable improvements in their practices. South Korean Congress in July 2000 passed a bill named 'The Effective Plan of the Public Construction Industry Bill' which mandated the construction firms to adopt Earned Value Analysis System (EVAS) in their project having worth more than USD50 million (Kwon et al, 2008).

EVA is a three-dimensional approach and is based on the following data sources:

- Planned Value (PV) describes portion of the project budget planned to be spent at any given point in time.
- Earned Value (EV) is a description of work progress at a given point in time and reflects the amount of work that has actually been accomplished at any particular time frame.
- Actual Cost (AC) is the amount of spending that is utilized for the completion of the package activity.

EVA takes these three data sources and is able to compare the budgeted value of work schedule (PV) with the Earned Value (EV) of physical work completed and the Actual Value (AV) of work completed. So, performance data achieved by using EVA is an objective measure of actual work performed. Figure 3 shows a graphical example of EVA approach.

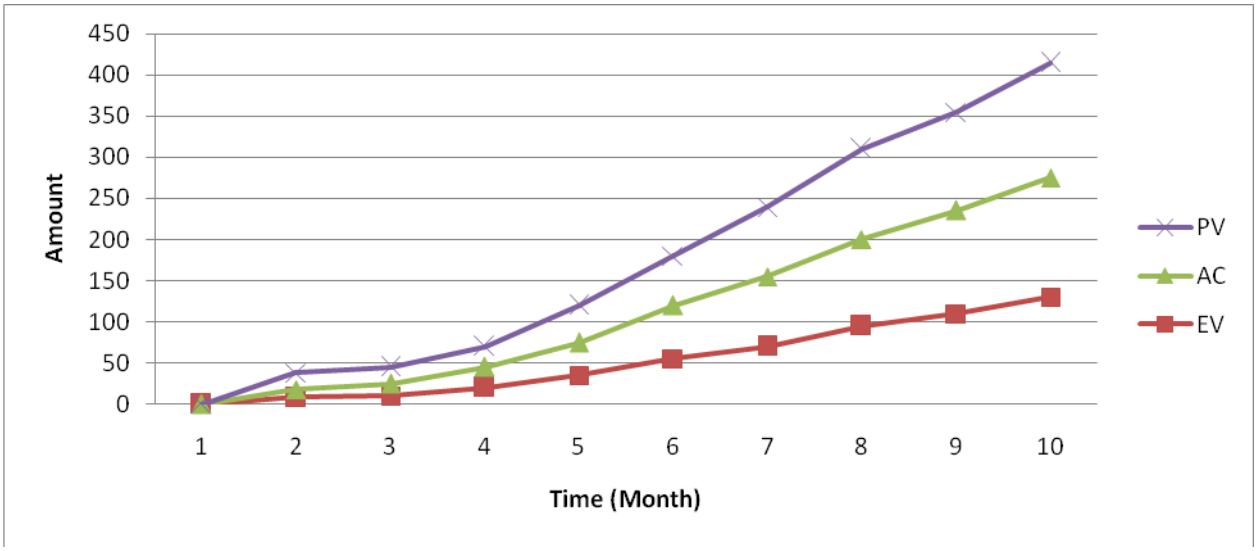


Figure 3: An Illustration of EV, PV and AC

After the terms PV, EV and AC are defined; the assessment of current and future cost performance can be done which will provide important information on the project progress.

Cost Analysis and forecasting

Project cost analysis and forecasting is an important concern of management and it needs for the wise evaluation of project performance. PMI PMBOK provides a list of Earned Value cost performance variance and indicators (Neale and Neale, 1989). Some of the key parameters are discussed below:

- Cost Variance (CV): It is the difference between the worth of the work that has been carried out and to the amount of money that was spent to do it. Mathematically, it is represented as:

  $$CV = EV - AC \quad (1)$$

  A positive value of CV shows that project is spending less than the planned budget whereas the negative value shows that actual cost is exceeded than the budgeted amount. Whenever the later condition happens, it signals an unfavourable scenario to the management and needs necessary corrective measures to control the negative variance within the approved limits.
- Cost Performance Index (CPI): It indicates the efficiency of resource use and measures the worth of the work that is achieved by spending every single unit cedi. Mathematically it is expressed as:

  $$CPI = EV/AC \quad (2)$$

A ratio less than 1.0 is an unfavourable and suggests the value of the work that has been accomplished is less than the amount of money spent. Similarly, conversely is the case for CPI ratio greater than 1.0.

Cost Estimate at Completion (EAC_c): It is a forecasting indicator and calculates the finishing cost of the project by assuming the current cost performance efficiency. It is calculated as:

$$EAC_c = BAC/CPI \quad (3)$$

Where BAC = Budget at Completion

Estimate to Complete (ETC): It indicates the estimated remaining worth of the project work. It is calculated as: $ETC = (BAC - EV)/CPI$ (4)

Anticipated Benefits of EVAS Implementation

Successful implementation of the Earned Value Analysis System can result in:

- **Better Visibility into Programmed Performance**
  The combination of advance planning, baseline maintenance, and earned value analysis yields earlier and better visibility into programmed performance than is provided by non-integrated methods of planning and control.
- **Reduced Cycle Time to Deliver a Product**
  Earned value management is premised on careful detail planning – task decomposition, scheduling, and budgeting. This planning often addresses/prevents problems from surfacing later in the effort that result in rework. Thus, as rework is prevented cycle time may, in fact, be reduced.
- **Fosters Accountability**
  When the developer, at the personal level, understands how their pieces fit into the overall project effort they are better able to estimate the work required to complete a task, thereby improving the overall accuracy of the budget/estimating process for future efforts.
- **Reduced Risk**
  Because earned value measures enable realistic estimates of completion (for both cost and schedule) to be derived early in the project, it is possible to make adjustments and take corrective action to mitigate the risk of cost overruns and schedule slippage.

Research Method

To solidify a specific set of objectives, literature review and personal interview were used to investigate exiting project cost monitoring and controlling systems in the construction industry. Literature review which is secondary source of data, involved the use of information from conference proceedings, books, periodicals, journals, and internet, about issues raised on cost monitoring and controlling systems discussed in the text. The personal interview was conducted among some identified contractors within Cape Coast Metropolis of Central region in Ghana. In all, fifteen (15) contractors were conveniently selected from these identified contractors for the interview. The co-operated contractors firms were small to large size, which meant that the interview was not confined to one size of organization. The analysis used for the study was basically qualitative in nature.

Discussion

Fore going section introduced several monitoring techniques and their use for project cost control on theoretical basis. It was noted that different systems are suitable for different situations. 'Activity based ratios' techniques for example is more suitable for short-term applications than the 'variance method'. The results of comparisons have also shown that some techniques are simpler and clearer to interpret than others. Depending on the systems to be used, the amount of information required by the system and consequently its use as a communication tool has to be considered.

It was concluded by Al-Jibouri (2003), on the basis of the experiments carried out, that the effectiveness of the monitoring systems in showing deviations of project performance varies considerably from one system to another. Some systems are more effective in indicating the need for control action than others. It has been found that the 'activity based ratio' technique gives a simpler and a clearer indication of the overall progress of the work than 'variances' techniques.

Integrated cost and schedule has evolved as a primary technique for advanced and systemised project management. The earned value analysis system (EVAS), formerly

known as C/SCSC, is one of the best practices for integrated cost and schedule control. Recently, the adoption of EVAS has been gaining popularity and several national and international standards bodies have started developing EVAS standards (Jung and Woo, 2004). Abba (1997) also stated that, governments of other countries and companies across the world have accepted earned value as an effective project management tool. Interview conducted by the researchers indicated that this promising technique/system (EVAS) has not been fully applied as monitoring and controlling system in the Ghanaian construction industry. According to some respondents, they normally used Cost-Value Reconciliation (CVR) approach to monitor their project cost. Other respondents also indicated that they use detailed Spread Sheet Model (standard for all projects), which analysis cost/value budget in all primary element of tender. Fellows et al point out that site personnel for controlling cost usually use standard costs and variance analysis control systems. But management team mostly adopts cost/value reconciliation as a form of budgetary control due to the unforeseen nature of the industry we find ourselves (Fellows et al, 2002).

According to Association for project management, UK, for any cost monitoring and controlling system to be effective, the system should be able to draw the project management's attention to problem areas. The details and reality in which any particular system can do this may be considered as a measure of its effectiveness. Jung and Woo (2004), stated that 'EVAS' provides an effective tool for monitoring the construction process because it integrated cost and schedule control and has the ability to indicate on-going cost status of each work item.

Conclusion

This research has identified several monitoring systems, their use and their effectiveness for project cost control in the construction industries. It was also identified in the research study that several systems were used in the construction industry for monitoring and controlling project cost. Example of commonly used monitoring system for controlling cost of project in the construction industries are: Activity based ratios, Variances, Earned Value Analysis, Cost–value Reconciliation approach, and Detail spread sheet Model.

Analysis and comparisons on these systems have indicated that different systems are suitable for different situations. 'Activity based ratios' techniques for example are more suitable for short-term applications than the 'Variance' method. Comparisons have also shown that some systems are simpler and clearer to interpret than others.

It can be concluded, on the basis of analysis that the effectiveness of the monitoring systems in showing deviations of project performance varies considerably from one system to another. Some systems are more effective in indicating the need for control action than others. It was indicated that 'Earned Value Analysis System 'gives a more detail indication of the overall progress of the work than the other systems. In principle EVAS compares the amount of work planned and its budget against the amount of work actually carried out, its budget and its actual cost. The measurement of this data can be used to show the current status of a project in terms of cost and time measured against the baseline plan and also to forecast the overturn positions.

Successful implementation of Earned Value analysis principle can result in: Better visibility into programme performance, fostering accountability, reducing cycle time to deliver a product and reducing risk.

Earned Value Analysis (EVA) is a proactive way of managing and controlling projects and is used extensively in a range of industries and is increasingly being used as a project management tool in construction. The Earned Value Analysis System (EVAS), formerly known as C/SCSC, is one of the best practices for integrated cost and time control. Recently, the adoption of EVAS has been gaining popularity and several national and

international standards bodies have started developing EVAS standards. But it was found from the interviewers that this promising technique (EVAS) has not been applied in the Ghanaian construction industry.

Recommendation

Many developed countries have imposed Earned Value Analysis System (EVAS) in their public and private funded construction projects and have achieved remarkable improvements in their practices because of the effectiveness of the system. South Korean Congress in July 2000 passed a bill named 'The Effective Plan of the Public Construction Industry Bill' which mandated the construction firms to adopt EVAS in their project having worth more than USD50 million. This spaper therefore recommends that construction industry practitioners in Ghana who handle large construction projects should use this effective monitoring technique to monitor and control their Project cost to achieve effective project performance.

References

Abba, Wayne. October 1995. "Earned Value Management Rediscovered!" World Web Home Page for Earned Value Management,

Ahuja, H. N., Dozzi, S. P and Abourizk, S. M. (1994) " Plan Implementation, Monitoring and Control in Project Management Techniques in Planning and Controlling Construction projects, vol. II, New York: Wiley, pp 274-277

Al-jibouri, S. H. (2003): Monitoring Systems and their Effectiveness for Project Cost Control in Constructions. International Journal of Project Management 21: 145-154

Benchmarking the Government Client Stage, (1999); 2 Study.

Charoenngam, C. and Sriprasert, E. (2001): Assessment of Cost Control Systems: A Case Study of Thai Construction Organisations. Engineering, Construction and Architectural Management, 8/5/6, 368-380

Cleland D.I and Ireland R.L. (October 2002): 4th Edition: Project Management (Strategic Design and Implementation). London, McGraw-Hill, Inc.

Cooke, B and Williams P. (2004): Construction Planning, Programming and Control. Blackwell Publishing Ltd.

Fellows, R. S., Langford, D., Newcombe, R and Urry, S. (2002); 2nd Edition: Construction Management in Practice. Oxford, Blackwell Science.
Http://www.acq.osd:80/pm/newpolicy/misc/abba art.html.

Jung, Y and Woo, S. (2004). Flexible Work Breakdown Structure for Integrated Cost and Schedule control. Journal of Construction Engineering and Management, ASCE/ September/October, 616-625

Kenley, R. (2003) "Management through Earned Value", in financing construction, London and New York: spon Press, , pp 105-135

Kern, P.A and Formoso, T.C. (2004) "Guidelines for improving cost management in fast, complex and uncertain construction projects", Proc. of 12th Annual Conference on Lean Construction, Denmark

Kwon, O., Kim, S., Paek, J., and Eom, S., (2008) "Application of Earned Value in Korean Construction Industry – A Case Study, "Journal of Asian Architecture and Building Engineering vol. 7, pp. 69-76

Locker, K. G and Gordon, J. H. (1996) Project Management and project Network Techniques, 6th Edition. London: Pitman Publishing

Nicco – Annan, J. (2006) Partnering in Construction. The Quantity Surveyor. Official Magazine of Quantity Surveying Division of the Ghana Institute of Surveyors. Issue I., pp 14 – 19.

Neale, H and Neale, D. (1989) “Construction Planning”, London: Thomas Telford, pp.160
Oxley, R. and Poskitt, J. (1996) 5th Edition: Management Techniques Applied to Construction Industry. Oxford, Blackwell Science.
Pilcher, R. (1994): 2nd Edition: Project Cost Control in Construction. Oxford Blackwell Science
PMI Project Management Body of Knowledge, (2004) 3rd Edition,