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# CONSTRUCTION PROJECT MANAGEMENT THROUGH EARNED VALUE MANAGEMENT SYSTEM

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***ABSTRAT: ndia is a standout amongst the most creating countries in the world; different developments have been made in construction industry. In most recent couple of decades, the idea of project management has increased expanding interest among big construction industries. During the construction project it has been observed that certain causes may lead to delay in construction activities. This will result in time and cost overrun in the project. So it has turned into a major issue to finish the project on time and cost. As an answer for this, the idea of construction management by Earned Value Management System (EVMS) is assessed. Earned Value Management is a capable approach as a part of monitoring and controlling of the project EVMS is the project management technique developed to measure the performance and progress of the project based on the combination of schedule, cost and work performed. By using this technique, the project status can be investigated in ongoing project at any stage which detects whether the project is under or over budget and behind or ahead of the planned schedule. Also the estimate cost and time required to complete the project from current situation can be investigate.***

***Keywords- Construction Management, Cost Controlling, Earned Value, Performance Measurement, Monitoring.***

## 1 GUJARAT INFRASTRUCTURE SECTOR SCENARIO

Gujarat, located on west of India, have biggest industries of the country. Gujarat infrastructure is quite developed and accommodates many industries. The major industrial and infrastructural hubs of the state include Surat, Ahmedabad, Rajkot, Vadodara, Bhavnagar, and Jamnagar.(11) The outlay for the Tenth Five Year plan for the state was fixed at Rs.47000.00 crore against that an expenditure of Rs.49415.54 crore was incurred during the plan period. The proposed outlay for the Eleventh Five Year plan of the state has been fixed at Rs.111111.00 crore which is 136.40 percent more than Tenth Five Year Plan.(12)

### 1.1 Ongoing projects in Gujarat:

- Gujarat International finance Tec-city is central business under-construction on the bank of river Sabarmati between Gandhinagar and Ahmedabad. GIFT City will have a special economic zone, entertainment zone, international techno park and one of the best Software Technology Parks of India. Source: Wikipedia

- India's first solar park at Charanka village in Gujarat then Dhirubhai Ambani Solar Park near Pokran in the Jaisalmer are two major solar power projects in India. Gujarat Solar Park known as Charanka Solar Park is Asia's largest solar park hub. Source: Wikipedia
- India got its first Bus rapid transit in Gujarat, Janmarg also known as Ahmedabad BRTS has specialized design, services and infrastructure to improve system quality.
- The Grand and largest dam of the Narmada Valley Project is the second largest concrete gravity dam (by volume) after Grand Coulee Dam in the US and has world's third largest spillway discharging capacity.
- The state of the art infrastructure projects have helped Gujarat become one of the richest and most developed states in the country. The various industries in the state depend on the infrastructure sectors significantly

**1.2 Surat scenario:**

Surat is India's eighth most populated and fastest growing cities in India. Its rank is fourth in a global study of fastest developing cities conducted by The City Mayors Foundation, an international think tank on urban affairs.Surat is located in the Southern part of Gujarat and is the second largest commercial hub in the State. Recently, the district of Surat was bifurcated into two new districts, viz. Surat district with headquarters at Surat and Tapi district with it's headquarter at Vyara. Surat is mainly known for its textiles & diamond processing industries.The district is emerging as a potential hub for IT/ITeS sector in Gujarat. Hazira and Magdalla Ports in the district provide logistic support to industrial operations in the state. Vyara and Songadh in Tapi district are known for dense forests with a major production of bamboos. The unit of Central Pulp Mills is located in Songadh. The estimated gross domestic product of Surat is at $10 billion in 2010. Surat contributed a maximum of 11.5% of Gross Domestic Product (GDP) to the State, as compared to any other district of India.(12)

**2 Issues in construction**

As construction field is a wide growing field and it is developing at its peak so as there are two sides of coin it has benefits and issues. There are lots of issues which effects the construction field in various ways these issues are listed below:-

- Rising cost
- Materials and supplies
- Equipments
- Time over run
- Labours
- Productivity
- Capital equipment
- Inflatation
- Procurement
- Safety
- Risk
- Planning and execution issues
- Improper scheduling
- Environmental factors
- Human resources
- Legal government issues
- Land issues
- Stakeholders issues
- Feasibility on land
- Supervision (13)

To overcome these issues Earned Value Management can be applied.

**3 Why EVM application is important**

It is a project management technique for measuring project performance and progress. In a single integrated system, Earned Value Management (EVM) is able to provide accurate

forecasts of project performance problems, which is an important contribution for good project performance. It is therefore considered a Performance Management approach. (14)
Its application is important due to following reasons:

- To check whether we are ahead or behind the schedule of the project.
- To check whether we are currently under or over budget of the project.
- To check how efficiently we are working with the project.
- To know when the project is likely to be complete.
- To know what is the remaining or entire project is likely to cost.

## 4 ELEMENTS OF EVM

The elements of earned value management system which helps to track the status of project are-

### 4.1 Planned Value (PV)

It is also called as Budgeted Cost of Work Schedule (BCWS). Planned value is defined as, "The authorized budget assigned to the scheduled work to be accomplished for a schedule activity or work breakdown structure elements." The planned value can be calculated by using following formula,

P. V = % Planned work completed x BAC

BAC = Budgeted cost at completion

### 4.2 Earned Value (EV)

It is also called as Budgeted Cost of Work Performed (BCWP). Earned Value is defined as, "The value of work performed expressed in terms of the budget assigned to that work for a schedule activity or work breakdown structure element." Earned value is total cost of work completed / performed as of reporting time. Earned Value can be calculated by using following formula,

E. V = % complete work x BAC

Where, BAC = Budget at completion

### 4.3 Actual Cost (AC)

It is also called as Actual Cost of Work Performed (ACWP). Actual cost is defined as, "The total costs actually incurred and recorded in accomplishing work performed for a schedule activity or work breakdown structure element." Actual cost is the total cost taken to complete the work as of reporting date. The actual cost can be calculated by using following formula,

A. C = Hourly Rate x Total hour spent

### 4.4 Cost Variance (CV)

Cost variance is the algebraic difference between the worth of the work that has been carried out and to the amount of money that was spent to do it. Mathematically it is represented by,

CV = EV – AC

A positive value of CV shows the project is spending less than the planned budget means it is favorable while the negative value shows that actual cost is exceeded than the budgeted amount which is unfavorable condition.

**4.5 Schedule Variance (SV)**

Schedule Variance is the algebraic difference between the worth of the work that has been carried out and to the amount of money that has to be spent according to the planning to do it. Mathematically it is represented by,

$$SV = EV - PV.$$

It determines whether the project is ahead or behind the schedule. Positive value of SV shows the project is ahead of the planned schedule which is a favorable condition and negative value shows it is behind which is an unfavorable condition.

**4.6 Cost Performance Index (CPI)**

Cost Performance Index is the ratio of earned value (EV) to actual costs (AC). It indicates the efficiency of resource use and measures the worth of the work that is achieved by spending every single unit cost. CPI is represented mathematically as,

$$CPI = EV / AC$$

A ratio less than 1 is an unfavorable and suggests the value of the work that has been accomplished is less than the amount of money spent and the cost is overrun. Whereas, the ratio more than 1 indicates favorable condition n tells more amount of work is achieved as that of the corresponding cost.

**4.7 Schedule Performance Index (SPI)**

Schedule Performance Index is the ratio of earned value (EV) to planned value (PV). It indicates the efficiency of time use and measures the worth of the work that is achieved by spending every single unit time. SPI is represented mathematically as,

$$SPI = EV / PV$$

A ratio less than 1 is an unfavorable and suggests the value of the work that has been accomplished is less than the amount of time spent and the cost is overrun. Whereas, the ratio more than 1 indicates favorable condition n tells more amount of work is achieved as that of the corresponding time.

**4.8 Budget at Completion (BAC)**

Budget at Completion is the total amount of money expected to be spent on the project. The "Fig.1" indicates the graph of EVM elements.

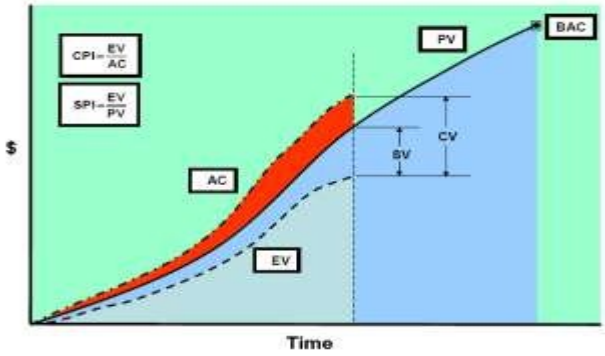


**Figure 1 – Elements of EVMS**

**5 Evm and other analysis techniques:**

There are many methods of forecasting but we have studied 4 methods for forcasting for this paper they are CPM, EVM, KFFM, BAFM.The critical path method (CPM) and earned value management (EVM) are deterministic where as Kalman filter forecasting

method (KFFM) and the Bayesian adaptive forecasting method (BAFM) are probabilistic methods.

| Criteria | CPM | EVM | KFFM | BAFM |
|---|---|---|---|---|
| Major Properties | - Activity level control<br>- Retrospective | - Project level control<br>-Linear extrapolation | - Project level control<br>- Probabilistic prediction<br>- Use of prior information | - Project level control<br>- Probabilistic prediction<br>- Use of prior information |
| Input requirements | - Activity network<br>-Activity estimates | - The planned value<br>- The earned value<br>- The actual cost | - Prior probability distribution of project duration<br>- The baseline curve<br>- The actual progress | - Prior probability distribution of project duration<br>- The baseline curve<br>- The actual progress |
| Limitations | - Only for schedule | - For schedule and cost. | - For schedule and cost. | - For schedule and cost. |
| Applicability | - Only for projects with a network schedule available | - Universally applicable to all projects of all types, sizes, and complexities | - Universally applicable to all projects of all types, sizes, and complexities | - Universally applicable to all projects of all types, sizes, and complexities. |
| Ease of implementation | - Activity level knowledge is required<br>- Activity level updates<br>- Commercial software | - Project level update<br>- Simple formulas based on three variables | - Project level update<br>- Simple formulas based on three variables<br>- Basic knowledge about probabilistic forecasting | - Project level update<br>- Simple formulas based on three variables<br>- Basic knowledge about probabilistic forecasting |
| Ease of communication | - Difficulty increases with the number of activities. | -Understanding of the three Basic variables is required. | - Understanding of EVM and probabilistic forecasting is required. | - Understanding of EVM And probabilistic forecasting is required. |

**Table 1 Comparison of forecasting methods: Basic properties (15)**

**6 Losses for not following EVM**

- If EVM is not followed then there will be cost overrun and time overrun issues which will drag down the project to a dead level.

- More cost expenditure and wastage of time is incurred if EVM is not applied.
- Due to no working of time and cost expenditure is increased in project.
- No prediction of ongoing project will be there if EVM is not applied.
- No track of activities and schedule will be there by contractors so will ultimately incur loss to contractor.

**6.1 Concrete application and contractor benefits areas**

- EVM keeps the management on their toes. As EVA is done periodically, management tries to make sure that all the project parameters are on track.
- It is used to measure and predict the progress in the ongoing project.
- It is the only system used at present which track the project in terms of work, time and money.
- It allows the project manager to be on time and on budget.
- The cost performance index (CPI) and schedule performance index (SPI) provides an early warning signal.
- It can be applied to any construction project and is mainly useful for huge construction project.
- Timely performance measurement makes sure that steps can be taken to the bring project back on track before it's too late.

**6.2 Drawbacks of EVM**

- While doing Earned Value analysis, we don't take quality into consideration..
- Cost of implementing Earned value management causes managers to not use it extensively. Generally, software is required and coordination between different departments should be good to achieve the goal
- It is required to be carried out at different stages as the uncertainty may occur any time throughout the project.

## 7 CONCLUSION

On the basis of above concept of EVMS, we have concluded the following points,

- On comparing Earned Value Management method to traditional management, traditional management does not allow for analysis of physical amount of work performed. Earn value management allows both schedule cost analysis against physical work performed.
- Earned Value provides an early warning signal to managers to take the corrective action.
- It helps the project manager to understand time estimate for the completion of the project and provide further insight for making better decision about the project schedule.
- Where the traditional method focuses on planned accomplishment, the Earned Value Management goes one step ahead and examines actual accomplishment.
- Timely performance measurement makes sure that steps can be taken to bring project back on track before it's too late.
- Earned Value Management gives executives, project manager and other stakeholder's ability to visualize project status throughout the project life cycle and helps to manage the project more effectively.

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