# "Quality Control at Site; Effectiveness of Cost Management"

Milind N. Telavane[1]

Department of Civil Engineering
Shivajirao S. Jondhle College of Engineering & Technology
Asangaon-421601

*telavanem@gmail.com*

Prof. R.M.Swamy[2]

Department of Civil Engineering
Shivajirao S. Jondhle College of Engineering & Technology
Asangaon-421601

*rmswamy68@gmail.com*

**Abstract:-**Achieving project completion within the estimated cost is fundamental criteria for success of any project. Hence cost management and control is very important consideration for ensuring cost performance. Various cost management techniques can be applied throughout the project life cycle to avoid poor cost performance and overrun of cost. This study focused assessing project cost performance and level of effectiveness of various assessing project cost performance and level of effectiveness of various cost management techniques implemented in large construction project over the world. Most of projects face cost overrun problem which may result into construction delay. Realizing the advantages of cost management, it should be considered to implement this method to achieve better cost performance.

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## LIST OF ABBREVIATION

| | |
|---|---|
| AC | Actual Cost |
| ACWP | Actual Cost of Work Performed |
| BCWP | Budgeted Cost of Work Performed |
| BCWS | Budgeted Cost of Work Scheduled |
| CPI | Cost Performance Indicator |
| CV | Cost Variance |
| EV | Earned Value |
| EVM | Earned Value Management |
| PV | Planned Value |
| SPI | Schedule Performance Indicator |
| SV | Scheduled Variance |
| TCPI | Total Cost Performance Indicator |
| TSPI | Total Schedule Performance Indicator |

## I.   INTRODUCTION

The cost is the most common measure of success of a project in construction industry. All projects are managed and measured by success criteria of several types, cost being only one of many important metrics but cost as a resource and as a measure possesses unique attributes which differentiate it from other project measures and requires unique considerations and methodologies in order to provide for its effective management. EVM is the one of the technique used for cost management. Earned value, planned value, actual cost are the term involved in Earned Value Management.

Cost management is the process of effectively planning and controlling the costs involved in the business. Cost performance is fundamental criteria for success of any project. It helps to identify future expenditure in a business to reduce budget overages. When cost management is applied to specific project the expected cost in business are analyzed in the management is applied to specific project the expected cost in business are analysed in the beginning phase of the planning period. The project manager then approves the predicted expenses in purchasing the material required for the project. In cost management, cost and expenses are recorded and monitored during the project execution period to ensure that the cost is in line with the actual cost management plan. Once the project is complete, actual cost are compared with the predicted cost which will help in predicting future expenses.

## II.   OBJECTIVES OF COST MANAGEMENT

The objective of cost management is
- To reduce the cost expended by an organization while strengthening the strategic position of the firm.
- To identify future expenditure in a business to reduce budget overages.
- Tackle challenging task in business management, to reduce construction delays.
- To improve pricing decision.

## IMPORTANCE OF COST MANAGEMENT :-

- It helps to finish project on time & in given budget.
- It also helps to analyse expected cost to control project expenses.
- Cost management tackle challenging task in business management, to reduce construction delays.
- It improves pricing decision.
- Cost management link corporate strategies.
- It evaluate the effectiveness of activities for investment.
- The ability to predict a project's future expenses and costs.
- The maintenance of a central record of all predicted expenses and costs.
- The ability to ensure that costs are approved before purchases are made.
- The ability to control project expenses.
- Ability to evaluate source of cost.

## III. LITERATURE REVIEW

**MahanimHanid, LauriKoskela Mohan Siriwardena [1]**

This paper provides an overview of the state of research in the fields of construction cost management. It is noted that waste is an important issue that needs to be tackled in construction cost management. This is so because waste is considered as illogical from an economic point of view and it needs to be better managed, reduced or ideally resolved. Waste is seen as uses of resources that do not involve transformation or generating value for the customer.

Failure to overcome waste in the construction cost management system will weaken system. There is scope for further research to improve the traditional cost management system which looks into the issue of wastage.

**Mr. Joseph A Lukas [2]** This paper will first provide a review of earned value terminology, formulas and key metrics to monitor when using earned value analysis. After this review, the common errors encountered in implementing EVA and corrective actions will be covered in detail. By the end of this paper you'll hopefully realize this paper really isn't just about using earned value analysis, but really covers the more important topic of having a complete and integrated project plan in place, which is a cornerstone of earned value` management.

**J. Magalhaes-Mendes [3]** In a construction project there are two main factors, such as project duration and project cost, These are depended to each other. The activity duration is a function of resources (i.e. crew size, equipments and materials) availability. On the other hand resources demand direct costs. Therefore, the relationship between project time and direct cost of each activity is a monotonously decreasing curve. It means if activity duration is compressed then that leads to an increase in resources and so that direct costs. But, project indirect costs increase with the project duration. In general, for a project, the total cost is the sum of direct and indirect costs and exists an optimum duration for the least cost. Hence, relationship between project time and cost is trade-off. The main purposes of this study is to incorporate both the duration time and cost into the objective function and to develop an efficient heuristic search scheduling rule using a genetic algorithm.

**Dr. M. K. Trivedi and Sapan Namdev [4]** Over a year many research had solved construction optimization problems. The techniques used by them varied in nature between mathematical techniques or conventional techniques to heuristic techniques. Over a past 20 years researchers had emphasized on Evolutionary Algorithms (EA) to solve construction optimization problems. Different Evolutionary Algorithms techniques such as Genetic Algorithm (GA), Ant colony method etc, had been used by many researchers to optimize the time-cost of a construction project. In this paper a detailed literature review of different approaches used by researchers to optimize the time-cost of a construction project is going to be highlighted.

**Andrea P. Kern, Carlos T Formoso Kern [5]** This paper discusses traditional cost management practices in the construction industry and proposes some guidelines for improving cost control such guidelines involve the integrated application of operational cost, estimating, target costing of S-Curves. It is argued that traditional management has been identified as infective mainly for the fact that it does not take into consideration the production processes involved, due to conceptual base on which these are founded.

This can integrated application of operational cost estimating. S-Curves and target costing has been outlined aiming to improve cost management will become proactive and able to deal with the dynamic, uncertain and complex construction environment that exists in many projects. Besides the utility of the information that is produced the implementation of the tools can also benefits production management by increasing process temporary revealing some problems related to the firm organization.

## IV. METHODOLOGY

Cost is the value of money that has been used up to produce something. Cost is the metric used in the standard modeling paradigm applied to economic process. In business cost may be one of acquisition, in which case the amount of money expended to acquire it is counted as a cost or cost is the value of money that has been used up to produce something. In simple word cost can be defined as the amount spent to achieve goal.

Cost has vital importance in construction industry as it is a measure for success or failure of the project.

**Types of cost**
**Direct cost**
Direct cost can be defined as the cost which can be accurately traced to a cost object with little effort

**Examples:-**
Cost of gravel, sand, cement and wages incurred on production of concrete.

**Indirect cost**
Cost which cannot be accurately attributed to specific cost objects are called indirect cost.

**Examples:-**
Cost of depreciation, insurance, power, salaries of supervisors incurred in concrete plant.

**Accounting cost**
Accounting cost is the monetary value of expenditure for supplies, services, labour, products, equipment and other item purchased for a use by a business or other account entity.

**Opportunity cost**
It also referred to an economic cost is the value of the best alternative that was not chosen in order to pursue the current endeavour i.e., what could have been accomplished

with the resources expended in the undertaking it represents opportunities forgone. In theoretical economics, cost used without qualification often means opportunity cost.

## COST MANAGEMENT

Project cost management is method that uses technology to measure cost productivity through the full lifecycle of enterprises level projects. It is collecting, analyzing, evaluating and reporting cost information used for budgeting, estimating, forecasting and monitoring costs.

Strategic cost management is the application of cost management techniques that simultaneously improve the strategic position of a firm and reduce costs. Strategic cost management methods can be applied in service, manufacturing, and not-for-profit arenas.

## EARNED VALUE MANAGEMENT

Earned value management (EVM) is a project management technique that objectively tracks physical accomplishment of work.

- Earn value management (EVM) technique used to track the progress and status of a project & forecast the likely future performance of the project.
- EVM technique integrates the scope, schedule and cost of a project.
- EVM technique answers a lot of questions to the stakeholders in a project related to the performance of the project.
- EVM technique can be used to show past performance of the project, current performance of the project and predict the future performance of the project by the use of statistical techniques.
- Good planning coupled with effective use of the EVM technique will reduce a large amount of issues arising out of schedule and cost overruns

EVM emerged as a financial analysis specialty in united states government programs in the 1960s, but it has since become a significant branch of project management

In the late 1980s and early 1990s, EVM emerged as a project management methodology to be understood and used by managers and executives, not just EVS specialists. Today, EVM has become an essential part of every project tracking.

## Basic Concepts Of EVM

Following are the three basic elements of EVM
- Planned value (PV)
- Actual cost (AC)
- Earned value (EV)

All the three elements are captured on a regular basis as of a reporting date

## Planned Value (PV)

This is also referred to as budgeted cost of work scheduled (BCWS). Planned value (PV) or BCWS is the total cost of the work scheduled/planned as of a reporting date

This is calculate as:

PV or BCWS=Hourly Rate* Total Hours Planned or Scheduled

## Earned Value (EV)

This is also referred to as actual cost of work performed (ACWP). Actual cost (AC) or ACWP is the total cost of the work completed/ performed as of a reporting date
This is calculated as:

EV or BCWP= Base lined Cost* Complete Actula

All these three elements can be derived from work breakdown structure by associating the cost to each of the tasks. For a big project, it will be a tedious task to calculate these elements manually. Scheduling software like Microsoft project is used to calculate these three elements.

## Percentage Completed Planned

The percentage of work which was planned to be completed by the reporting date this is calculated using the following formula:

$$\%completed\ planned=PV/BAC$$

## percentage completed actual

The percentage of work which was actually completed by the reporting date this is calculated using the following formula:

$$\%completed\ actual= AC/EAC$$

## Cost Variance

Cost variance (CV) is a very important factor to measure project performance cost variance (CV)indicates how much over under budget the project is

$$Cost\ variance\ (CV)= earned\ value\ (EV)-Actual\ cost\ (AC)$$
OR
$$Cost\ variance\ (CV)=BCWP-ACWP$$

- The formula mentioned above gives the variance in terms of cost which will indicate how less or more cost has been used 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

## Cost variance Percentage

Cost variance percentage indicates how much over or under budget the project is in terms of percentage

Cost variance % can be calculated using the following formula:

$$Cv\%=cost\ variance\ (cv)\ /earned\ value\ (ev)$$
Or
$$CV\%=CV/BCWP$$

- The formula mentioned above gives the variance in terms of percentage which will indicate how much less or more money has been used to complete the work as planned in terms of percentage.
- Positive variance % indicates % under budget
- Negative variance % indicates % over budget

**Cost Performance Indicator (CPI)**

Cost performance indicator is an index showing the efficiency of the utilization of the resources on the project cost performance indicator can be calculated using the following formula

CPI= Earned Value (EV)/ actual Cost (AC)

Or

CPI=BCWP/ACWP

- The formula mentioned above gives the efficiency of the utilization of the resources allocated to the project
- CPI value above i indicates efficiency in utilizing the resources allocated to the project is good
- CPI value below i indicates efficiency in utilizing the resources allocated to the project is not good

**To Complete Cost Performance Indicator (TCPI)**

To complete cost performance indicator is an index showing the efficency at which the resources on the project should be utilized for the remainder of the project this can be calculated using the following formula

TCPI =(total budget-ev)/(total budget-AC)

Or

TCPI=(total budget-bcwp)/(total budget-ACWP)

- The formula mentioned above gives the efficiency at which the project should be utilized for the remainder of the project
- TCPI value above i indicates utilization of the project team for the remainder of the project can be stringent
- TCPI value below i indicates utilization of the project team for remainder of the project should be lenient

**Schedule Variance**

Schedule variance indicates how much ahead or behind schedule the project is schedule variance can be calculated as using the following formula

Schedule variance (sv)=earned value (ev)-palnned value (pv)

Or

Schedule variance (sv)=bcwp-bcws

The formula mentioned above gives the variance in terms of cost which will indicate how much cost of the work is yet to be completed as per schedule or how much cost of work has been completed over and above the scheduled cost

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

**Schedule Variance Percentage**

Schedule variance percentage indicates how much ahead or behind schedule the project is in terms of percnetage

Schedule variance percentage can be calculated using the following formula

Sv%=schedule variance (sv)/planned value (pv)

Or

SV%=SV/BCWS

- The formula mentioned above goves the variance in terms of percentage which will indicate how much percentage of work is yet to be completed as per schedule or how much percentage of work has been completed over and above the scheduled cost
- Positive variance %indicates %ahead of schedule
- Negative variance%indicates %behind of schedule

**Schedule Performance Indicator (SPI)**

Schedule performance indicator is an index showing the efficiency of the time utilized on the project schedule performance indicator can be calcuated using the following formula

SPI=earned value (ev)/planned value (pv)

Or

SPI=BCWP/BCWS

- The formula mentioned above above gives the efficiency of the project team in utilizing the time allocated for the project
- SPIvalue above i indicates project team is very efficient in utilizing the time allocated to the project
- SPI value below i indicates project team is less efficient in utilizing the time allocated to the project

**To Complete SchedulePperformance Indicator (TSPI)**

To complete schedule performance indicator is an index showing the efficiency at which the remaining time on the project should be utilized this can be calculated using the following formula

TSPI=(total budge-ev)/(total budget-PV)

Or

TSPI=(total budget-bcwp)/(total budget-BCWS)

- The formula mentioned above gives the efficiency at which the project team should utilize the remaining time allocated for the project
- TSPI value below i indicates project team can be lenient in utilizing the remaining time allocated to the project

TSPI value above i indicates project team need to work harder in utilizing the remaining time allocated to the project
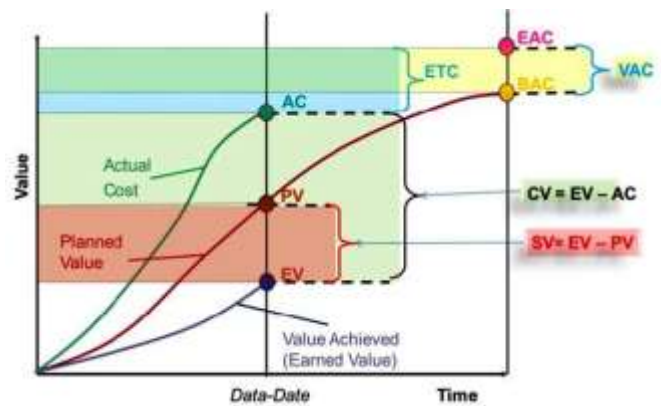


Earned Value Analysis Graph

## V. STRENGTH AND WEAKNESSES

### ADVANTAGES OF COST MANAGEMENT

As we discuss earlier cost performance is fundamental criteria for success of any project i n construction industry cost management employed by many business is an integral part of business management advantages of cost management are as follows

1. It helps to identify future expenditure in a business to reduce budget overages
2. When cost management is applied to specific project the expected cost in business are analysed in the beginning phase of the planning period
3. The project manager then approves the predicted expenses in purchasing the material required for the project
4. In cost management cost and expenses are recorded and monitored during the project execution period to ensure that the cost is in line with the actual cost mangagement plan
5. Once the project is complete actula cost are compared with the predicted cost which will help in predicting future expenses

6. It helps to finish project on time & in given budget
7. It evaluate the effectiveness of activities for investment

### LIMITATION OF COST MANAGEMENT

As cost management is not an exact science like other branches of accounting practices based on common sense and reasoning there are some limitation associated with cost management
Limitation of cost management are as follows
1. The system is more complex
2. It is expensive
3. Inapplicability of costing method and technique
4. Not suitable for small scale unit
5. Need preparation of prequnent reconciliation to verify accuracy

6. Does not control cost by itself
7. It is based on estimation and previous data
8. Use of secondary data
9. Lack of cooperation of employees

### CONCLUSION

- Cost is the important metric in construction industry for success of any project.
- Cost management employed by many businesses is in integral part of business management.
- EVM(Earned Value Analysis) is most easily associated with the monitoring and evaluation of project cost that are undertaken within an organization.

- This method will not actually reduce the cost of the project it will just help us to show current status of project work.
- Not only are the techniques, methodologies but management, Employee, worker also the people who responsible for cost management.
- There is a future scope to improve cost management by developing the cost management technique.

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