Earn Value Management a Boon to Indian Construction Industry

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Abstract— **Earned Value Management (EVM) is a systematic approach to the integration and measurement of cost, schedule, and technical (scope) accomplishments on a project or task. It provides both the government and contractors the ability to examine detailed schedule information, critical program and technical milestones, and cost data. .EVM technique can do forecasting of duration for a project .It gives a well-defined pathway of existence to the project and when to take precautionary measures for updating the project if project is behind the schedule. It can be used to identify the cost overruns and time overruns. EVM technique can be applied using certain software's like MSP, Primavera, etc.**

Keywords—*Technical Milestones, EVM, Primavera, MSP.*

I. INTRODUCTION

Proper analysis of a project requires four major items: Budget, earned value, actual costs and forecasts. All four are needed to obtain a true picture of the project's health. If you analyze only the budget versus actual costs, an incorrect representation often results. For example, if the project spending is 10% under budget, this might appear as if the project is doing very well. However, when the project status or earned value is added to the analysis, it may then show that only half of the originally planned work has been performed. If so, we have a project that is behind schedule, and the completed work costs much more than originally planned.

This study can be applied at various levels of a WBS and can be helpful in tracking the progress of a project. It will also help in knowing the status of the project and help in taking appropriate action for the delay or over budget.

It allows projects to be managed better – on time, on budget. Earned Value Management System is not a specific system or tool set, but rather, a set of guidelines that guide a company's management control system. In the case of cost overrun, project management team may execute a value engineering program for cost reduction either reducing scope and quality in some sections of project or providing additional budget to cover overrun cost. Similarly, for time overrun case, the may plan some program such as fast tracking or time crashing for time reduction. Therefore, the role of EVM as well as correct and on time forecasting is very important to achieve project goals.

II. TERMINOLOGY

A. Planned Value (PV)

The planned value (PV), formerly called the budgeted cost of work scheduled (BCWS), also called the budget, is that portion of the approved total cost estimate planned to be spent on an activity during a given period.[1] *Planned Value = Physical Work + Approved Budget* PV can be looked at in two ways:
1. Cumulative PV is the sum of the approved budget for activities scheduled to be performed to date.
2. Current PV is the approved budget for activities scheduled to be performed during a given period. This period could represent days, weeks, months, etc.

B. Actual cost (AC)

Actual cost (AC), formerly called actual cost of work performed (ACWP), is the total of direct and indirect costs incurred in accomplishing work on an activity during a given period.[1] It can be looked at in terms of cumulative and current.
1. Cumulative AC is the sum of the actual cost for activities performed to date.
2. Current AC is the actual costs of activities performed during a given period.

C. Earned Value (EV)

The earned value (EV), formerly called the budgeted cost of work performed (BCWP), is an estimate of the value of the physical work actually completed. EV is based on the original planned costs for the project or activity and the rate at which the team is completing work on the project or activity to date.

EV is the quantification of the "worth" of the work done to date. Earned Value (EV) tells you, in physical terms, what the project accomplished.[1] EV can be presented in a Cumulative and Current fashion.

1. Cumulative EV is the sum of the budget for the activities accomplished to Date.

2. Current EV is the sum of the budget for the activities accomplished in a given period.

D. Estimate at Completion (EAC)

The Estimate at Completion (EAC) is the actual cost to date plus an objective estimate of costs for remaining authorized work[1]. The most common is: $EAC = Actual\ Cost\ (AC) + Estimate\ to\ Complete\ (ETC)$ The Estimate to Complete (ETC) is the cost of completing the authorized remaining work.

E. Rate of Performance (RP)

Rate of performance (RP) is the ratio of actual work completed to the percentage of work planned to have been completed at any given time during the life of the project or activity.[1] For example, suppose the server installation was halfway completed by the end of week 1; the rate of performance would be 50% because by the end of week 1, the planned schedule reflects that the task should be 100% complete and only 50% of that work has been completed. The EV would thus be \$5,000 after week 1 (\$10,000*50%)

F. Schedule Variance (SV)

Schedule Variance is the comparison of amount of work performed during a given period of time to what was scheduled to be performed. It is calculated as follows $SV = EV - PV$ A negative schedule variance means the project is behind schedule i.e. it took longer than planned to perform the work.

G. Cost Variance (CV)

Cost Variance is thecomparison of the budgeted cost of work performed with actual cost.It is calculated as follows $CV = EV - AC$ A negative cost variance means the project is over budget i.e. performing the work cost more than planned.

H. Schedule Performance Index(SPI)
SPI can be used to estimate the projected time to complete the project. It is calculated as follows $SPI = EV / PV$ SPI = 1 means that project is on schedule. SPI < 1 means that project is behind schedule. SPI > 1 means that project is ahead of schedule.

I. Cost Performance Index(CPI)

CPI can be used to estimate the projected cost to complete the project based on performance to date. It is calculated as follows $CPI = EV / AC$ CPI = 1 means that the planned and

actual costs are same. CPI < 1 means that project is under budget. CPI > 1 means that project is over budget.

III. ELEMENTS OF EARNED VALUE MANAGEMENT

EVM integrates three critical elements of project management: scope management, cost management, and time management. It requires the periodic monitoring of actual expenditures and the amount of work done (expressed in cost units). To determine cost performance, EVM compares how much we have spent to what we planned to have spent to do the work we have done. To determine time performance, it compares the amount of work done to the amount of work scheduled to be done. To make these comparisons, EVM calculates cost and schedule variances, along with performance indices for project performance management. Based on these results, it forecasts the date and cost of the project at completion and highlights the possible need for corrective action. EVM uses the following project parameters to evaluate project performance:
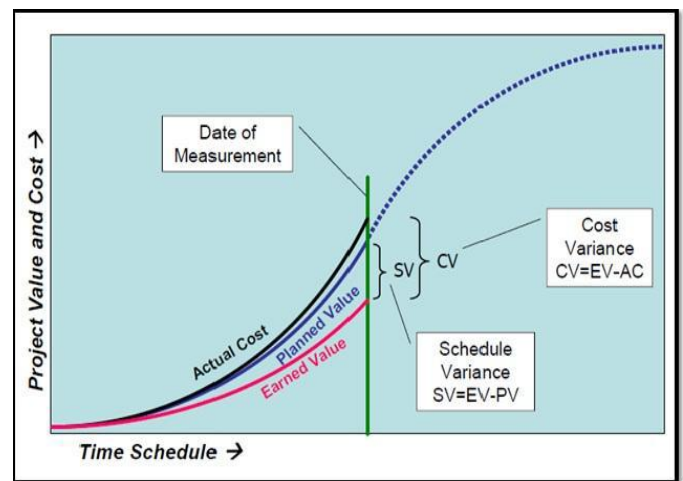

Figure 1: Earned value basics

Planned Value (PV): This is the cumulative planned cost for the work planned to be done on the project up to a given point in time. It is the approved budget for completing the work planned so far, and as such it is the cost baseline for the project. It was previously called the budgeted cost of work scheduled (BCWS).

Budget at Completion (BAC): This is the total amount of money expected to be spent on the project, and as such it is the value that PV is planned to reach at completion. Actual cost (AC): This is the cumulative actual cost spent on the project so far, including all accrued cost on the work done. AC was previously called the actual cost of work performed (ACWP).

Earned value (EV): This represents the cumulative amoun of work done up to a point in time, expressed in

cost units. It is expressed as the amount that was planned to have been spent on the work that has been completed up to this point. EV was previously called the budgeted cost of performed (BCWP). To calculate the EV for a given element

of work, the planned cost is multiplied by the percentage complete. The EV for the project is the sum of the EV for all the work elements. BAC, PV, AC and EV are expressed in cost units. That may be in units of actual money, in any currency. Or it can be expressed in hours or days of work done. PV, AC and EV can be calculated for any element of work.

DETAILS OF SOFTWARE Taking lead from the literature review the present study aims at evaluating Earned Value Analysis function of three software namely Microsoft Project 07, Primavera 6 and Develop Software. The following sections explain the software in brief.

A. M.S. Project 07(MSP)
Microsoft Project (or MSP or WinProj) is a project management software program which is designed to assist project managers in developing plans, assigning resources to tasks, tracking progress, managing budgets and analyzing workloads. The application creates critical path schedules, and critical chain and event chain methodology with third-party add-ons. Cost Variance and Schedule Variance are visualized in a Report.

B. Primavera 6
Primavera 6 manages and controls activities related to project management as well as portfolio management. Resources representing labour, materials and equipment are used to track time and costs for the project. Slippages of projects' activities are updated resulting in the adjustment of time related bars. It requires Data Base of Oracle My SQL.

C. Developed Software The Earned value analysis software developed in Visual studio 2008, SQL server and .NET (C#) language. And it provides robust project scheduling and management functionality. Features available are Planning, Scheduling, Cost Management and Project review.

CONCLUSION
There is a variety of challenges while planning Construction projects. When we are working to deliver high quality product on time and within budget constraints. Many of these challenges are related to a large degree of uncertainty, either in schedule duration, quality factors, or in design issues. By applying techniques that help quantify the nature of the uncertainty, separate the distribution of uncertainty in project schedule and insulate the project budget from the effects of the uncertainty, projects can be successful in gaining value from earned value analysis..In comparing Earned Value Management to Traditional Management, Traditional Management does not allow for analysis of the physical amount of work performed. Earned Value Management allows for both schedule and cost analysis against physical amount of work performed. The EVM approach deserves more attention in the construction field, where planning and estimation is needed.

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