Tracking of Construction Projects using Earned Value Analysis

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Abstract-*Earned Value method is the well known project management tool. It is used to establish the current status of the project with the help of information gathered such as information on cost, schedule and work performance. The key parameters from which any project's success and failure that can be determined are project scheduling and tracking. EVM helps project managers to measure project performance. It can be said that it is the systematic project management process used to find the variance in the project. This aim of this paper is to focus on the concept and importance of Earned Value Management. It uses Earned value elements for tracking and forecasting the project.*

Keywords-Earned Value Analysis, Schedule, Cost, Project

I. INTRODUCTION

Construction industry is one of the fastest growing industry in the whole world. Construction industry in India plays a vital role in its economic growth. In any project to ensure that work is carried out to desired quality in the allowed time and according to budget it is very important to plan the whole thing prior the execution of the project.

In earlier days, the only way of checking the progress of the project was based on two parameters: planned cost of the project and the actual cost spent on the project which helped them to compare how much was planned to be spent and how much has been spent till date. The drawback of this method was that it did not give any idea about the completed work, this information was not sufficient.

Moreover, it was also not possible to relate the completed work with the amount of money spent on it. This is where the concept of Earned Value Management became so popular which helped project managers to overcome the shortcomings of traditional project management methods.

II. LITERATURE REVIEW

[1] A work done by Prof. Shelke, Prof. Attarde, & Mrs. Chavan (2015) was Focused on planning, scheduling and delay analysis of construction projects under which the information was provided regarding introduction of planning, steps in project planning, Introduction of scheduling, Project Scheduling Steps, Manpower Management & manpower planning. Further the case study of residential project of residential apartment was included by using MS Project and MS Excel software. At the end of paper, discussion was done regarding Master Schedule, Activities, Unskilled labours, Shortage of workers, Shortageof materials, improper management, improper planning & Weather problems which causes the delay. Also the recommendations were given to minimise the delay.

[2] Another classical work done by author's Subramanil,Jabasingh, & Jaylakshmi, (2014) aims at evaluating EarnedValue Analysis function of three software namely MicrosoftProject 07, Primavera 6 and Developed Software. The CaseStudy of Residential building Project (having 120 sq.m.Built-up Area) had been taken. This study also indicated thatnewly developed software EVA has significant value andpresents unique features that can benefit clients,consultants and industries. The two Projects were analysedusing the developed software, MS Project 2007 andPrimavera P6 based on Earned Value Analysis Method. Theresult showed a strong relation between each software. Thefinal result gives more than 99.5% accuracy. A newparameter SV (t) (Schedule Variances respect to time) isidentified and incorporated in developed software which isnot in MS Project 2007 and Primavera 6.

[3] "An Analysis on Resource Planning, Cost Estimation and Tracking of Project by Earned Value Management" Shaik Mohammad Masood, Devanand.R, Harsha H. N,Construction industry is the second largest sector in India. Many construction projects suffer from time and cost overruns due to a multiplicity of factors. Earned value management (EVM) is a project performance evaluation which has been adapted for application in project management. This technique helps in comparison of budgeted cost of work to actual cost. The present study deals with the scheduling and project monitoring process along with it also discusses main parameter's involving in the calculation of earned value analysis in cost and time management of civil construction project. Methodologies and analysis are demonstrated in this paper

using an example of real time project. Primavera P6 software is used for project planning and EVM calculations.

III. BASIC ELEMENTS OF EVM

The following are the basic elements of Earned Value Management. It compares the progress of the project with the baseline data. It gives an early indication about the delay occurred and the cost overruns on any site tp the project managers.

- Planned Value (PV): It is the planned or approved cost to be spent on the given activity during a given period or in simple way, the cost of the project according to the schedule of the project. PV is also known as Budgeted Cost of Work Scheduled (BCWS). Planned Value is calculated before actually doing the work, which also serves as a baseline. Total Planned Value for the project is known as Budget at Completion (BAC).

- Earned value (EV): EV is the budgeted or scheduled cost of the activities that are completed till date or the planned value of actually completed work. It is also known as Budgeted Cost of Work Performed (BCWP).

- Actual Cost (AC): AC is the total of costs incurred in accomplishing work on the activity in a given period or the amount spent on the project to date. It is also known as Actual Cost of Work Performed (ACWP).

IV. PERFORMANCE INDICATORS IN EVM

Using Earned Value Management technique for large or complex construction projects helps in indicating and forecasting the cost performance (over budget or under budget) and schedule performance (behind schedule or ahead of schedule).

Cost Variance (CV): It is very important factor to measure Project Performance. Cost Variance (CV) indicates how much over or under budget the project is. Cost Variance can be calculated as using the following formula.

Cost Variance (CV) = EV – AC
- The formula mentioned above gives the variance in terms of cost which will indicate how less or more cost has been to complete the work as of date.
- Positive Cost Variance indicates the project is under budget.
- Negative Cost Variance indicates the project is over budget.

Schedule Variance (SV):It indicates how much ahead or behind schedule the project is. Schedule Variance (SV) can be calculated as using the following formula.
Schedule Variance (SV) = EV – PV

- Positive schedule variance indicates we are ahead of schedule.
- Negative schedule variance indicates we are behind of schedule.

Cost Performance indicator (CPI): It is the index showing the efficiency of the utilization of the resources on the project. Cost performance indicator can be calculated using the following formula.
CPI = EV / AC

Schedule performance indicator (SPI): It is the index showing the efficiency of the time utilised on the project. Schedule performance indicator can be calculated using the following formula.
SPI = EV / PV
- The formula mentioned above gives the efficiency of the project team in utilizing the time allocated for the project.
- SPI value below 1 indicates project team is less efficient in utilizing the time allocated to the project.

V. LIMITATIONS

- The case study selected is a residential project.
- Only the RCC work is undertaken for the study.

VI. CASE STUDY

The case study is a residential site, situated at balewadi pune. For the RCC work of first slab (Area 10000 Sqft) 28 days has been planned and the Labour plus Material rate floated as per contract is 380rs/Sqft. The Grade of concrete adopted is M30 for column and M20 for beam and slab. The Contract is as per Built up Area.

So the Estimated cost of construction for 1st slab is 38 Lakhs (BAC).

The Actual cost spent is calculated from the actual quantities (concrete and steel) of column, beam and slab.

Column Concrete quantity = 70.69 Cum.

As per mix design, for 1m3 of concrete the following quantity of cementatious materials are used.

Cement	6.6 bags
Flyash	59.4kg
Crushed sand	792kg
20mm Metal	1148.4kg
Water	175.23ml
Admixture	2805ml

Table No 1.

Calculating the total amount of cementatious material we get the total cost for 70.69 Cum as follows.

Material	Quantity	Unit	Cost (Rs.)
Cement	466.61	Bags	151649.8Rs
Flysah	4.20	Tons	9056.292Rs
Crushed sand	10.36	Brass	29012.31Rs
20mm Metal	16.44	Brass	29583.75Rs
Admixture	198.31	Litres	8011.775Rs
		Total cost	**227313.9Rs**

Table No 2.

In the same way for the quantity for columns in beam is 17.6748 Cum.

Material	Quantity	Unit	Cost (Rs.)
Cement	116.65	Bags	37911.25Rs
Flyash	1.05	Tons	2264.33Rs
Crushed Sand	2.59	Brass	7252Rs
20mm Metal	4.11	Brass	7398Rs
Admixture	49.58	Litres	2003.03Rs
		Total	**56828.61Rs**

Table No 3.

For Beam and Slab the cementatious materials as per mix design for 1m3 of concrete is as follows.

Cement	5.6 bags
Flyash	61.6kg
Crushed sand	862.4kg
20mm Metal	1170.4kg
Water	187.55ml
Admixture	1400ml

Table No 4.

For Beam and slab Concrete Quantity of 108.736Cum and 83.95Cum respectively the cost is as follows.

Beam Quantity 108.736Cum

Material	Quantity	Unit	Cost (Rs.)
Cement	608.92	Bags	197899.712Rs
Flyash	6.70	Tons	14444.547Rs
Crushed Sand	17.35	Brass	48587.574Rs
20mm Metal	25.76	Brass	46371.767Rs
Admixture	152.23	Litres	6150.114Rs
		Total	313453.71Rs

Table No 5.

Slab Quantity 83.95Cum.

Material	Quantity	Unit	Cost (Rs)
Cement	470.12	Bags	152789.43Rs
Flyash	0.92	Tons	1991.43Rs
Crushed Sand	13.40	Brass	37512.27Rs
20mm Metal	19.89	Brass	35801.55Rs
Admixture	117.53	Litres	4748.23Rs
		Total	232842.91Rs

Table No 6.

By adding the cost of construction for Column, beam and slab we get the total RCC cost as 830439Rs, in the same way the cost of construction of staircase is 19836Rs.

So now the total cost equals to 850275Rs.

The total cost of steel is calculated from Built up area rate floated. For each sqft the steel required is 3.5kg and the cost of steel for each sqft of steel is 48rs. So the cost of steel is (10000*3.5*48) =1680000Rs.
The labour rate is 135/Sqft. So cost of labour is (10000*135) =1350000Rs.

The total cost spent is (Actual Cost) 830439+19836+1680000+1350000= 3880275 Rs.

At the end of 28 days, from the daily project reports it was seen that the construction of the slab was completed. For this the following calculations have been done.

Actual Cost (AC) = Rs. 3880275.
Earned Value (EV) = 100% of work = 100% of BAC = 3800000Rs.
Planned value (PV) = 100% of work = 100% of BAC = 3800000Rs.
Schedule Variance = Earned Value – Planned Value = 3800000-3800000= 0Rs
Cost Variance = Earned Value – Actual Cost = 3800000-3880275= -80275Rs.

From the above calculations it is seen that the cost variance is negative which means that the project is over budget, and the as schedule variance is zero which indicates that the project is on schedule.

VII. CONCLUSION

Tracking of construction projects using Earned Value Management is useful in recognising the risk factors of the construction projects and to forecast the potential problems in order to face the remaining project work. It also helps the project team in decision making and to be proactive in managing their projects.

It is helpful tool in knowing the following situations to the contractor and/or the project managers- Where he is in project, Whether the project is behind the schedule, ahead of the schedule or on schedule. Whether the project is under budgeted or over budgeted. Hence, it proves most helpful to any contractor or project manager.

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