

STUDY ON PROJECT FORECASTING AND CONTROL IN RESIDENTIAL BUILDING USING EARNED VALUE MANAGEMENT

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ABSTRACT

In construction industry Project Planning, Scheduling plays a major role in efficient monitoring of project completion with respect to both the time and cost of project. Improper scheduling and planning leads to Project delay, customer dissatisfaction and Stakeholders risk in investing the project etc. Due to this company growth, profit, funding for the project and their reputation is greatly affected. There are many system and methods available which are used to monitor and regulate the project. One best method employed is Earned Value Management System. Earned Value is one of the well-known project management tool that uses information on cost, schedule and work performance to establish the status of the current scenario and progress of the project. The main purpose of Earned Value Management system is to use effective internal cost and permit not only customer but also stakeholder and other personnel to rely on precise data to forecast about the project. It allows the manager to extrapolate current trends to predict their likely final effect. This system proved to be useful in practice of cost control and developed to account better for schedule and time aspects. This paper aims in evaluating the work progress of the ongoing Residential Construction project and its activities over the duration of the project thereby helps in identifying the status of the project in aspect to schedule and cost of the project. Further the factors influencing the work activities of the project are taken into account and the risk involved are studied which enables us to forecast the Project cost. Analysis results such as Performance Indexes, Variance are illustrated, also recommending measures for the similar project. This Management system enables the Project manager for efficient monitoring and forecasting the Project duration, cost and schedule in the construction industry.

Keywords: *Earned Value Management, Performance Indexes, Project cost, Project duration, Variance Analysis*

I.INTRODUCTION

Earned value management (EVM) has a common aim of providing decision makers with the best information available when setting objectives and considering management strategies. EVM establishes project performance status and extrapolates that information to gain an understanding of future trends and the allocation of resource needed to successfully meet these objectives. Risk Management looks to the unknown future to identify risks (threat and opportunity) and recommend early action to be taken to limit the impact and probability of threat occurrence and the exploitation of opportunities.

In construction industry, the phase of both the cost and completion of project plays a crucial role. Uncertainties will prevail in a project which will affect both the time phase and cost of project. This results in delay and increase in cost of the project. Hence it is necessary to forecast such parameters for better completion of project both in terms of quality and quantity and also to deliver the project on time.

1.1 OBJECTIVE

The objective of the study are as follows,

- Forecast the project with Variance and Indices related to the Cost and Schedule of the Project.
- Tracking the project phase in accordance with work progress.
- Analyze the level of risk in aspect with cost and time overrun of the project.
- To generate variance analysis of the project.

1.2 SCOPE

The scope of the project is limited in applying the Earned value management system in an ongoing residential construction project and to determine the factors influencing cost and schedule of the project. This project also aimed to forecast the project performance thereby providing a clear and better understanding both to the manager as well as the stakeholder involved in the project.

The project is used to predict the status of the work ongoing in the light of planned value. The work progress of the Residential Building is thoroughly studied which provides vision about the future of the Project. The project includes the case study of the Building located at Guduvanchery in which earned value Management techniques are practiced.

II.METHODOLOGY

1.3 EARNED VALUE ANALYSIS

Planned value (PV), Actual cost (AC) and Earned value (EV) are the three major parameters that will be considered throughout the project to conduct the Earned Value Analysis. Planned Value (PV) is the authorized budget assigned to the work to be accomplished for an activity or WBS component. It is the value one should have earned as per schedule.

The cost incurred during the execution of an activity or the cost incurred during the execution of the entire project with respect to the actual time taken is termed as Actual Cost (AC). Actual cost might include both direct and indirect costs.

Value of work Performed to that work for an activity or WBS component is termed as Earned Value (EV). It determines the value of work actually completed to date.

1.4 TRACKING METHODS

Cost variance: It is used to measure the cost performance of the project. It's the difference between Earned Value and Actual cost. In simpler form it is the difference between what you planned to spend and what you actually spent.

$$CV = EV - AC$$

If CV is +ve then the project is under budget

If CV is -ve then the project is over budget

If CV is 0 then the project is on budget

Cost performance index: It signifies the efficiency of the project in terms of cost. It's the ratio between Earned Value and Actual Cost.

$$CPI = EV/AC$$

If $CPI \geq 1$ Project is under and on budget

If $CPI < 1$ Project is over budget

Schedule variance: It signifies the schedule performance of the project and. It's the difference between Earned Value and Planned Value. In simpler form it is the difference between what you planned to spend and what you actually spent based on being ahead or behind schedule.

$$SV = EV - PV$$

If SV is +ve then the project is ahead schedule

If SV is -ve then the project is behind schedule

If SV is 0 then the project is on schedule

Schedule performance index: It determines the efficiency of time utilised on the project. It's the ratio between Earned Value and Planned Value. The progressing efficiency with respect to the planned schedule is understood.

$$SPI = EV/PV$$

If $SPI \geq 1$ Project is ahead or on schedule

If $SPI < 1$ Project is behind schedule

III. FORECASTING METHODS

Estimate at completion (EAC): To obtain the estimated total cost for a given work breakdown structure item or to estimate the cost at completion multiply the total budgeted cost to the ratio of actual cost by earned value. It shows the current spending pattern which might continue till the completion.

$$EAC = (AC/EV) * \text{total budget}$$

Estimate to completion (ETC): It estimates the total cost which is required at the end of the completion of the project if the current pattern is maintained. It also helps to give a clear picture of budget needed to complete the project. The difference between Estimation at Completion and Actual Cost Gives Estimation to completion.

$$ETC = EAC - AC$$

IV.CASE STUDY

The project taken for study is a Residential Apartment building with G+5 storey consisting of plinth area of about 2,000 sq. ft per floor. The The plinth rate of the area is around Rs 2000/sq.ft.

Thus, the Estimate amount to complete the project is **Rs 2,40,00,000.00.(2.4 crores)**.

This is called as *Budgeted at Completion (BAC)*.

TABLE 1 AMOUNT ALLOCATION

Type of work	% Amount planned to Spend	Allotted Amount (in Rupees)
Preliminary Work	5%	12,00,000
Structural Work	52.3%	12,552,000
Masonry Finishing	7.1%	1,704,000
Plastering Work	10%	2,400,000
Electrical Work	12.8%	3,072,000
Plumbing and Sanitary	5.98%	1,435,200
Miscellaneous Work	6.72%	1,612,800
Total	100%	2,40,00,000

TABLE 2 CUMULATIVE OF PV, EV, AND AC

Month	Cumulative Planned Value	Cumulative Actual Cost (in Rupees)	Cumulative Earned Value (in Rupees)
SEPT 2017	540,000	556890	480,000
OCT 2017	11,40,000	11,72,650	10,20,000
NOV 2017	23,40,000	23,95,750	21,00,000

DEC 2017	34,80,000	35,67,830	31,80,000
JAN 2018	49,20,000	51,57,820	48,00,000
FEB 2018	61,20,000	62,30,750	61,80,000

FIGURE 1 DURATIONVS PLANNED VALUE



The table 1 illustrates about the capital invested in the project in a monthly basis with respect to plan and schedule of the project. The cumulative Planned value are calculated with % work scheduled in accordance with BAC and cumulative Earned Value are calculated with % work performed in accordance with BAC. This enables us to monitor the cost and schedule of the project in the monthly basis which provides the clear-cut idea of the project.

The figure 1 represents the duration of the project with the scheduled cost allotted for the project. It is a typical S curve which show the flow of the project in the monthly manner.

TABLE 3 MONTHWISE CV & SV OF THE PROJECT

Month	Cost Variance	Schedule variance
SEPT 2017	-76890	-60000

OCT 2017	-152650	-120000
NOV 2017	-295750	-295750
DEC 2017	-387830	-300000
JAN 2018	-357820	-120000
FEB 2018	--50750	60000

TABLE 4 MONTHWISE CPI & SPI OF THE PROJECT

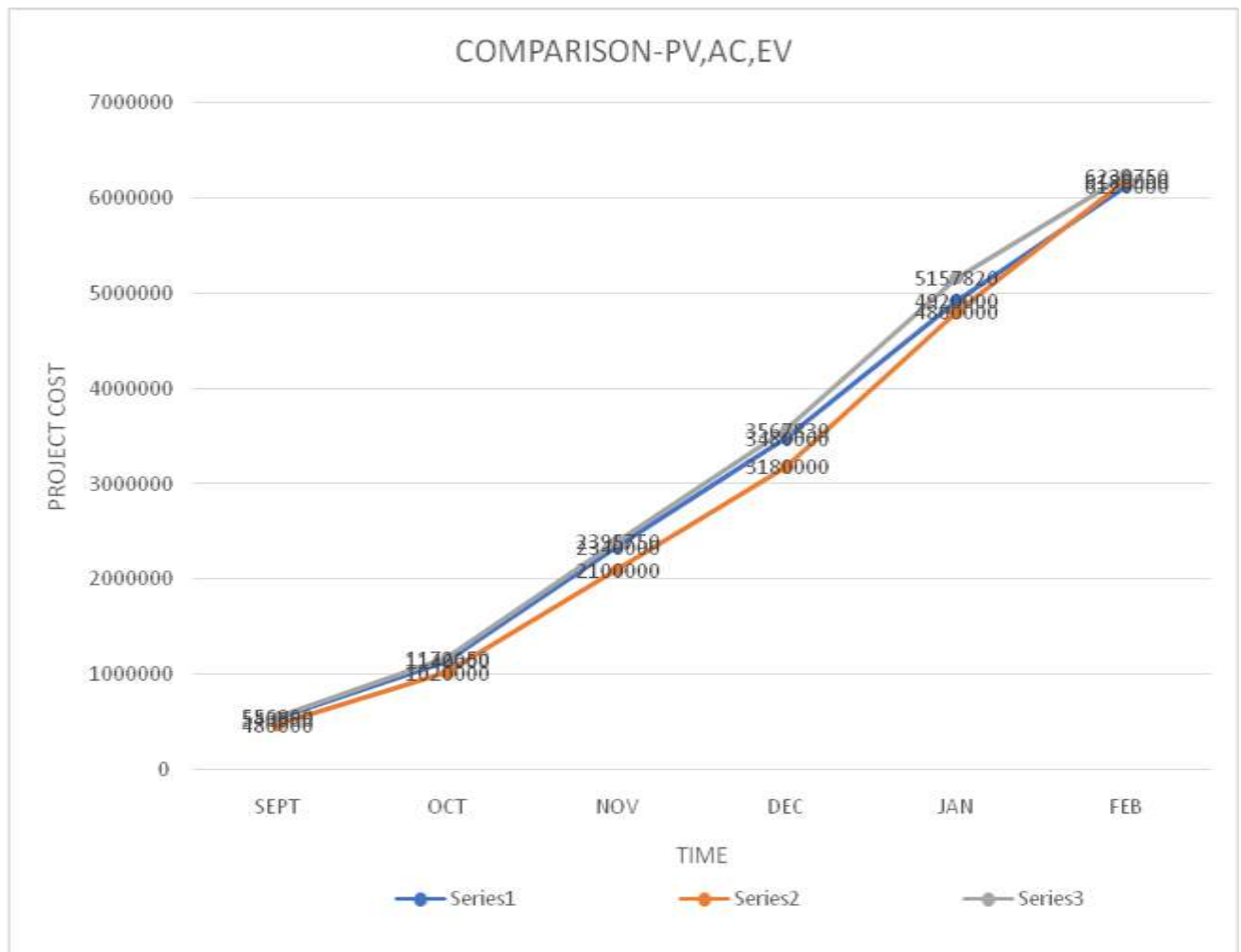
Month	Cost Performance Index	Schedule Performance index
SEPT 2017	0.862	0.889
OCT 2017	0.870	0.895
NOV 2017	0.877	0.897
DEC 2017	0.891	0.914
JAN 2018	0.931	0.976
FEB 2018	0.991	1.009

Table 5 FORECASTING OF PROJECT (MONTHWISE)

Month	Estimate At Completion (EAC)
SEPT 2017	2,78,44,500
OCT 2017	3,46,50,500
NOV 2017	2,73,80.000
DEC 2017	2.69.27.080
JAN 2018	2.57.89.100

FEB 2018	2.41.97.090
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Figure 2 COMPARISON OF PV EV AND
 AC



V.RESULTS AND CONCLUSION

The above Variance and Performance Index will tell us about the project condition in Cost and schedule aspects. The value of SPI, CPI, SV and CV will illustrate the following,

- $SPI < 1$ – Less Work Completed with respect to planned work and behind schedule.
- $CPI < 1$ – Over budget i.e., Earning less than amount spent.
- $SV < 1$ – The project is behind the Schedule.
- $CV < 1$ - The project is overly budgeted

The project can be tracked easily with the help of month wise cumulative table and the graph plotted with PV, EV and AC.

The Actual cost of the project during the entire month tends to increase in a drastic manner affecting both the Planned value and Earned value.

The value of CV for all the month is negative and the value of SV are also negative expect during the month of February 2018.

Only during the month of February 2018, the SPI is above 1 such that the project is ahead schedule which provide the good insight about the Project progress.

From the Values of CPI and SPI, I can conclude that my study project is both behind the schedule and over budget during the initial stages of the project which every project faces.

During the month of January 2018, both the performance index value increases towards 1 having a value of 0.931 and 0.976, which implies the project tends to be on schedule and budget if it continues further but the project is behind the schedule.

At the month of February 2018, the Estimate At Completion (EAC) of the project is nearly equal to the Budgeted At Completion (excess of 2 lakhs will be spent) which suggests that the Project can be assured to be completed in the stipulated amount as per client needs and requirements

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