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PROJECT PERFORMANCE IN REAL TIME CONSTRUCTION INDUSTRY - A CASE STUDY

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ABSTRACT

Construction project involves risk and it is complex in nature. The Complexity of project may increase Cost and time of the project. Even a small construction project involves many activities starting from land acquisition ending with finishing and handing over the project to end user. Thus, commitment between customer and Contractor/ Client/ Developer plays important role. For timely completion of project, construction project Planning, Scheduling and controlling of activities from commencement stage up to completion stage is essential. Hence reduction in Cost Overruns and Schedule Overruns can be observed only if proper Planning and Controlling of project is carried out. This paper aims at Planning, Scheduling and Tracking a real time eighteen storey luxury apartment construction project. The tracking was carried out for seven months to observe the pattern of construction project and Earned value management (EVM) was carried out to measure the performance and efficiency of the project. The result of Cost performance Index (CPI) and Schedule Performance Index (SPI) was obtained. The MS Project software tool also simulated the project's Budget at Completion (BAC) and Variance at Completion (VAC). The results obtained from simulation helps project manager in controlling the cost and avoiding the delay of the project.

Key words: Earned vale management (EVM), Construction project performance, Cost and Schedule Overruns.

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1. INTRODUCTION

Construction Industry is the oldest form of industry since dawn of Civilization. In India, second largest industry next to agriculture is Construction, as it employs about 33 million people.(Jha, 2012).Construction Project has its own end product in the way of facility such as Building, Roads, Bridges, or assembly of some of infrastructure.

A project involves a set of complex activities which are sometimes interrelated and also consume resources such as Time, Manpower, Machinery and Money. Thus it is very essential to plan, coordinate and complete a construction project within stipulated conditions.

Construction is a complex process and it varies from every project, hence we can determine the pattern in which a project has to move on. The following are some of key features of construction project (Jha, 2012)

- Construction is a single time execution
- Construction projects are complex
- Construction projects require huge time for execution and completion, it includes several risks.
- Cause for failure of construction projects may be due to lack of Experience of Resource associated with it.

A project is basically coordinator with all departments of the organization. Any reputed construction organization will have following departments-

- Contracts and Purchase department.
- Engineering department.
- Materials department.
- Planning department.
- Finance department.
- Quantity surveying department.
- Land department.
- Legal and Liasioning department
- Human resource department.

Thus, it becomes a key role of project manager to coordinate with all departments for the effectiveness and success of a construction project.

2. BACKGROUND STUDY

Infrastructure acts as a major role in the economic growth of India. Investments on Infrastructure are growing consistently in India. Every five year plan aims at investment higher to the prior five year plan. (Institute and KPMG, 2012)

In 2012, study on time and cost overruns across major infrastructure projects was carried by KPMG, on request of Ministry of Stastics and Programme Implementation (MoSPI).

According to the report (Institute and KPMG, 2012) lack of requisite skill is a major concern and also the skilled resources, political risks and cultural variability accounts to the cost and time overruns of project.

It is also noted that cost overruns is due to changes in design and bad procurement planning, which in turn can be rectified by training of project managers.

From the data published by KPMG report (Institute and KPMG, 2012), about 86 percent of the participants of survey agree that project management office could be a better way for monitoring projects.

Thus, it can be concluded that project management is an effective way for monitoring the projects (Institute and KPMG, 2012)

According to (Assaf and Al-Hejj, 2006) construction delay can be defined in terms of cost overruns and time overruns, the major reason for delay is improper communication between contractor, consultant and engineer in every simple or complex type of construction projects. Thus, it can be said that improper planning, management and scheduling acts as a controlling factor for delay.

A successful project is when it is completed within scheduled time and cost (Hannah and Srinivasan, 2014)

According to (Hannah and Srinivasan, 2014), the major cause factor for cost overruns and time overruns is management of manpower resources. Hence, management of resource is easy when the proper planning and allocation of resource is achieved.

Cost and timetable invades can happen for a wide mixed bag of reasons on different sorts of ventures which has prompted the open deliberation on the best way to minimize these construction cost and schedule overruns. (Jenpanitsub, 2011)

Construction industry is the unique industry through which economy of a nation can be achieved. Due to the present complexity and environmental hindrances for construction project, construction managers play a major role in co-ordination of the projects. (Enhaasi et al., 2003)

Construction and infrastructure industry is one that assumes an indispensable part in the economic development of a nation. Monetarily, it leads to the contribution in the changing to the general gross domestic product of a country. It likewise improves the infrastructure of the country, for example, streets, healing centers, schools and other essential commercial offices. Thus, it requires very basic plan and critical thinking to make the development activities finish effectively inside of the time, spending plan and quality anticipated. In any case, being a perplexing, divided and timetable driven industry it is dependably confronting constant issues, for example, low quality, low efficiency, expense invade, time overwhelm, development waste and so on. Of these, expense invade is the real issue as cash is dependably of high significance.

Cost Overruns is a worldwide wonder in the development business and extremely once in a while undertakings are done inside of the planned expense. The issue of expense invade in development tasks is exceptionally prevailing in both created and creating nations yet, this pattern is exceptionally serious in creating nations where these overruns may exceed 100% of the foreseen cost. (Azhar, Farooqui and Ahmed, 2008)

Worldwide investigation of development venture execution inferred that cost overruns are a noteworthy issue in the development industry where nine of ten construction projects are confronted by these invades which generally run between fifty to hundred percent. In developed nations like United Kingdom, additionally construction industry is influenced by this issue and about 33% of the customer's complaint is that their project overruns by estimated resources. (Memon, 2013).

3. RESEARCH OBJECTIVE

The major is to represent the construction industry of India in aspects of planning, scheduling and tracking. As per the previous investigations and the report published by Government of India with the help of Project Management Institute and KPMG, it can be noted that improvement in Project management leads to success of any construction project (Institute and KPMG, 2012). So, it was decided to make approach on real time construction project. Hence, it would be help anyone who is interested in studying real scenario of construction project with aspects of Planning.

The objectives are-

- To carry out literature survey about Planning, Scheduling and Tracking related to real time construction project.
- To use project management software such as MS Project for scheduling and allocation of resources for the project.

- To track the construction project for few months and check the variance in terms of cost and schedule.
- To analyse the causes for delay of the construction project.

4. METHODOLOGY

The construction activities were planned according to the project and it was programmed in MS Project.

Each activity was allocated with different kinds of resource. Usually resource is classified as Material, work and cost. Here, manpower, equipment falls under criteria of work as they are charged on hourly basis, where as cost can be considered for Lumpsum activities such as Installation of electrical work etc.

MS Project is project management software which is developed by Microsoft and sold by Microsoft. MS project helps the project manager in designing of activities, which are carried out throughout the project. It helps in planning, scheduling the activities, allocating the resource for each activities and also tracking the information of resources throughout the project.

It also helps in calculation of budget of the project.

An 18 storey residential apartment construction project was considered. The construction is carried out by Jain Heights, Bengaluru. Project name is Grand west

In this project, resources were calculated and uploaded to each activities of construction

This Project was started 2nd of November, 2015. As per planned schedule the project is to be completed by 26th of June, 2020.

The brief description of project is as follows

- Number of towers: 2
- Number of storey in each tower: LB+UB+G+18 floors
- Amenities: Clubhouse, swimming pool, Playground and other sports activities.

Figure 1 shows the MS project program and allocation of resources to the respective activities and Figure 2 shows that there are 347 activities involved in project

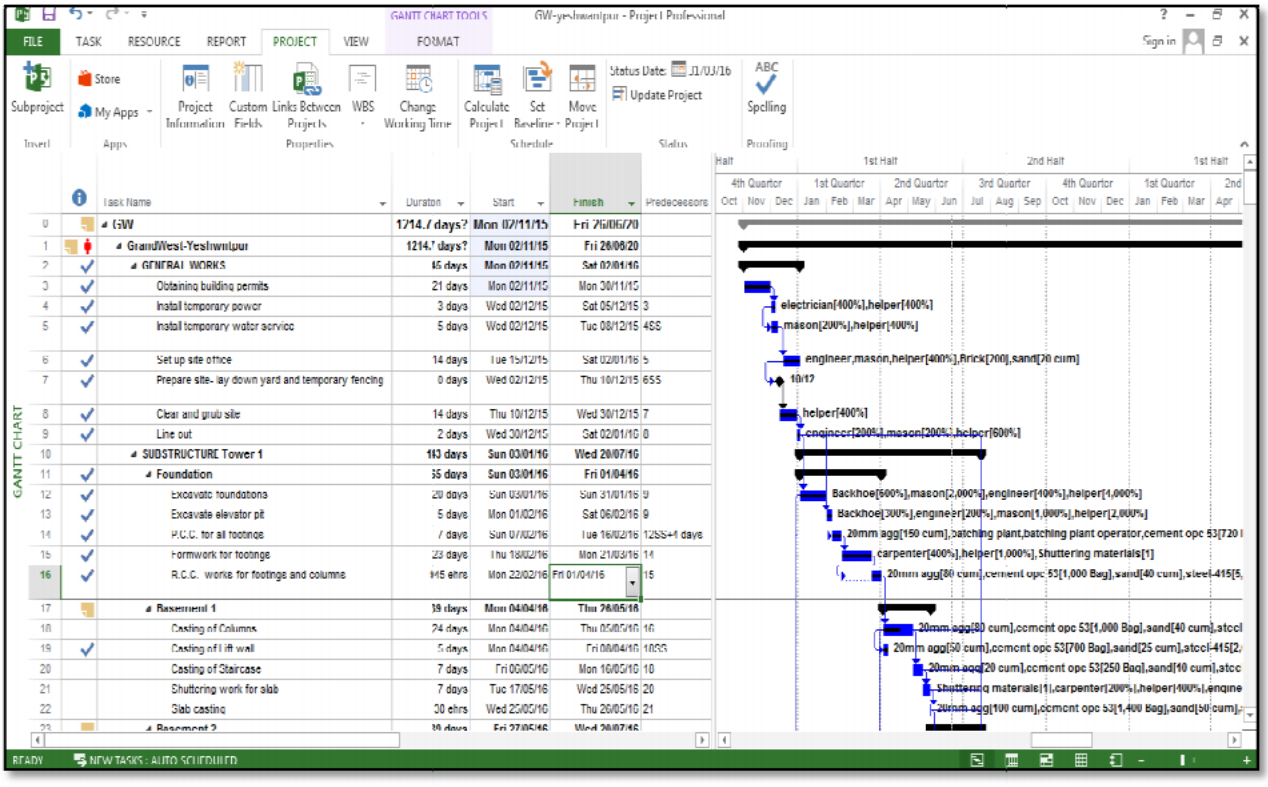


Figure 1 MS Project program

The activities are loaded in MS Project software. Each activity is tracked and status is updated at frequent intervals.

The resources such as Manpower, Machinery and Materials are allocated to their respective activities. Figure 3 shows the list of resources considered for the project. These resources are loaded to the activities according to the requirements and they are tracked.

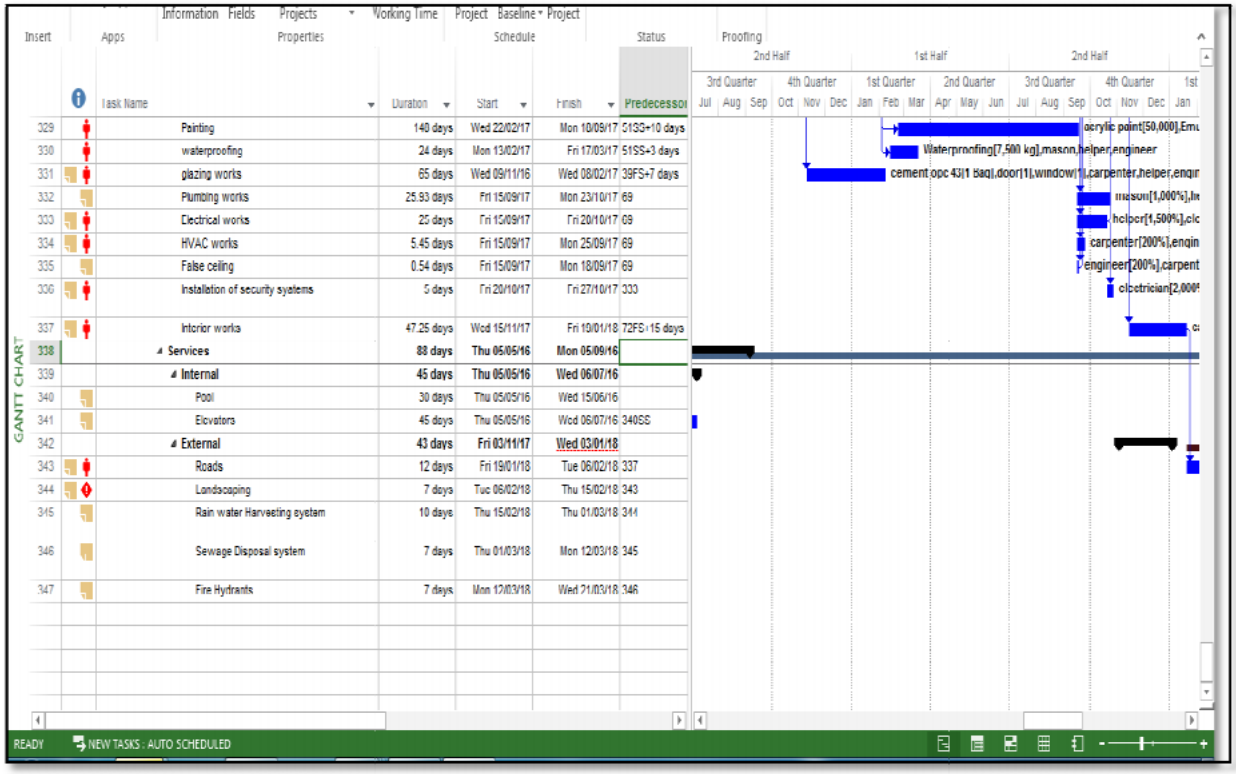


Figure 2 MS Project Program

COST DETAILS

Cost details for all work resources.

RESOURCE COST OVERVIEW

Name	Actual Work	Actual Cost	Standard Rate
carpenter	1,528 hrs	Rs. 57,300.00	Rs. 300.00/day
mason	5,432 hrs	Rs. 169,750.00	Rs. 250.00/day
helper	13,654 hrs	Rs. 341,350.00	Rs. 200.00/day
engineer	1,600 hrs	Rs. 180,000.00	Rs. 900.00/day
batching plant	504 hrs	Rs. 403,200.00	Rs. 800.00/hr
batching plant operator	504 hrs	Rs. 15,750.00	Rs. 250.00/day
Backhoe	1,080 hrs	Rs. 1,080,000.00	Rs. 8,000.00/day
electrician	96 hrs	Rs. 4,800.00	Rs. 400.00/day
painter	0 hrs	Rs. 0.00	Rs. 250.00/day
project manager	1,724.6 hrs	Rs. 862,300.00	Rs. 4,000.00/day

Figure 3 List of Resources for Project

The status of work can be extracted from site progress and updated to software. This calculates the variation of project from planned budget and schedule. The project was tracked from 2nd of November, 2015 till 31st of May, 2016. Figure 4 shows the Baseline Cost Report, Budgeted Cost and actual Cost of the project.

Work of the project is measured in term of man hours. Figure 5 shows the Baseline work, Budgeted work and Actual work completed till 31st May, 2016.

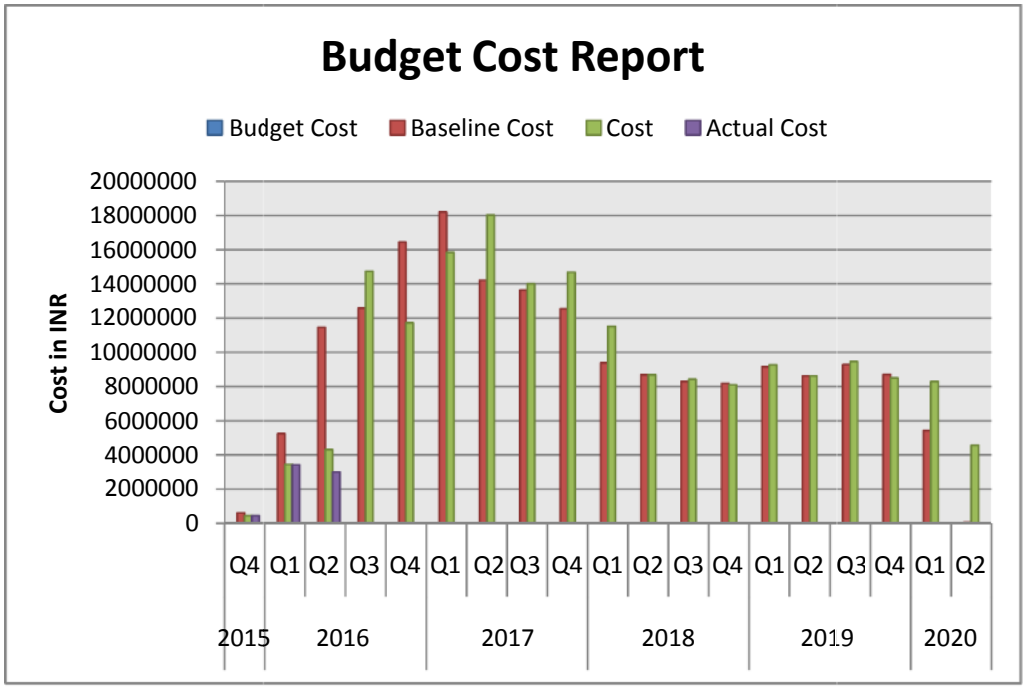


Figure 4 Cost Report of the Project

The Baseline work comparison with actual work is shown in Figure 5.

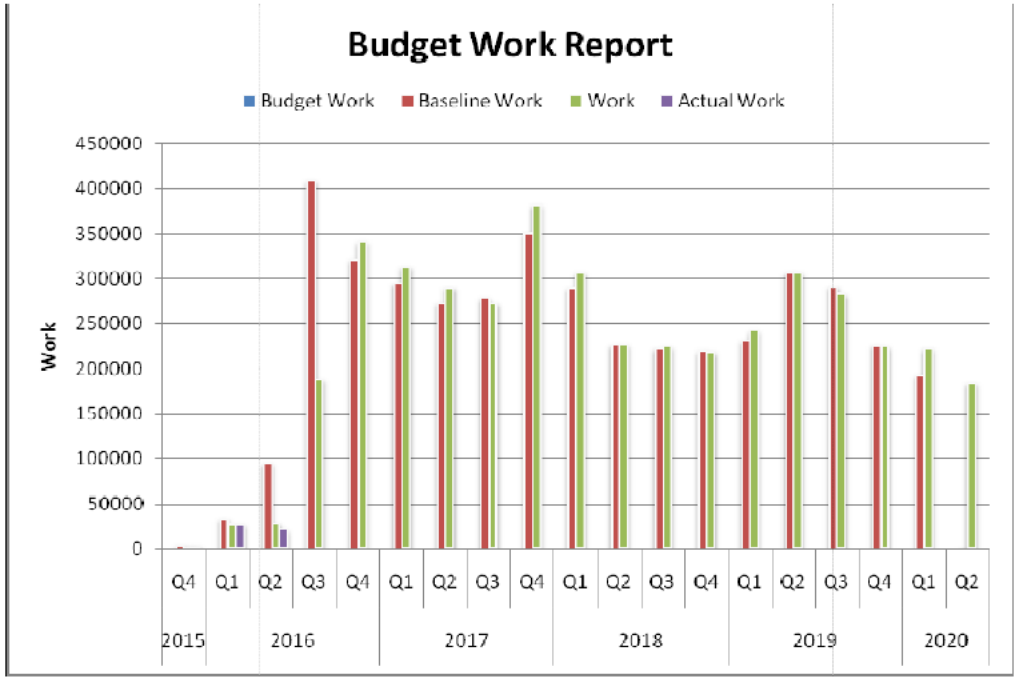


Figure 5 Work Comparison of the Project

Earned Value Management is a technique used to measure the performance of a project. The purpose of EVM are-

- Compare time phased budgets to specified tasks or specific activity of project.
- To provide the progress analysis of project against the baseline plan.
- To interrelate technical, schedule and cost performance of project.

Figure 6 shows the Earned value over time report. Earned value is calculated by multiplying Baseline cost and Actual percentage completion of project.

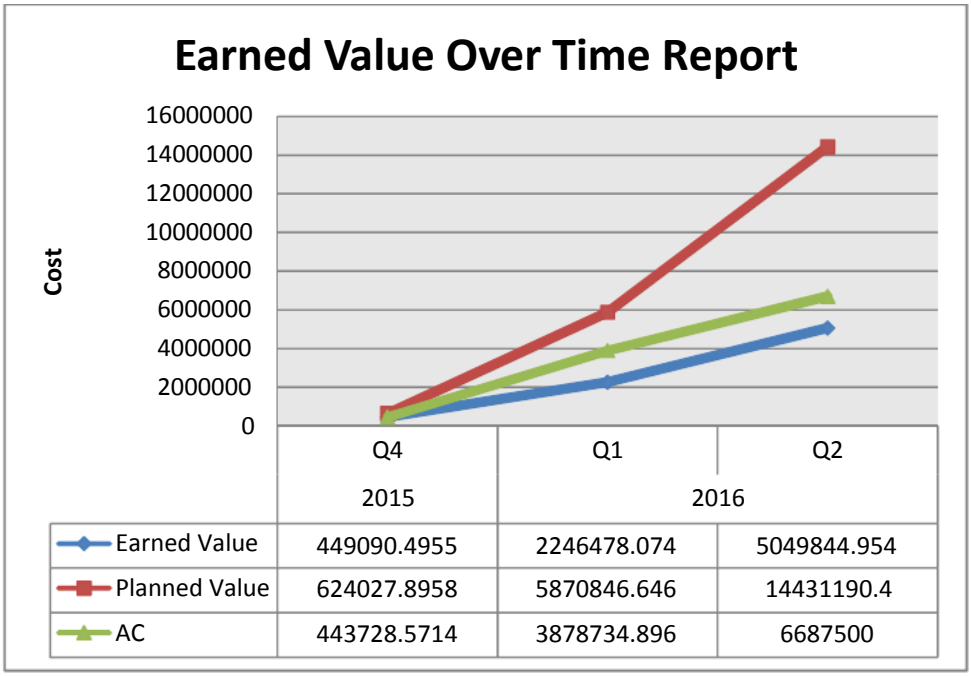
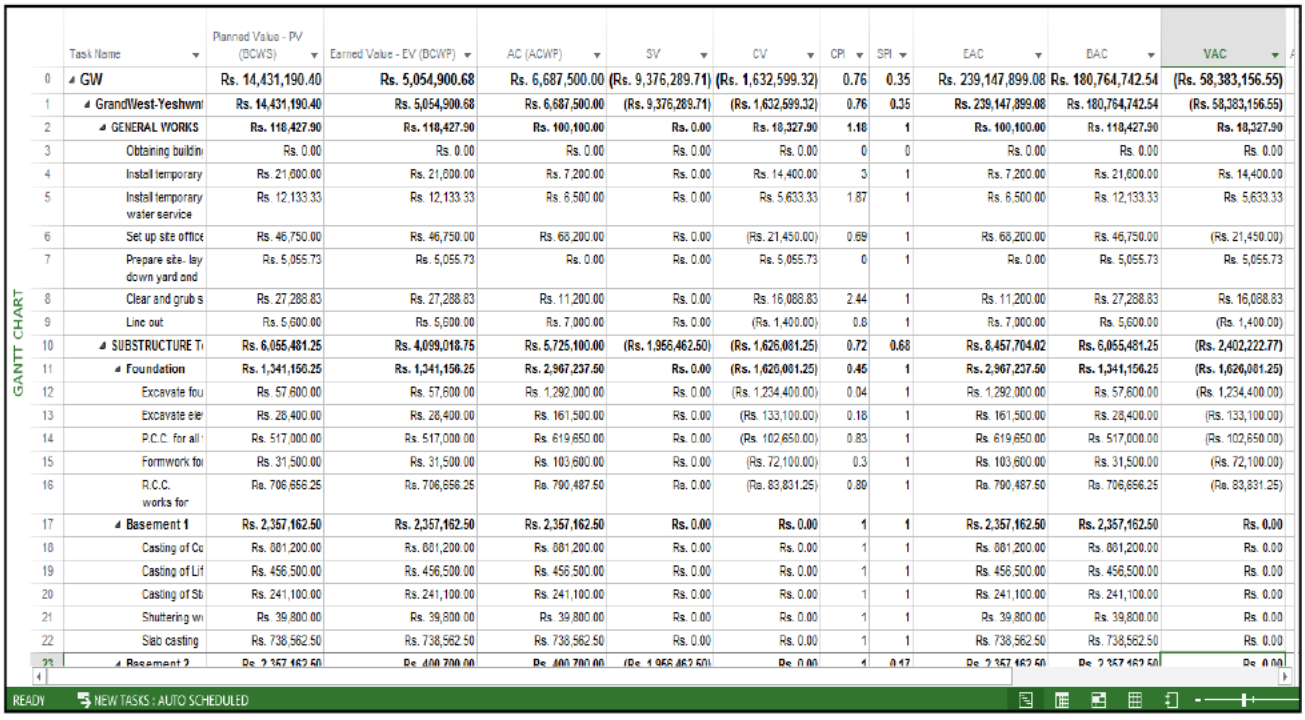


Figure 6 Earned Value Report



	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	AC (ACWP)	SV	CV	CPI	SPI	EAC	BAC	VAC
0	GW	Rs. 14,431,190.40	Rs. 5,054,900.68	Rs. 6,687,500.00	(Rs. 9,376,289.71)	(Rs. 1,632,599.32)	0.76	0.35	Rs. 239,147,899.08	Rs. 180,764,742.54	(Rs. 58,383,156.55)
1	GrandWest-Yeshwnt	Rs. 14,431,190.40	Rs. 5,054,900.68	Rs. 6,687,500.00	(Rs. 9,376,289.71)	(Rs. 1,632,599.32)	0.76	0.35	Rs. 239,147,899.08	Rs. 180,764,742.54	(Rs. 58,383,156.55)
2	GENERAL WORKS	Rs. 118,427.90	Rs. 118,427.90	Rs. 100,100.00	Rs. 0.00	Rs. 18,327.90	1.18	1	Rs. 100,100.00	Rs. 118,427.90	Rs. 18,327.90
3	Obtaining buildin	Rs. 0.00	Rs. 0.00	Rs. 0.00	Rs. 0.00	Rs. 0.00	0	0	Rs. 0.00	Rs. 0.00	Rs. 0.00
4	Install temporary	Rs. 21,600.00	Rs. 21,600.00	Rs. 7,200.00	Rs. 0.00	Rs. 14,400.00	3	1	Rs. 7,200.00	Rs. 21,600.00	Rs. 14,400.00
5	Install temporary water service	Rs. 12,133.33	Rs. 12,133.33	Rs. 6,500.00	Rs. 0.00	Rs. 5,633.33	1.87	1	Rs. 6,500.00	Rs. 12,133.33	Rs. 5,633.33
6	Set up site office	Rs. 46,750.00	Rs. 46,750.00	Rs. 68,200.00	Rs. 0.00	(Rs. 21,450.00)	0.69	1	Rs. 68,200.00	Rs. 46,750.00	(Rs. 21,450.00)
7	Prepare site- lay down yard and	Rs. 5,055.73	Rs. 5,055.73	Rs. 0.00	Rs. 0.00	Rs. 5,055.73	0	1	Rs. 0.00	Rs. 5,055.73	Rs. 5,055.73
8	Clear and grub s	Rs. 27,288.83	Rs. 27,288.83	Rs. 11,200.00	Rs. 0.00	Rs. 16,088.83	2.44	1	Rs. 11,200.00	Rs. 27,288.83	Rs. 16,088.83
9	Line out	Rs. 5,600.00	Rs. 5,600.00	Rs. 7,000.00	Rs. 0.00	(Rs. 1,400.00)	0.8	1	Rs. 7,000.00	Rs. 5,600.00	(Rs. 1,400.00)
10	SUBSTRUCTURE T	Rs. 6,055,481.25	Rs. 4,099,018.75	Rs. 5,725,100.00	(Rs. 1,956,462.50)	(Rs. 1,626,081.25)	0.72	0.68	Rs. 8,457,704.02	Rs. 6,055,481.25	(Rs. 2,402,222.77)
11	Foundation	Rs. 1,341,156.25	Rs. 1,341,156.25	Rs. 2,967,237.50	Rs. 0.00	(Rs. 1,626,081.25)	0.45	1	Rs. 2,967,237.50	Rs. 1,341,156.25	(Rs. 1,626,081.25)
12	Excavate fou	Rs. 57,600.00	Rs. 57,600.00	Rs. 1,292,000.00	Rs. 0.00	(Rs. 1,234,400.00)	0.04	1	Rs. 1,292,000.00	Rs. 57,600.00	(Rs. 1,234,400.00)
13	Excavate eler	Rs. 28,400.00	Rs. 28,400.00	Rs. 161,500.00	Rs. 0.00	(Rs. 133,100.00)	0.18	1	Rs. 161,500.00	Rs. 28,400.00	(Rs. 133,100.00)
14	P.C.C. for all	Rs. 517,000.00	Rs. 517,000.00	Rs. 619,650.00	Rs. 0.00	(Rs. 102,650.00)	0.83	1	Rs. 619,650.00	Rs. 517,000.00	(Rs. 102,650.00)
15	Formwork for	Rs. 31,500.00	Rs. 31,500.00	Rs. 103,600.00	Rs. 0.00	(Rs. 72,100.00)	0.3	1	Rs. 103,600.00	Rs. 31,500.00	(Rs. 72,100.00)
16	R.C.C. works for	Rs. 706,656.25	Rs. 706,656.25	Rs. 790,487.50	Rs. 0.00	(Rs. 83,831.25)	0.89	1	Rs. 790,487.50	Rs. 706,656.25	(Rs. 83,831.25)
17	Basement 1	Rs. 2,357,162.50	Rs. 2,357,162.50	Rs. 2,357,162.50	Rs. 0.00	Rs. 0.00	1	1	Rs. 2,357,162.50	Rs. 2,357,162.50	Rs. 0.00
18	Casting of Co	Rs. 861,200.00	Rs. 861,200.00	Rs. 861,200.00	Rs. 0.00	Rs. 0.00	1	1	Rs. 861,200.00	Rs. 861,200.00	Rs. 0.00
19	Casting of Lif	Rs. 456,500.00	Rs. 456,500.00	Rs. 456,500.00	Rs. 0.00	Rs. 0.00	1	1	Rs. 456,500.00	Rs. 456,500.00	Rs. 0.00
20	Casting of Sh	Rs. 241,100.00	Rs. 241,100.00	Rs. 241,100.00	Rs. 0.00	Rs. 0.00	1	1	Rs. 241,100.00	Rs. 241,100.00	Rs. 0.00
21	Shuttering wi	Rs. 39,800.00	Rs. 39,800.00	Rs. 39,800.00	Rs. 0.00	Rs. 0.00	1	1	Rs. 39,800.00	Rs. 39,800.00	Rs. 0.00
22	Slab casting	Rs. 738,562.50	Rs. 738,562.50	Rs. 738,562.50	Rs. 0.00	Rs. 0.00	1	1	Rs. 738,562.50	Rs. 738,562.50	Rs. 0.00
23	Basement 2	Rs. 2,357,162.50	Rs. 400,700.00	Rs. 400,700.00	(Rs. 1,956,462.50)	Rs. 0.00	1	0.17	Rs. 2,357,162.50	Rs. 2,357,162.50	Rs. 0.00

Figure 7 EVM Calculation using MS Project

The Planned Value (Budgeted Cost of Work Scheduled-BCWS), Earned Value-EV(Budgeted Cost of Work Performed), Actual Cost-AC(Actual Cost of Work Performed), Schedule Variance(SV), Cost Variance(CV), Cost Performance Index (CPI), Schedule Performance Index (SPI), Estimate at Completion(EAC), Budget at Completion(BAC), Variance at Completion(VAC) are calculated by MS Project using this data, the decision for project can be made.

5. RESULTS AND DISCUSSIONS

Results of Project:

The tracking was carried out till May 2016; the following results were obtained-

- Planned cost (before start of project): Rs.18,07,64,742.....(1)
- Actual cost of completed works (till 31st May, 2016):
- Rs.68,68,600..... (2)
- Planned cost as per present schedule : Rs.18,26,52,496.....(3)
- Remaining cost of project = (3)-(2)= Rs.17,57,83,896

Hence, cost variance = (3)-(1) = Rs.18,87,753

Calculations for Earned Value results:

Earned value management is a method of analysing the project performance.

The following are the terms used in Earned value management-

- Planned value (BCWS): Budgeted Cost of work scheduled or BCWS includes cumulative value of time phased baseline costs up to status date.
- Earned value (EV): EV or Budgeted Cost of work performed (BCWP) includes the cumulative value of percent complete (it may be of the task, resource or assignment) multiplied by time phased baseline costs.
- Actual Cost of Work Performed (ACWP): It includes the costs incurred for work up to the project status date/ project updated date.
- Schedule Variance (SV): BCWP-BCWS
- Cost Variance (CV): BCWP-ACWP
- Cost Performance Index (CPI): BCWP/ACWP
- Schedule Performance Index (SPI): BCWP/BCWS
- Estimate at Completion (EAC) = ACWP+(Baseline cost*BCWP)/CPI
- Budget at completion (BAC)/ Baseline cost: Cost estimated after scheduling and resource allocation of project.
- Variance at Completion (VAC): BAC-EAC
- Project Actual Cost: Actual Cost of work already performed by resources on its tasks along with costs associated of that task.

From the MS project data, the following are the results-

- PV/ BCWS = Rs.1,44,31,190.40
- EV/BCWP = Rs.50,54,900.68
- AC/ACWP = Rs.66,87,500
- SV = Rs.93,76,289.71
- CV = Rs.16,32,599.32
- CPI = 0.76 < 1 (Over budget)
- SPI = 0.35 < 1 (Behind schedule)
- EAC = Rs.23,91,47,899.08

- BAC = Rs.18,07,64,742.54
- VAC = Rs. 5,83,83,156.55

6. DISCUSSIONS

Planning, scheduling and controlling was third objective, considering Grand west project there were 347 inclusive of major activities and sub activities was scheduled using MS project software. The tracking was carried out till May 2016; the following results were obtained-

- Planned cost (before start of project): Rs.18,07,64,742
- Actual cost of completed works (till may 2016): Rs.46,99,090
- Actual cost after start of the project : Rs.18,26,52,496
- Remaining cost of project : Rs.17,79,53,405
- Hence, cost variance : Rs.18,87,753
- CPI = 0.76 < 1 (Over budget)
- SPI = 0.35 < 1 (Behind schedule)
- Estimate at Completion (EAC) = Rs.23,91,47,899.08
- Budget at Completion (BAC) = Rs.18,07,64,742.54
- Variance at Completion (VAC) = Rs. 5,83,83,156.55

From the result obtained, it can be noted that

- CPI is less than one; hence project will be **over budgeted**.
- It can also be noted that SPI is **less than one**, so it can be concluded that project is **behind schedule.**
- After tracking of project for seven months and with a delay of project for 2 months, the cost variance of about **1.044%** was observed and hence if the project has progress in same pattern it can be predicted that project cost might increase up to **32.29%** at completion stage. Hence, delay causes schedule and cost overruns.
- This data helps a project manager to focus on the project progress and to manage the project as per planned budget.

Thus Planning, scheduling, tracking and controlling plays a major role in any project, if the project is not properly planned and tracked, the cost variance at different situations may increase. So, project management plays a key role in any construction project.

From, results it can be noted cost variance of resource allocated. This is due to delay in project. Therefore it is essential to follow the planned schedule of the project, otherwise increase in cost of project increases as delay increases.

There are many factors causing project delay, but identifying them and rectifying them plays a critical role.

7. CONCLUSION

Project Management approach eliminates the thumb rule that is practiced in Indian construction industry. So, it is essential for any project to implement project management with the assistance of any software. In this way project may be more successful.

Thus Planning, scheduling, tracking and controlling plays a major role in any project, if the project is not properly planned and tracked, the cost variance at different situations may increase. So, project management plays a key role in any construction project.

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