

POTENTIAL OF APPLYING EARNED VALUE MANAGEMENT (EVM) AS A PERFORMANCE EVALUATION TECHNIQUE IN BUILDING CONSTRUCTION PROJECTS IN SRI LANKA

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ABSTRACT

Construction industry has some unique characteristics that brings specific challenges in achieving required performance. Currently majority of construction companies evaluate the project performance by program review method, which can identify the performance after the activity accomplishment or action is accomplished. The project should have begun to use the existing performance technique. Earned Value Management (EVM) is a more robust, internationally recognized and adhering process to evaluate the project performance. EVM considers the performance in Time, Cost and Quality aspects. EVM compares the project Planned Value (PV), Earned Value (EV) and Actual Cost (AC). Current knowledge showed no evidence of EVM in Sri Lankan construction projects. This research was conducted to identify the potential of applying Earned Value Management (EVM) as a Performance Evaluation Technique in Building Construction Project in Sri Lanka. The research followed a qualitative approach. The researcher could be able to identify the facilitators, barriers and the challenges of applying EVM in current context. Semi-structured interviews were conducted to investigate status and key challenges for the implementation. After analysing the data, the researcher could conclude major barriers and challenges on implementing EVM as a performance evaluation technique for Sri Lanka construction industry. Its consumption of considerable extra cost, need to train staff, reluctance of some qualified employees to adhere to the technique due to various constraints could be identify as common bottlenecks.

Keywords: Barriers; Earned Value Management (EVM); Facilitators; Sri Lanka.

1. INTRODUCTION

The organizational value of carrying out project management is a vital theme involving much of the field's existing research and debate (Thomas and Mullaly, 2005). According to the viewpoint of Project Management Institute, EVM is one of most effective performance measurement tool and a feedback tool for managing the projects (Khan et al., 2010). The tool facilitates to close the loop in the plan-do-check-act management cycle in an effectual manner. EVM is known to be "Management with lights on" since it could aid straightly in an objective manner to identify the status of project and its progress compared to the planned (Anon., 2005). Evaluating the performance of a project alongside the lifespan of it is an approach to provide early cautioning indications which can be used as triggers for remedial arrangements in case the project is in jeopardy (Vanhoucke, 2011). In the past period various project-planning methods such as Gantt chart, Programme Evaluation and Review Technique (PERT) and Critical Path Method (CPM) have been developed (Anon., 2012). The Earned Value Project Management is a powerful tool that support the management to measure performance of the project and progress in objective manner. This tool can measure the performance and progress by using basic triple constraints such as project scope, time and cost (Anon, 2014). EVM considers the completed work amount, the time utilized to complete them and the costs sustained to accomplish the specified work and it aids to assess and regulate project risk by quantifying the project advancement in financial

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terms (Vandevoorde and Vanhoucke, 2006). Numerous studies have been led relating to EVM by Fleming and Koppelman (2010) relating to the applicability of EVM and as a performance evaluation method with related to construction field. Relating to Sri Lankan context, a study has been conducted Hettipathirana and Karunasena (2014) about EVM as a performance measurement technique and its practice in Sri Lankan construction industry comparing with the traditional method of construction. However, its' potential on Sri Lankan construction industry to implement EVM considering enablers and barriers is discussed in this study.

2. RESEARCH METHODOLOGY

In order to identify the potential of applying Earned Value Management (EVM) as a performance evaluation technique in building construction project in Sri Lanka, a qualitative approach was applied. Thus to proceed with the qualitative approach, a sample of six number of expertise were selected from contracting and consulting organizations among the professionals such as Planning Engineers and Quantity Surveyors. In depth, interviews were conducted to examine the status of the facilitators and barriers to apply EVMS in Sri Lankan construction Industry. This mainly focused to find whether EVM is using within Sri Lankan context and to identify major requirement and challenges to implement this technique in Sri Lankan construction industry. Collected data was qualitatively analysed and interpreted under identified themes categorized as facilitators or barrires of EVM to arrive at conclusions. Table 1 represents the respondent profile of the conducted interviews.

Table 1: Respondent Profile

Organization	Respondent	Type of Organization	Designation	Years of experience
01	R1	Consulting	Planning Engineer	Less Than 5 Year
01	R2	Consulting	Quantity Surveyor	5 – 10 Years
03	R3	Contracting	Planning Engineer	5 – 10 Years
04	R4	Contracting	Quantity Surveyor	5 – 10 Years
05	R5	Contracting	Planning Engineer	Less Than 5 Year
06	R6	Consulting	Planning Engineer	5 – 10 Years

3. EARNED VALUE MANAGEMENT AS A TECHNIQUE

The PMI delivers a historical outlook on the advancement of EVM technique departing from the primary efforts with PERT/COST method. Major advances are the integration of planning, control and delineation of project scopes into a single tool (Anon., 2014). The Earned Value method has been developed as a tool which aiding control of the project progress. It has been used to determine the status of the project and the measure of current variances from the plan (Czarnigowska, 2008). This tool could measure the performance and progress by using basic triple constraints such as scope of the project, time and cost. It allows the calculation of cost and schedule variances and performance indices and predicts the project cost and schedule at completion (Andari, 2003). With respect to Anon (2012) EVM concept is a comprehensive management approach that once integrated on any kind of program, even if in research and development, construction or production offers all levels of management with a prior view into cost and schedule problems. Thus EVM is currently used on programs worldwide. According to Usmani (2012) three major elements of EVM are identified as Planned Value (VE), Earned value (EV) and Actual Cost (AC) and their terms explanations were identified as follows (Fleming and Koppelman, 2010).

- Planned Value: Entails of the certified work, alongside with the approved budget, within the approved time duration, which completely formulates the project baseline.
- Earned Value: Includes the approved work that has been finished, along with the original budget for the work.
- Actual Costs: Contains the actual costs sustained to transform the Planned Value into the Earned Value.

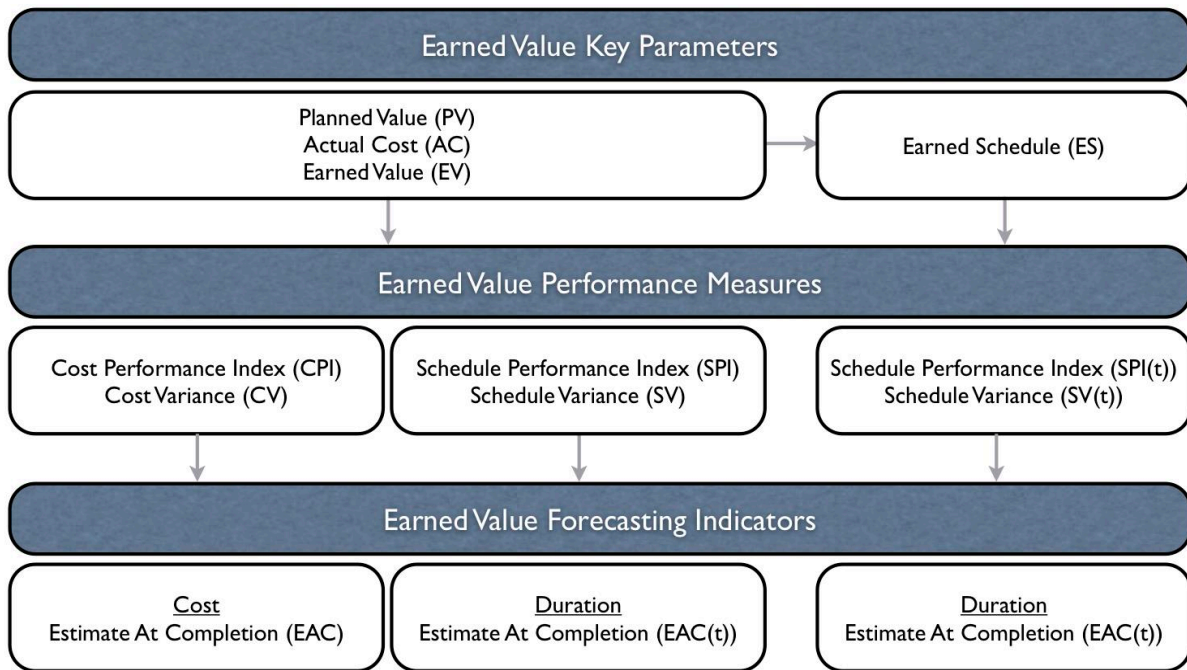


Figure 1: Three Main Components of EVM

Source: (Vanhoucke, 2011)

Project managers may adopt a value-engineering program for cost saving whichever by decreasing scope and quality in certain divisions of a project or offer supplementary budget to conceal the overrun cost. Correspondingly, in a situation of time overrun, they might plot some program such as fast-tracking or time crashing to suite situation through the reduction of time. Thus, the role of EVM as well as precise and on time predicting is extremely significant to attain project goals. Following Figure 2 will give clear identification about this technique and advantages of practicing this. Appraisal of those figures could aid to detect exact work packages in which performance and advancement are insufficient or advanced, which will optimistically lead to counteractive action by the project manager and team. Cost and schedule performance should be evaluated and analysed as viable with consistency and intensity consistent with project management need including the magnitude of performance risk.

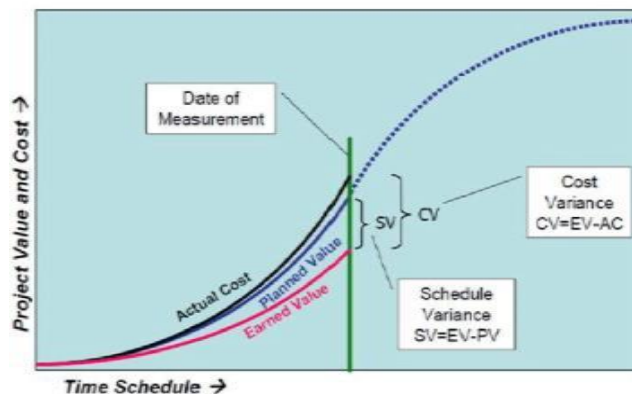


Figure 2: Standard Earn Value Analysis Graph

Time and Cost constraints could be interpreted by the key parameters indicators. By using parameters evaluation of the performance could be done through the performance calculation formulas. Mainly using Planned Value (PV), Actual Value (AC), Earned Value (EV) and Earned Schedule (ES), which results in the following performance measures (Anon, 2017).

3.1. TIME PERFORMANCE

The Schedule Performance Index (abbreviated as SPI or SPI (t) dependent on whether EV or ES is used) is a measure to explicit the current time performance of the project, presenting whether the project is progressing beyond the schedule (>100%), on time (=100%) or late (<100%).

3.2. COST PERFORMANCE

The Cost Performance Index (abbreviated as CPI) is a measure to convey the present time performance of the project, showing whether the project cost is below budget (>100%), on budget (=100%) or above budget (<100%) (Vanhoucke, 2011).

3.3. FORECASTING MEASURES

The project time and cost performance measures are expected to be an illustrative indication for impending project performance, and thus it could be utilized to predict the ultimate project duration and cost.

- **Time forecasting:** The Expected at Completion - Time (abbreviated as EAC (t)) is a prediction of the final project duration at the status date, given the current project performance. Clearly, this prediction might vary from the baseline Planned Duration (PD).
- **Cost forecasting:** The Expected at Completion - Cost (abbreviated as EAC) is a prediction of the entire cost of the project at the status date, given the current project performance. Perceptibly, this prediction might be diverse from the original budget or Budget at Completion (BAC).

Project performance measures can be reevaluated as of below. When the project CV=0 & CPI=1 and SV=0 & SPI=1 the project is executing expected schedule as well as expected budget. The performance measures with respect to cost and schedule components are illustrated in Figure 3 as follows.

PERFORMANCE MEASURES		SCHEDULE		
		SV > 0 & SPI > 1	SV = 0 & SPI = 1	SV < 0 & SPI < 1
COST	CV > 0 & CPI > 1	Ahead of Schedule Under Budget	On Schedule Under Budget	Behind Schedule Under Budget
	CV = 0 & CPI = 1	Ahead of Schedule Under Budget	On Schedule On Budget	Behind Schedule On Budget
	CV < 0 & CPI < 1	Ahead of Schedule Over Budget	On Schedule Over Budget	Behind Schedule Over Budget

Figure 3: Performance Measurement Interpretation of EVM

Source: (Prashanth and Raja, 2014)

4. FACILITATORS OF EMV

EVM supports to project managers and team members to gain early cautionary indications that let them take well-timed actions. It will helpful for project success. EVM can be utilized for progress payments to contractors based on the EV of contracted or outsourced work. Thus, the identified enablers within the current context of Sri Lankan industry is illustrated in the following Table 2.

Table 2: Enablers to Implement EVM in Construction Projects

Enablers to implement EVM in construction projects	
Enable to utilize as a Progress Evaluation Technique	Although several progress measurement techniques are currently available in the construction industry no proper method is utilized to measure progress accurately which enable to use EVM as an effective method to measure progress successfully.
EVM offers early signal	For the evaluation of the progress in a project, it is required to attain prior notification for project managers. Thus, if it is not available in the current practices, EVM can be introduced to gain an early signal for upcoming events.

Enablers to implement EVM in construction projects	
Early Planning is required to utilize this technique	Planning is included in the prior stage of the project and if there is a lack of proper planning in the execution of the project then progress evaluation could not be adopted suddenly. Hence, projects must consist of decent early planning where EVM can be executed to measure progress.
Ability to execute in a project with a good collaborative teamwork	A competent teamwork is required to run a project successfully where objectives will be achieved on time. Through the cooperative team, EVM could be implemented within the project to attain the required progress.
Should consist of Reliable Data	With the availability of the reliable data it is easy to apply EVM for the evaluation of performance.
Enable to utilize as a cost management tool	EVM could deduce early alerts on cost overruns which are financially advantageous to the project enabling EVM to use as a cost management tool.
Less documentary utilization	Most of the organizations utilize documentation irrespective of their necessity. Hence the use of EVM software enable the reduction of documentation.
Enable in the intensification Employees skills	With the application of EVM software employees could improve on certain skills.
The demand of the company would be increased	New implementation of EVM within an organization would add extra value for the company while increasing the demand of the organization.
Helps to build an effective communication in between employees	Effective communication build a good interrelationship in between employees thus a new technique like EVM would increase the strength of the bond through employees.
Relate the current status of the project	With EVM project managers could identify project status very early which could be a positive factor against to barriers.
Ability to use as a good management tool	EVM help to manage those parameters of the projects on the aspects of time, cost and quality.

5. BARRIERS AFFECTING TO THE EVMS

Sri Lankan construction industry required a well-known and established performance monitoring technique for the development of the industry and for its better performance. Consequently, it is vital to investigate the applicability of introducing EVM as an effective performance indicator for the construction industry. However, currently, SriLankan Project Managers are exercising several types of tools to measure their performance. Nevertheless, it could be identified that the knowledge on the usability of the technique and outcome to be achieved and its reliability is lack among the management due to their poor knowledge on the awareness of the EMV. Thus, with the analysis as represented by Table 3, the identified barriers and their current status could be represented in a comprehensive manner.

Table 3: Barriers Identified within Sri Lankan Construction Industry for the Implementation of EVM

Barriers	Status
EVM perform	EVM covers a large area and with the limited within Sri Lankan projects, employees do not interest in doing additional work.
The struggle of Employees	Lacks a rigid bondage between employees and management results in the lack of adherence of EVM in their projects.
Cost factor	Most of the project managers are not risk taking with a new technology with the note of high cost involved in the implementation of EVMS in a project.
A Longtime period for the execution and implementation of the EVM	Due to the lack of expertise in the industry more time is required in acquiring required knowledge and skills in the EVM software.
Accuracy of data	Lack of reliable data in the construction industry in a major hindrance which required regular monitoring to acquire them for the productive implementation of EVM.

Barriers	Status
Lack of awareness on EVM	Most of the employees not compatible with EVMS due to their lack of awareness which results in the construction projects to use them.
Fear for language	Lack of knowledge on the English language act as a hindrance for the employees to embrace and utilize EVM in Sri Lankan context.
Minimum support from the top management	Some managers do not like to share their knowledge with the middle, lower level employees. It may be the cause for newly implementation.
Technical issues	Since Sri Lanka is lack of technical facilities required IT physical and human resources should be available for a project to implement EVMS.
Demotivation of the employees	Motivation and encouragement of the employees are required within the employees for the implementation of EVMS, however within Sri Lankan context demotivation appeared to be a considerable barrier for the EVM implementation.

Thus, for the efficacious application of EVM as a performance evaluation, discussed facilitators and barriers should be minimized. Hence the several actions could be implemented to enhance the possibility to adopt EMV within Sri Lankan context while utilizing the top management supports effectively. The introduction of training programmes about EVM would surpass the lack of awareness about the EVM among the employees while enabling more expansion towards its development. Additionally, though the improvement of skills in the information technology this could be further enhanced as it motivates the employees for its adaptation. Effective communication between parties could introduce an organization friendly environment where the whole organization would move on to adherence to EMV without any hindrances. Introduction of a support team would enable an organization to upsurge with additional aid during the implementation stage of EVM.

6. IMPLICATIONS OF THE STUDY TO INDUSTRY AND KNOWLEDGE

The potential of applying EVM to the construction industry is high once the barriers to the implementation are mitigated. The enablers of the EVM emphasis on the benefits of it to the construction industry as a performance indicator and hence, it would be favourable for them to utilize it as a management tool. Consequently, the construction and contracting organization would be benefited in the utilizing of EMV with the required technical knowledge and capital investments. Thus, required training sessions with knowledgeable professionals would aid to increase the knowledge of the employees. Additionally, EVM is identified to be a cost management tool which would enhance the resource management of a construction project.

7. CONCLUSIONS AND RECOMMENDATIONS

Through the extensive analysis conducted during the research, it was identified that there are facilitators and barriers for the implementation of EVM as performance technique within Sri Lankan context. Through conducted semi-structured interviews along 13 facilitators of EVM application have been identified and 10 existing barriers to the EVM application has been spotted out. Thus, it is clear that the current condition of Sri Lanka could be improved by mitigating the barriers identified in the survey since several enablers are existing for the upsurged potential within the industry.

Hence it is required to implement EVM within the capable construction organizations, enabling them to experience them through undertaking required training, facilities and with a cooperative environment.

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