APPLICATION OF PROJECT MANAGEMENT TOOL FOR APARTMENT BUILDING: A CASE STUDY

Sooraj Kumar[1], Sundip Shenoy[2]
[1]PG Student, [2]Assistant Professor
[1,2]Department of Civil Engineering, NMAM Institute of Technology, Nitte
Karkala,Udupi district, Karnataka India

Abstract

Earned value management is a management tool used extensively in construction for advancement in tracking and forecasting of work progress. It gives a clear picture about the variations incurred during the progress of work with respect to cost, schedule and scope. Earned value management gives statistical details regarding what we had to spend on a project at particular time against what we actually spent on a project. It helps in showing the project progress and also the actual cost at completion time with respect to the possible completion date.

Keywords: Actual cost, critical path method, Earned value analysis, EVM, forecasting method, planned value, tracking method.

I. INTRODUCTION

Cost and performance of a project always plays major tool to indicate the success and progress of the work in future. Therefore most valid data needs to be gathered at the beginning of the project and theses appreciable data list can be found in Earned value analysis. This technique is known as Earned value management technique.

A project can be said successful when there is a proper way of execution of jobs as per schedule and budget estimation. But project overruns due to cost and time is a very common problem in developing countries like India which directly contributes to project execution delay. It results many uncertainties in handling of resources, proving facilities and also it creates over budget scenarios.

Earned value management is a type of management tool to track and forecast the project under study. It also enables to see the project performance at any particular duration. It also provides tentative completion cost details if the project progresses as per the present condition. EVM sheds light on budget control and explains in simpler form for what we spent for a particular activity against what we actually supposed to spend.

Manually the difference between the planned cost and actual cost gives the budgeted cost incurred for a project. Earned value exposes where the project is lagging behind the cost and time with respect to its completion status.

II. SCOPE AND OBJECTIVES

- To evaluate the project performance under cost and time.
- To track the project progress as per the scheduling details.
- To evaluate the resource requirement and total cost of the required resources for the considered activity.
- To manage and monitor the labor requirement for the project effectively.
- To minimize the over allocation of the resources for any activity.

III. METHODOLOGY

A. Scheduling and planning of the project:

In the very first step scheduling and planning of the various activities involved in the execution of work is well prepared by referring the date of completion, resource details, labor productivity and availability of machines nearby the site of construction. By gathering all these relevant data schedule of the project is prepared

by using "MICROSOFT PROJECT SOFTWARE". Also critical path method, program evaluation and review technique, Microsoft excel are being used to optimize the results in better manner.

B. Earned value analysis

Basically three types of major parameters needs to be understood properly before conducting the earned value analysis. The three parameters are namely, Planned value (PV), Actual cost (AC) and Earned value (EV). Here planned value is total budgeted cost allotted for an activity up to certain duration in a project and it can also be total budgeted cost of entire project up to its completion period. Actual cost is the cost incurred while executing the job or activity which may include direct and indirect cost. Earned value is nothing but approved budget for actual work on a given work breakdown structure item during specific time period.

C. Tracking methods

Cost variance: Performance of the project based on its cost can be expressed with its cost variance. It can be obtained by subtracting actual cost from earned value. In simpler form it is the difference between what you planned to spend and what you actually spent based on having lost or saved money.

$$CV = EV - AC$$

Conclusion can be drawn from the results, if obtained value is positive we can say under budget, if no difference then project is on budget. Both the results explain the proposed project is going well without spending unnecessary money on the jobs. If suppose the result is negative then the project is running over budget and it needs to be taken care of before it is too late.

Cost performance index: Cost performance index is essential same indicator as cost variance but in different format. It is handy indicator to examine whether the project is running as per the budget. It is the ratio of earned value to the actual cost.

$$CPI = EV/AC$$

If CPI>=1 Project is under and on budget
If CPI<1 Project is over budget

Schedule variance: It elaborates schedule performance of the project. It can be calculated by subtracting planned value from the earned value. In simpler form it is the difference between what you planned to spend and what you

actually spent base on being ahead or behind schedule.

$$SV = EV - PV$$

Positive schedule variance indicates you are ahead of schedule and if it is equal to zero you are on schedule, which is typically a favorable scenario. However a negative value shows you are behind schedule.

Schedule performance index: It gives a broader context to the schedule variance and becomes easy to evaluate the results. It can be calculated by dividing earned value by planned value.

$$SPI = EV/PV$$

If SPI>=1 Project is ahead or on schedule
If SPI<1 Project is behind schedule

D. Forecasting methods

Estimate at completion (EAC): To calculate estimate at total cost for a given work breakdown structure item or estimate at completion simply divide the actual cost by earned value and multiply the result by total budget. It is a definition on simplistic gauge and it shows current spending pattern will continue till the end of the project.

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

Estimate to completion (ETC): It foretells the total amount of money is required at the end of the project if the current spending pattern is maintained throughout it helps to have a clear picture of budget we need to have at the end and also we can alter the current spending pattern in case of nasty scenarios. It can be obtained by subtracting the estimate at completion by actual cost.
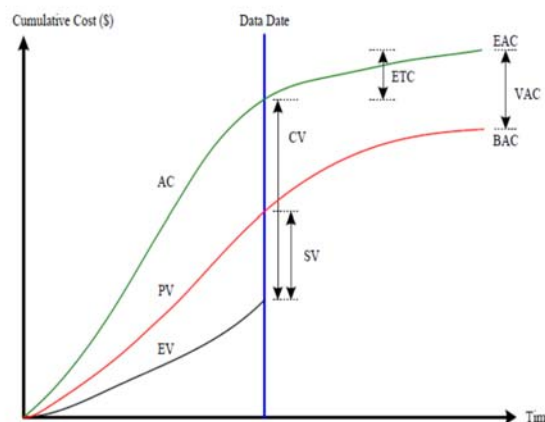
$$ETC = EAC - AC$$

Figure 1.EVM curve and its parameters.

IV CASE STUDY

An apartment building at Udupi is taken for case study. "KHAIN ASHIYANA" is the building by Khain properties one of the famous builders at Udupi which is located very near to world famous Krishna mutt a holy and devotional place.

Table I Project details

Description	Details
Client	Khain Properties, Udupi
Architects	Simons and associates, Udupi
Total duration	25 months
Total estimated value	80720000

The case study was started with the collection of required data like drawings and estimation so that preparation of bill of quantity can be prepared precisely.

Table II Project cost details

Description	Cost (Rs.)
Preliminary work	2,30,46,764
Structural work	78,00,000
Masonry and finishing	45,63,981
Plastering work	75,17,240
Electrical	54,00,000
Plumbing, painting and sanitary	2,83,86,826
Miscellaneous work	40,05,189
Total	8,07,20,000

Work break structure of the project is done and tentative days and labor requirements are calculated with the help of labor productivity chart and it is further manipulated by site knowledge. Gant chart is prepared and critical tasks are obtained by Microsoft Project software.

Table III Project schedule details

Task	Start	Finish
Total duration(708 days)	3 February 2016	1 May 2018
Start of the project	3 February 2016	
Preliminary works	3 February 2016	13 February 2016
Substructure portion	15 February 2016	31 March 2016
Stilt floor	1 April 2016	26 May 2016
Ground floor	9 May 2016	4 July 2016
First floor	15 June 2016	10 August 2016
Second floor	22 July 2016	17 September 2016
Third floor	29 August 2016	27 October 2016
Fourth floor	6 October 2016	3 December 2016
Finishes	10 August 2016	11 August 2017
Other works	31 July 2017	31 March 2018
Finish of the work		4 November 2018

Resources are allocated and over allocations can be tackled by resource leveling and resource smoothening. Hence labor management can be done successfully without undergoing any conflict of allocation in later stage of work progress.

Table IV Resource sheet

Resource	Max units	Std. Rate (Rs/day)
Mason	6	435
Carpenters	4	435
Fitters	4	435
Painters	4	400
Helpers	13	350
Skilled	4	370
F. Helpers	12	400
C. Helpers	8	400
P. Helpers	8	300
Poclain with driver & fuel	2	8000
Plumber	4	600
Pl. Helper	8	400

These standard rates were obtained from central public work department 2015 and site expertise.
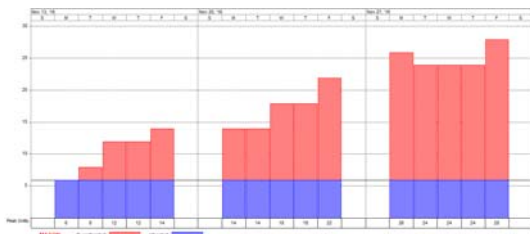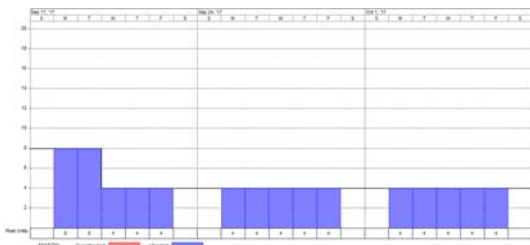

Figure.2. Resource over allocation

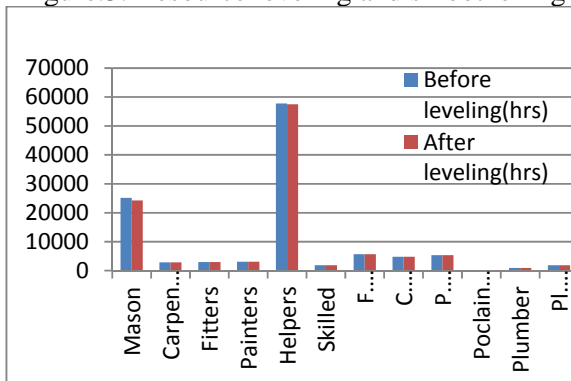Figure.3. Resource leveling and smoothening

Figure.4. Resource levelling graph

In the graph it was clear that working hours for different categories of labours were reduced after application of resource levelling tool.
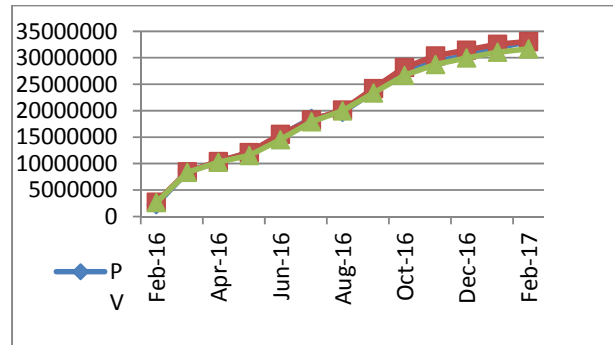

Figure.5 Cumulative EV, PV and AC for resource

Table V Tracking parameters

Month	Cost variances	CPI	Schedule variances	SPI
Feb 2016	-87555.8	0.97	347685.3	1.15
Mar 2016	-121707	0.99	-46186.5	0.99
Apr 2016	-132409	0.99	-96021.8	0.99
May 2016	-578437	0.95	-573635	0.95
June 2016	-1013355	0.93	-839025	0.95
July 2016	-376519	0.98	-657937	0.96
Aug 2016	-143557	0.99	278472.8	1.01
Sep 2016	-827660	0.97	-213060	0.99
Oct 2016	-1499270	0.95	-902612	0.97
Nov 2016	-1623172	0.95	-600600	0.98
Dec 2016	-1491734	0.95	-470706	0.98
Jan 2017	-1510419	0.95	-864701	0.97
Feb 2017	-1400824	0.96	-1336768	0.96

Table VI Forecasting parameter

Months	Estimate at Completion
Feb 2016	34126732
Mar 2016	33500903
Apr 2016	33444745
May 2016	34674814
June 2016	35322624
July 2016	33713548
Aug 2016	33256031
Sep 2016	34188852
Oct 2016	34874209
Nov 2016	34882316
Dec 2016	34662029
Jan 2017	34624412
Feb 2017	34478562

V RESULTS

Optimization of the over allocated resources are being easily nabbed by resource smoothening and levelling process in Microsoft Project Software. Graph showing the cumulative quantity of all the three parameters clearly describes the performance of the project. Tracking parameters elaborates further about the cost and schedule status of the project. As the values of cost variances are being negative and cost performance index is less than 1, it foretells that the project is in over budget scenario but since the project is in the beginning stage, these over budgeted cost values can be compensated in the future activities. In the month of February 2016 and August 2016, the schedule variance is positive and schedule performance index value is greater than 1. That means the project was ahead of schedule in that period but in later stage project was lagging behind the schedule.

VI CONCLUSION

Evaluating and analysing the performance of the project on the basis of cost and schedule plays an important role in project management. Earned value management tool for tracking and forecasting in this project is used successfully. Obtained results shows that the project is over budgeted and behind the schedule. The main reason for the cost overrun and delay in the work is due to considerable hike in the cost of the material and also lack of management in the execution of the work. Since these variations are observed in the beginning of the project progress, it can be maintained in better manner by proper management on labour and material.

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