

Construction cost monitoring through variance analysis

Mukesh Balwani¹, Md Zeeshan Khan², Sayyed Aamir Hussain³, Ashfaque Ansari⁴

^{1,2,3,4} Civil Engg. Dept, Anjuman College of Engg. & Technology, India

ABSTRACT: Time and cost are the lifelines of any and every project. They are vital, still they are neglected. Earned Value is a project control technique which provides a quantitative measure of work performance. Budgeted cost of work performed is compared against actual cost of work performed to give cost variance. This paper describes how excel spreadsheets can be useful for calculation of cost variance and its three components namely: quantity, price and productivity variance which can be applied at element level of any project.

Keywords: Variance analysis, earned value

I. INTRODUCTION

In a project, plans are usually drawn to ensure that work is carried out to the desired quality in the allowed time, and according to budget. Divergences from plan however occur and within construction such divergences are common. Such divergences are nevertheless expected because of the nature of the work and uncertainties associated with it. Progress of the project is required to be monitored and compared as the work proceeds in order to be able to identify and measure these differences. Monitoring provides quantitative information on which control action may be based. When controlling project performances, it is important to monitor cost and time variances for the actual project progress. Variance analysis helps to monitor the project at every level of an organization. Variance analysis identifies problems, determine reasons for the plan deviations, formulate corrective action plans and report the result based on performance to date and estimates of future conditions. By considering the current and final state of actual and the plan, it is possible to build a quite detailed picture of the project. It is possible to produce the figures for the whole project or any section. Earned Value is a project control technique which provides cost and schedule performance measurements. It compares actual accomplishment of scheduled work and associated cost against an integrated schedule and budget plan.

2.0 Procedure for calculation of cost variance and its components:

This paper is related to calculation of cost variance for different activities involved in the construction of underground water tank (UG). The work is allotted as an item rate contract. Cost variance is calculated from contractor's point of view. Rates are taken from District schedule rates (D.S.R). To calculate cost variance and its components, following data is required:

Project plan, schedule and budget.

Base rates of resources to be considered during rate analysis.

Actual quantities of activity executed.

Actual cost for activity executed.

From the project plan, a schedule of activities which are to be executed is prepared as below:

Act. No.	Qty.	Unit	Time Duration (Weeks)	Start	Finish
1	52.2	cum	3	0	3
2	20.9	sqm	1	3	4
3	10.1	cum	1	4	5
4	44.4	cum	2	5	7
5	20.2	sqm	1	7	8
6	47.5	sqm	2	8	10

7	30.3	sqm	1	10	11
---	------	-----	---	----	----

Rate analysis is done for the number of activities which are to be executed. After rate analysis is done, the first step is to prepare budget sheet where how much work should be done in a week is given as per schedule. The steps are as follows:

The budget quantity sheet is prepared first.

From the total budgeted quantity (Q_{tb}), the budgeted material quantity (Q_{bm}) and the budgeted labour quantity (Q_{bl}) is calculated.

Budgeted Material Quantity (Q_{bm}) = Total budgeted quantity (Q_{tb}) * Unit Material Quantity (Q_{um})

Budgeted Labour Quantity (Q_{bl}) = Total budgeted quantity (Q_{tb}) * Unit Labour Quantity (Q_{ul})

After calculating the quantities, the budgeted material rate (R_{bm}) and budgeted labour rate (R_{bl}) are taken from D.S.R.

The budgeted cost of material and labour is calculated by formula below:

Budgeted Material Cost (C_{bm}) = Budgeted Material Quantity (Q_{bm}) * Budgeted Material Rate (R_{bm})

Budgeted labour cost (C_{bl}) = Budgeted labour Quantity (Q_{bl}) * Budgeted Material Rate (R_{bl})

Now, after actual execution of work, the total actual quantity (Q_{ta}) is noted in actual quantity sheet.

After actual execution of work, the actual material quantity (Q_{am}) and actual labour quantity (Q_{al}) are noted.

The actual material rate (R_{am}) and actual labour rate (R_{al}) are noted.

The actual cost of material and labour is calculated by formula given below.

Actual Material Cost (C_{am}) = Actual Material Quantity (Q_{am}) * Actual Material Rate (R_{am})

Actual labour cost (C_{al}) = Actual labour Quantity (Q_{al}) * Actual Material Rate (R_{al})

The cost variance(CV) which is difference between budgeted cost and actual cost is as shown in formula below:

Cost Variance (CV) = Budgeted Cost – Actual Cost

Cost variance is further broken down into its 3 components and their formulas are given below:

Cost Quantity Variance (CV_{quant}) = (Total budgeted Quantity (Q_{tb}) - Total actual Quantity (Q_{ta}) * Actual material Quantity (Q_{am})

Cost Price Variance

(CV_{price}) = (Budgeted Rate (R_b) – Actual Rate (R_a)) * Total budgeted quantity (Q_{tb})

Cost Productivity Variance(CV_{prod}) = (Total Actual Quantity (Q_{ta}) * Unit labour quantity (Q_{ul}) – Actual labour quantity (Q_{al}) * Budgeted labour rate (R_{bl})

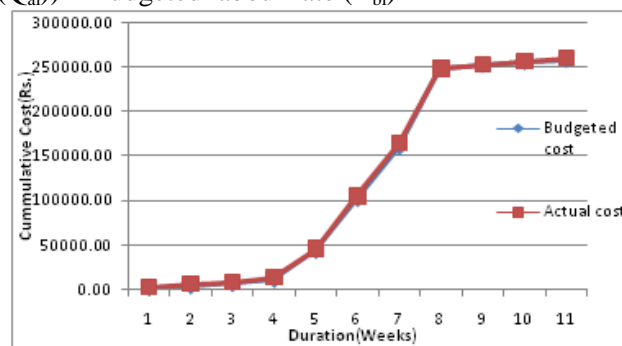


Fig 1: Graph showing S-curve of budgeted cost vs. actual cost

3.0 Graphs: Below are some graphs which show cost variance and its components

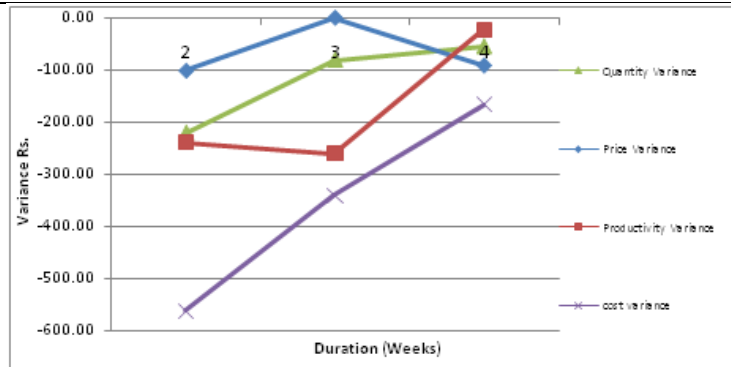


Fig. 2: Graph showing variance from 2nd to 4th week

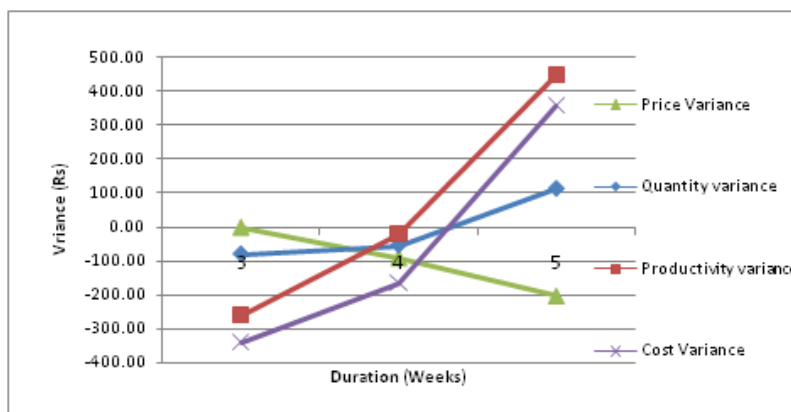


Fig. 3: Graph showing variance from 3rd to 5th week

II. CONCLUSION

From these variances, one can know how much variance is occurring with respective activity. Variances are calculated from the contractor's point of view. The components of variance give us an idea about how much amount of quantity, price and productivity variance is occurring with respective activity. By calculating the variance and its components one can know the factors and determine the reasons which cause these variances and accordingly formulate corrective action. Following points can be concluded from the project:

After variance analysis, it can be seen that the variances if calculated at early stage can reduce further costs overruns of the project.

It can be seen that by knowing the factors of variances, one can identify potential problems and can take corrective action accordingly which serves as a key element of a project's risk management process.

Variance analysis is a better method because it integrates cost, time and the work done and can be used to forecast future performance and project completion dates and costs.

It can be useful to any level of organization and a consistent assessment of work can be done.

It allows better and more effective management decision making to minimize adverse impacts to the project.

It ensures a clear definition of work prior to beginning that work.

It presents a logical plan for accomplishing the work.

REFERENCES

Robert I. Carr, (2010), "Cost, Schedule and Time Variances and Integration", *Journal of Construction Engineering and Management*, Vol. 119, page no. 245

Suneerat Wongwitdecha, (2009), "Owner contractor risk apportionment for Lump-sum and unit-price contracts using project control systems"

Alberto De Marco, Diego Briccarello, Carlo Rafele, (2009), "Cost and Schedule Monitoring of Industrial Building Projects: Case Study", *Journal of Construction Engineering and Management*, Vol. 135, page no.9

Sou-SenLeu, You-CheLin, (2005), "Project Performance Evaluation Based on Statistical Process Control Techniques", Vol.134, page no.10