A Review of Work Progress by Earned Value Management

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Abstract: **Earned value management is a project management technique for measuring project performance and progress. It has the ability to combine measurements of the project management triangle: scope, time, and costs. In a single integrated system, earned value management is able to provide accurate forecasts of project performance problems, which is an important contribution for project management. Early EVM research showed that the areas of planning and control are significantly impacted by its use; and similarly, using the methodology improves both scope definition as well as the analysis of overall project performance. More recent research studies have shown that the principles of EVM are positive predictors of project success. Popularity of EVM has grown in recent years beyond government contracting, a sector in which its importance continues to rise (e.g. recent new DFARS rules), in part because EVM can also surface in and help substantiate contract disputes. Essential features of any EVM implementation include: A project plan that identifies work to be accomplished. A valuation of planned work, called planned value (PV) or budgeted cost of work scheduled (BCWS). Pre-defined "earning rules" (also called metrics) to quantify the accomplishment of work, called earned value (EV) or budgeted cost of work performed**

Keywords: **earned value management**

1. Introduction

A successful project is one that is completed in time, that is within budget, and that satisfies the appropriate technical and safety standards. The successful delivery of a project depends on the proper management of the project. A well planned project may be a failure if it is not managed properly. It is here that we recognize the importance of Project Management. It is the application of knowledge, skills, tools and techniques to the project activities to meet or exceed the needs and expectations of stakeholders. Although- several systems and techniques are available to support project management efforts, the task of tracking costs and durations of a project is still difficult and challenging. This difficulty is perhaps due to the fact that the three basic categories of project data (i.e., cost, scheduling, and progress) are intimately interrelated, and they are also time dependent. This makes independent tracking of any one category of little or no value unless it is integrated with the other two. This shows the need for a practical quantitative method for measuring work progress, which would eliminate a major cause for this difficulty.

The objective of this paper is to present an outline for a comprehensive and practical system to measure work progress on a construction project objectively. The proposed system employs two principles. The Construction schedule bar chart is used to integrate cost and scheduling data, and the earned value concept is used to serve as the yardstick for measuring progress.

Earned Value Management (EVM) is a project management technique for measuring project progress in an objective manner. EVM has the ability to combine measurements of scope, schedule, and cost in a single integrated system. When properly applied, EVM provides an early warning of performance problems. Additionally, EVM promises to improve the definition of project scope, prevent scope creep, communicate objective progress to stakeholders, and keep the project team focused on achieving progress.

2. Work details

The work presented here is a demonstration of project tracking and controlling. The technique used for this was EVM. The project taken for the study was a commercial building in Areekode, Malappuram, Kerala. The total estimated amount for the entire project was Rs. 46.35 million. Our work was limited to the project tracking for 6 months ie; from September 2018 to February 2019. The estimated amount of the work from January 2018 to February 2019 was Rs 2,12,84,000 which includes skeleton work only. The concerned part of project was scheduled for 20 months with planned start date on 16th Jan, 2018, ie, 14 months for skeleton work and 6 months for other finishing works. Since it is a water logged area, each floor is constructed in two halves.

3. Earned value analysis

By updating the progress of each activity for the tracking period, we can analyse the project to find its performance and hence can be used for project forecasting.

The earned value analysis is carried out for the months, September 2018 – February 2019.

Planned Value (PV)   = Planned % completion x BAC
Earned Value (EV)   = Actual % work completed x BAC
BAC   = Rs 2,12,84,000

In Table 1, cumulative planned value, cumulative earned

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value and cumulative actual cost of the project for a period of 6-month duration and budget at completion for the project of 14-month duration are tabulated from the collected data and the values are given as:

1. Planned Value (BCWS)   = Rs. 2,12,84,000
2. Earned Value (BCWP)   = Rs. 1,51,11,640
3. Actual Cost (ACWP)   = Rs. 1,76,97,200
4. Budget at completion (BAC)   = Rs. 2,12,84,000

Table 1
Table title comes here

MONTH	PLANNED VALUE	EARNED VALUE	ACTUAL COST
UPTO SEP 2018	0.55 x 21284000 = 1,17,06,200	0.29 x 21284000 = 61,72,360	66,00,000
SEP	0.64 x 21284000 = 1,36,21,760	0.32 x 21284000 = 68,10,880	83,77,000
OCT	0.73 x 21284000 = 1,55,37,320	0.37 x 21284000 = 78,75,080	1,01,59,500
NOV	0.85 x 21284000 = 1,80,91,400	0.44 x 21284000 = 93,64,960	1,06,03,300
DEC	0.92 x 21284000 = 1,95,81,280	0.47 x 21284000 = 1,00,03,480	1,13,06,833
JAN 2019	0.98 x 21284000 = 2,08,58,320	0.57 x 21284000 = 1,21,31,880	1,46,33,800
FEB	1 x 21284000 = 2,12,84,000	0.71 x 21284000 = 1,51,11,640	1,76,97,200

It is clear that: The project has an unfavourable schedule variance of -61.72 that means the project is behind schedule. An SPI of 0.71 would tell that the project is progressing at 71% of the rate originally planned. SPI indicates the rate at which the project is progressing. The originally estimated completion time for the project was 14 months for skeleton work. Here we found that if work continuous at the current rate, the project will take 6 months longer than what was originally planned as time estimate for completion is now 20 months for skeleton work.So it takes 26 months for the entire project which includes 6 months for the finishing works. The project has an unfavourable cost variance of -25.85 which means the project is over budget. A CPI of 0.85 would tell that the project is currently running over budget by 15% that is for each rupee we spend, we are getting a value of rupee 0.85.

Estimate at completion shows that the expected total cost of the project at completion is based on the performance of the data date 2,12,84,000 Rs divided by 0.85 is 250.40 lakhs. Therefore, EAC is 250.40 lakhs for skeleton work. In other words, since the project is getting only 0.85 rupee out of every rupee, the project will cost Rs. 250.40 lakhs instead of Rs. 212.84 lakhs that were planned. So a total cost of Rs.501.1 lakhs are expected instead of Rs.463.5 lakhs for the entire project which includes Rs.250.7 lakhs for finishing works. Variance at completion shows the variance of the total cost of the work and expected cost. Here it is -37.56. That means at this status date, the project is over budget by Rs. 37.56 lakhs. Estimate to complete shows the expected cost required for finishing all the remaining work, here it is Rs.72.61 lakhs. This amount is needed to complete the work.

4. Conclusion

A practical procedure for evaluating work progress in a quantitative manner is presented in this report. The procedure uses the Construction schedule Bar Chart and the earned value technique and was demonstrated in the construction of a commercial building. The use of this procedure can minimize expensive contractual and legal disputes between owners and contractors regarding project status and associated contractor's compensation. The procedure is also a means of reducing the involvement of senior management in time-consuming routine tasks which can be delegated to less senior personnel. This would result in improving resource use, cost effectiveness, and contract administration. In addition, the procedure is an excellent project tracking tool for consultants and professional construction managers, since it only requires data which are available in the estimate (or control budget) and visual inspection of the project site. The procedure does not require any data which may be considered proprietary by contractors or additional information that has to be furnished by the contractor.

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