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A study on cost and schedule analysis on high-rise building by using earned value management

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ABSTRACT

High rise residential projects suffer from cost overrun and time overrun due to multiple reasons. The earned value management tool can act as a control to check project cost and schedule of any building construction. Earned Value Management is not implemented in many residential projects due to lack of understanding of importance. The main objective of my project is to apply EVM to a high rise residential project and to identify time overruns, cost overruns and probable schedule slippages in the projects through the parameters such as schedule variance, cost variance, schedule performance index and cost performance index. This Earned Value Management tool is very beneficial to track ongoing project and gives the performance of the project. The result of the project will show the difference between scheduled performance and actual performance of a project for a particular phase of the construction project. In this report, the study of an ongoing project of (G+3) APARTMENT is done. Calculation of construction data cost wise as well as month wise and activity wise plan value, actual cost and earned value for the project. From the study, I came to a conclusion that majority of the construction projects delayed due to time overrun and cost overrun. From the project parameters, it is found that the project is behind schedule as well as over budget. Original completion time for the project is 9 months but the project will take more two months for the final completion of the project, as well as estimated cost is also increased from planned cost. Using this Earned Value Management tool to track an ongoing project is extremely beneficial and gives better results about the performance of the project.

Keywords: *Earned Value Management, Cost, and Schedule Analysis, Primavera P6.*

1. INTRODUCTION

My primary goal to prepare this report is a comparison of traditional and new technique. I found there is scope for research in Earned Value Management (EVM). It is one of the methods of "Performance Measurement" techniques that use "Work in Progress" to indicate the future work of the project. Project managers can prevent risks based on actual cost, schedule and technical progress at work. It allows projects to be managed better on time and on cost. it is an "Early Warning" project management tool that enables project managers to identify and control the problems before they become too great to overcome. Earned Value Management is a set of guidelines that guide company's management control system. Earned Value Management calculates the performance of the project and compares the actual performance against planned performance.

2. IMPORTANCE OF STUDY

The construction industry is an important study at both the national and global level. It is the largest sector in India. It provides huge employment to the people and plays a vital role in the country's economy. Project delay is the main problem in the construction industry. Time and cost overruns are the main factors for the delays in the project work during execution stage. Time and cost overruns is a serious core where project implementation faces many uncertainties.

It is a process of measuring performance against a baseline plan. In Earned Value Management baseline plan plays a very important role. It is like setting a target for the on-going project. Earned Value Management applications provide performance standard for the evaluation of the progress of the project. It provides better performance picture and gives a better forecast of the final completion of the project. It is an enhancement over traditional process. In the traditional process, the budgeted cost is evaluated by computing

planned cost and the actual cost of the project. The focus is mainly on planned expenditure and actual costs. It reveals future opportunities for the project and the present actual cost is examined.

3. RESEARCH METHODOLOGY

The research aims an empirical study on the application of Primavera P6 software in a single aspect of the project from planning and scheduling phase and followed by monitoring and controlling phase. For the construction of any structure, proper planning is required. For effective completion of work. The building construction is larger in the budget and that needs a sequence of work with the required cost of estimates. To understand the earned value analysis in the building construction Earned Value Analysis is used. A (G+3) Apartment building is taken as a case study. There are mainly two phases in the methodology and are collections of necessary data and second phase is to analyze the collected data through Primavera P6. For the cost analysis, research methodology adopted is as follows.

Fig 1 Procedure of Research Methodology

Site Details

The working site details of my project is (G+3) Apartment building construction which is located at Madinaguda, Miyapur, Hyderabad. The planned project cost is Rs 80,00,000.00.
The building is having 2 flats on each floor.

Pre-Data Collection

I have visited the onsite of the project construction. A pilot survey was done. Pre-data collections are required to study Earned Value Management in construction and analysis of the future scope of work for the project. It consists of the study of literature reviews which includes the concept of planning, scheduling and earned value Analysis and the discussions made are studied thoroughly. After the literature reviews, the objective of studies is made to clear understanding of the project.

DATA COLLECTION

In the data collection part, the data required for the study of planning, scheduling, and earned value analysis are collected. These data collections are made in three parts and are as follows.

- DPR (Daily progress report).
- Work output of the Labour.
- Activities with, planned duration.

4. DATA ANALYSIS IN PRIMAVERA P6

The activities in the apartment building are collected and entered into the primavera P6 software. The sequence of activities is found out on site. Linking of activities with Predecessors and Successors is made. Assigning relationships to each activity is made. After that resources for each activity are assigned. After that, results generated from the Primavera P6 are collected and Earned Value Analysis is done.

Table 1: Procedure in Primavera P6 software

1	Create project
2	Define Work Breakdown Structure
3	Creating Calendars
4	Define Activities
5	Appoint Activity Durations
6	Allocating Resources
7	Tracking and Updating
8	Run Reports
9	Generate Earned Value Reports

SCHEDULE ANALYSIS

Earned value is a technique for measuring project performance according to project cost and schedule. The comparison between budgeted and actual performance is performed. There are three earned value parameters as shown below.

Planned Value (PV): It is the cost of the project according to the schedule of the project. It is also called Budgeted Cost of Work Schedule (BCWS).

Earned Value (EV): It is the Budgeted Cost of the Work Performed (BCWP) till date. It is cumulative budgeted cost incurred in activities that have been completed on the due date.

Actual Cost (AC): It is the actual cost that has spent on the project till date. It is also called as actual Cost of Work Performed (ACWP).

The variances are used to check deflection or deviation of project from the path of original schedule. It is also used to analyze the extent and cause for the delays of works or tasks of the project.
Following re two variances:

Cost Variances (CV): It is used to check the difference between the proposed planned project and present project on the specific date. It shows the variation of project in form of cost. The formula used for calculating cost variances is Cost Variance = Earned Value – Actual Cost

Schedule Variance (SV): It is used to examine the deflection of present project in from the planned project. If considerable change appears than the project objectives must be revised. The formula for calculating the schedule variance is Schedule Variance = Earned Value – Planned Value

Schedule Performance Index (SPI): SPI can be used to estimate the projected time to complete the project. It is calculated as follows,

SPI = Earned Value / Planned Value
SPI = 1 means Project is on Schedule
SPI < 1 means Project is behind Schedule
SPI > 1 means Project is ahead of Schedule

Cost Performance Index (CPI): CPI can be used estimate the project cost to complete the project based on performance to date. It is calculated as follows,

CPI = Earned Value / Actual Cost
CPI = 1 means Planned and Actual cost are same
CPI < 1 means Project is under Budget CPI > 1 means Project is over Budget.

Estimate at Completion (EAC): The Estimate at Completion is the actual cost to date plus an objective estimate of costs for remaining authorized work. The most common is
EAC = Actual cost + Estimate to Complete

Activities

Back Forward Hom

Layout: Classic WBS Layout | Filter: All Activities

Planned Total Cost	Planned Value Cost	Earned Value Cost	Actual Cost	Cost Variance	Schedule Variance	Cost Performance Index	Schedule Performance Index	Estimate At Completion - Labor Units	Budget At Complet
Rs2,179,426.66	Rs2,659,555.50	Rs1,986,373.00	Rs1,782,256.67	Rs204,116.33	(Rs673,182.50)	1.11	0.75	475d	Rs2,866,098.
Rs3,200.00	Rs3,200.00	Rs3,200.00	Rs2,333.33	Rs866.67	Rs0.00	1.37	1.00	2d	Rs3,200.
Rs2,800.00	Rs2,800.00	Rs2,800.00	Rs2,100.00	Rs700.00	Rs0.00	1.33	1.00	3d	Rs2,800.
Rs23,300.00	Rs23,300.00	Rs23,300.00	Rs4,533.33	Rs18,766.67	Rs0.00	5.14	1.00	2d	Rs23,300.
Rs5,300.00	Rs5,300.00	Rs5,300.00	Rs5,300.00	Rs0.00	Rs0.00	1.00	1.00	5d	Rs5,300.
Rs23,100.00	Rs23,100.00	Rs23,100.00	Rs1,980.00	Rs21,120.00	Rs0.00	11.67	1.00	3d	Rs23,100.
Rs65,300.00	Rs65,300.00	Rs65,300.00	Rs63,500.00	Rs1,800.00	Rs0.00	1.03	1.00	22d	Rs65,300.
Rs11,900.00	Rs8,900.00	Rs8,900.00	Rs11,600.00	(Rs2,700.00)	Rs0.00	0.77	1.00	6d	Rs8,900.
Rs36,060.00	Rs28,848.00	Rs28,848.00	Rs32,760.00	(Rs3,912.00)	Rs0.00	0.88	1.00	16d	Rs28,848.
Rs18,400.00	Rs8,800.00	Rs8,800.00	Rs18,400.00	(Rs9,600.00)	Rs0.00	0.48	1.00	13d	Rs8,800.
Rs34,800.00	Rs11,600.00	Rs11,600.00	Rs14,400.00	(Rs2,800.00)	Rs0.00	0.81	1.00	7d	Rs11,600.
Rs8,300.00	Rs8,300.00	Rs8,300.00	Rs8,300.00	Rs0.00	Rs0.00	1.00	1.00	3d	Rs8,300.
Rs38,000.00	Rs28,500.00	Rs28,500.00	Rs37,400.00	(Rs8,900.00)	Rs0.00	0.76	1.00	32d	Rs28,500.
Rs29,400.00	Rs29,400.00	Rs29,400.00	Rs29,400.00	Rs0.00	Rs0.00	1.00	1.00	21d	Rs29,400.
Rs4,800.00	Rs4,200.00	Rs4,200.00	Rs1,200.00	Rs3,000.00	Rs0.00	3.50	1.00	2d	Rs4,200.
Rs224,200.00	Rs200,200.00	Rs200,200.00	Rs158,000.00	Rs42,200.00	Rs0.00	1.27	1.00	30d	Rs200,200.
Rs19,200.00	Rs19,200.00	Rs19,200.00	Rs18,800.00	Rs400.00	Rs0.00	1.02	1.00	16d	Rs19,200.
Rs202,266.66	Rs303,400.00	Rs303,400.00	Rs313,100.00	(Rs9,700.00)	Rs0.00	0.97	1.00	78d	Rs303,400.

Fig 2 Parameters of Earned Value Management

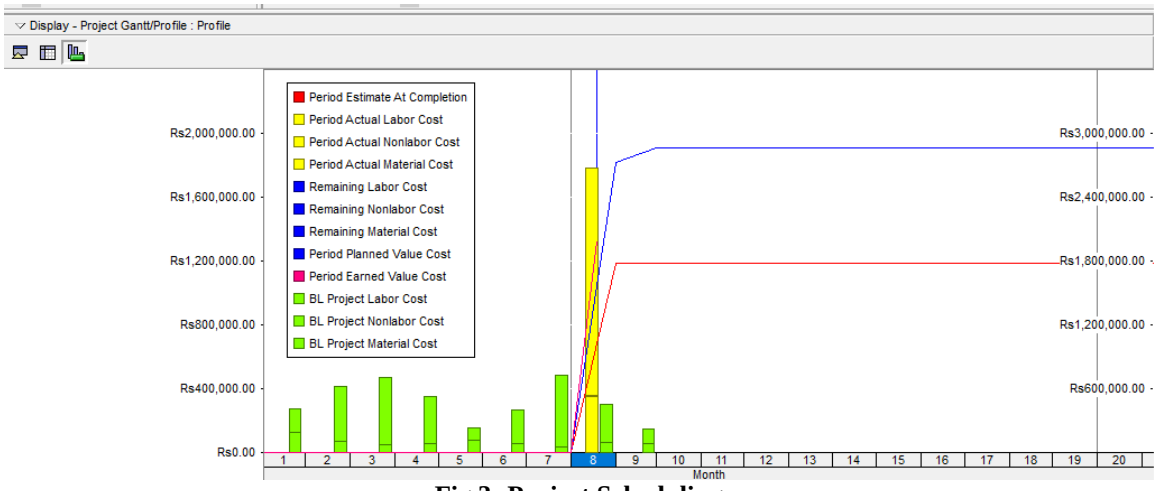

Fig 3: Project Scheduling

The above graph explains project scheduling.

- Blue curve represents planned value cost.
- Red curve represents Estimation at completion cost.
- The pink curve represents Earned value cost. Yellow bar represents an Actual cost.
- The green bar represents labour cost.

The conclusion from the graph is the project cost is exceeding than the planned cost. And the schedule is behind the schedule.

S Curve:

A S Curve is defined as “a display of cumulative costs of labour and non-labour plotted against the time”. For plotting S curve go to activity usage profile sheet then right click on it. Go to profile settings then make ticks only on cumulative costs. Apply ok we will get the curve.

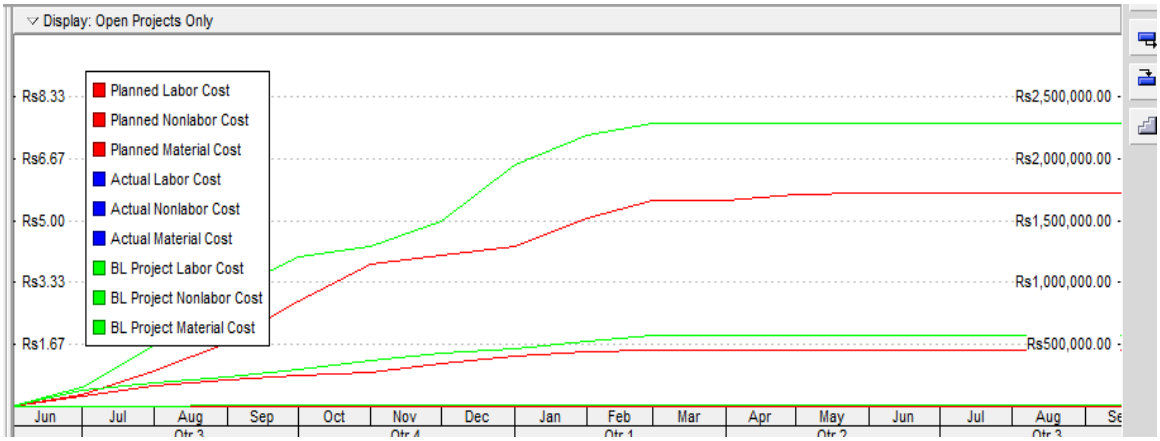

Fig 4: S-Curve of the Project

From the graph, I can conclude that Planned labour and Actual labour cost is not equal. This indicates that the project goes behind the schedule.

Table 2

Project Budgeted cost	Rs. 8,000,000.00
Total Duration of the Project	300 days
Actual Cost	Rs. 1,782,656.77
Planned Value	Rs. 2,847,296.00
Earned Value	Rs. 1,986,373.00
Cost Variance	Rs. 204,116.33
Schedule Variance	Rs. -860,923.00
Cost Performance Index	1.11
Schedule Performance Index	0.70

5. CONCLUSION

The values obtained from the Primavera P6 software given the satisfactory results which are very helpful for the project managers and the site engineers. Earned Value Management system gives very help guidelines to the work.

•Here Cost Variance is Rs. 204,116.33 has the positive value, indicates that the project is under the budget.

•Here Schedule Variance is Rs. -860,923.00 has negative value, indicates that the project is behind schedule.

•Cost Performance Index is 1.11, so the value obtained is more than 1 that indicates the performance of the project is good.

•Schedule Performance Index is 0.70, so the value obtained is less than 1 that indicates that the project is behind the schedule.

• The project is under planned durations, therefore the overall project is behind the schedule and could not spend the finances for the progress of the project due to natural disturbances and time delay in construction because of rains.

6. SCOPE FOR FUTURE WORK

This study has emphasized on the performance of a residential building and provided useful understandings on different aspects related to Earned Value Management methodology. Further, the study can be elaborated by considering the following elements:

- Research can be carried on more accurate planning techniques thus increases the productivity of construction activities.
- Further, the study can even be improved by combining Value engineering principles with Earned Value Management in construction which lead even to reduce the wastage in construction.
- The implementation of Earned Value Management system helps in making project schedules more predictable to complete the project in time.
- The study shows important, implementation and unique features of Earned Value Management that benefits project managers and ultimately result in project success.

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