Earned Value Management as a Project Management Tool

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Abstract: **Project management has an increasingly important role in the current construction field. In a construction project, a project manager aims to finish on time, within budget and according to the specifications and quality standards. Moreover, the priority is for a satisfied client. Need for analytical and quantitative tools have become significant with increasing demand for cost effectiveness and quality. Earned Value Management (EVM) is a management tool that has the potential to integrate cost, schedule and technical performance. The present work is an attempt to study the effectiveness of EVM in the control of a big construction project**

Keywords: **Earned value, Earn Value Management, Project Management.**

I. INTRODUCTION

The management of technical project has become challenging to professional engineers in an increasingly competitive market in place in which effective project planning and control approaches in compliance with clients contractual requirements. Successful project managers demand that their projects meet technical objectives and would be completed on schedule and within budget.

This study can be applied to various levels of a project WBS (work breakdown structure) and to various cost components, such as labour, material and subcontractors. For the project discussed in this paper, the authors use Construction Computer Software – Candy. CCS Candy is a project control software which deals with the various sections like Estimation, Planning, Cash flow, Valuation and Earned Value. The case study of Raw Water Treatment Plant located at BPCL, Kochi Refineries is studied here.

The first objective is to track the progress of work at various stages of construction and further to provide early indications of expected project results based on project performance and forecasting of the project which creates an opportunity to take better decisions and views the possible need for corrective action by using EVM technique. The second objective of this study is to identify budget overruns and delays. By this study, we can predict the future of the project based on present progress and work out technical performance requirements for better resource planning and scheduling. It enables a contractor and his customer to monitor the progress of a project objectively and in terms of cost schedule and technical performance values and helps them to be aware of the status of the project. [5][11]

In this paper, we propose an innovative and simple graphical framework for project control and monitoring, to know the dimensions of project cost and schedule therefore extending the Earned Value Management (EVM). This paper consists of five sections. The first one is the introduction part which briefly gives a background of the paper. Then the second part is the case study of RWTP for project tracking using EVM. The third section is literature which gives concept of EVM. The fourth section is the analysis of case study. The last section gives the conclusion of the paper.

II. CASE STUDY

The EVM tool is used for the tracking of a live project. The selected site for case study is located in Ambalamugal, Kochi, Kerala, India. BPCL Kochi refineries decided to construct a RWTP to meet the increased water demand arises as a part of their expansion work. The project considered for tracking is the civil construction of the RWTP for BPCL, KOCHI. General contractor of this project is Triveni Engineering & Industries limited. They gave subcontractor of civil work to ABM Civil Ventures. The total contract amount is 20 crore and the total duration of this project is 503 days. This is an

ongoing project and according to the schedule, the project (civil work) was started on 30th august, 2013. The planned schedule was to complete the project in 16th January 2015. Total budget of the project (only civil work) was estimated to be 16 crores.

The sub-contractor (ABM Civil Ventures) who had undertaken the civil construction had made the estimate and done the scheduling. But proper project management by EVM or any other tool is absent. This had adversely affected the progress of the work in time. Due to this, the project cannot be completed in scheduled time and is still going on

III. LITERATURE

The Project Management Institute defines EVM as a method for integrating scope, schedule, and resources, and also for measuring project performance. EVM emerged as a financial analysis specialty in United States Government programs in the 1960s, but it has since become a significant branch of project management and cost engineering.

Project tracking tools are used in the construction field. However many projects run over budget and delay in schedule, which suggests that there is something wrong in our project control system. The Earned-Value method (EVM) is project control technique that provides a quantitative measure of work performance. It is considered as an advanced technique for integration of schedule and cost.

Earned Value provides analysis of cost performance. To know what's happening to the cost of your project before it is completed, it is needed to know what the planned cost at any time and corresponding cost of the completed work done. This is depicted in Figure 1.
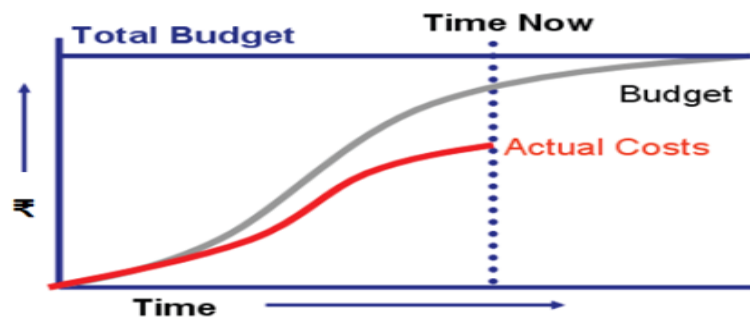

Figure 1.1: Time and Cost Schedule

It seems that the actual costs are considerably below the planned cost which appears to be a positive progress indication. However, unless the planned cost of the completed work is known, the construction manager cannot decide it is desirable or not. That is exactly the missing information that Earned Value provides. Figure 2 provides a graphical illustration of Earned Value. In comparison to Figure 2 here there is a third curve that indicates project progress considering both the time and cost factors simultaneously. It is called Earned value curve. In this case the manager would be able to judge about the project progress exactly because for providing Earned Value curve both the time and cost factors considered simultaneously and manager sure that if actual cost is less than budget physical progress is according the plan schedule or not. If physical progress according to plan project save cost and actual cost is really less than budget, on the other hand, if physical progress is less than plan schedule, manager cannot be happy because he cannot judge about the real project progress. Earn Value curve prepared according to Earned Value methods.
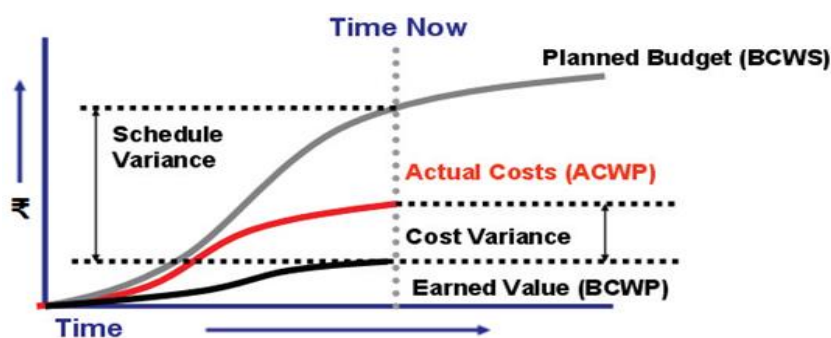

Figure 1.2: Earned Value Time And Cost Schedule

Earned Value is a program management technique that uses "work in progress" for prediction. EVA uses cost as the common measure of project cost and schedule performance. It allows the measurement of cost in currency, hours, worker-days, or any other similar quantity that can be used as a common measurement of the values associated with project work. EVA uses the following project parameters to evaluate project performance:

- Planned Value (PV)
- Earned Value (EV)
- Actual Value (AV)

As noted, there are many ways to calculate the EV, PV and AC of work in a project that are in progress. Comparison of those figures can serve to identify specific work packages in which performance and progress is inadequate or advanced, which will hopefully lead to remedial action by the project manager and team. Cost and schedule performance should be measured and analysed as feasible with regularity and intensity consistent with project management need including the magnitude of performance risk. Analysis should be progressive and should follow the principle of management by exception. Variance thresholds should be established in the planning phase and should be used to guide the examination of performance. [1]

Table 1.1: Parameter Of Earned Value Analysis

| Name	Formula	Interpretation
Cost variance (CV)	EV – AC	NEGATIVE is over budget, POSITIVE is under budget.
Schedule Variance (SV)	EV – PV	NEGATIVE is behind schedule, POSITIVE is ahead of schedule.
Cost Performance Index (CPI)	EV / AC	Less than 1 poor performance Greater than 1 good performance.
Schedule Performance Index (SPI)	EV / PV	Less than 1 poor performance Greater than 1 good performance.
Estimate At Completion(EAC)	BAC / CPI AC + ETC	As of now how much do we expect the total project to cost Rs__. • Used if no variances from the BAC have occurred. • Actual plus a new estimate for remaining work. Used when original estimate was fundamentally flawed. • Actual to date plus remaining budget. Used when current variances are atypical. • Actual to date plus remaining budget modified by performance. When current variances are typical.
Estimate To Complete (ETC)	EAC – AC	How much more will the project cost?
Variance At Completion (VAC)	BAC – EAC	How much over budget will we be at the end of the project?

IV. ANALYSIS
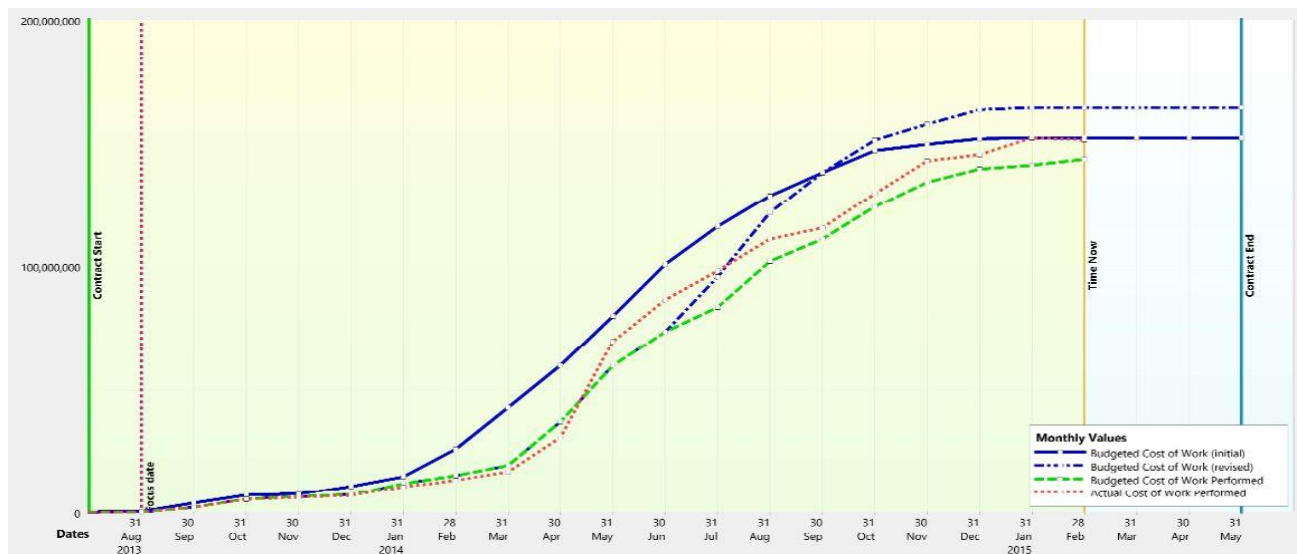
Figure 1.3: Time Vs Cost

Figure 1.4: Variation In Cost Performance Index And Schedule Performance Index

Figure 1.5: Variation In Cost And Schedule Variances

Table 1.2: Earned Value Data

Planned Value	Earned Value	Actual Costs
70,026	70,026	66,612
19,75,390	19,75,390	18,87,050
54,50,184	54,50,184	52,09,054
63,60,294	63,60,294	60,81,045
71,62,673	71,62,673	68,68,171
1,18,43,481	1,18,43,481	1,04,71,808
1,51,10,657	1,51,10,657	1,31,73,090
1,91,91,738	1,91,91,738	1,65,89,540
3,68,70,808	3,68,70,808	3,05,70,291
5,95,96,723	5,95,96,723	6,95,51,515
7,34,30,663	7,34,30,663	8,63,31,245
9,56,62,808	8,34,06,958	9,79,88,868
12,14,52,610	10,18,68,532	11,07,80,708
13,78,29,520	11,07,64,021	11,52,60,354
15,10,41,424	12,38,03,613	12,92,37,937
15,74,20,822	13,39,15,625	14,25,10,693
16,33,28,457	13,92,84,750	14,50,94,797
16,41,38,285	14,08,11,551	15,20,03,318
16,41,38,285	14,32,58,184	15,11,43,376
16,41,38,285	14,90,66,770	15,70,65,090
16,41,38,285	15,13,22,930	15,93,46,786
16,41,38,285	15,18,82,436	15,99,18,317

V. CONCLUSION

Although EVA (Earned Value Analysis) associated with the monitoring and evaluation of project cost that are undertaken within an organization, it can also be readily applied, with some adjustment, to the control of project cost that are performed by contractors. In those circumstances, however, it must be recognized that the client and contractor will have different views on actual and budgeted costs. This study also indicated that EVA has significant value and unique features that can benefit clients, consultants and contractors involved in the wide range of construction projects.

A Project was analysed using the developed software CCS Candy based on Earned Value Analysis Method.

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