Performance Measurement of Cost and Schedule Analysis by Using Earned Value Management for a Commercial Building in Primavera-P6

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Abstract - *Construction industry is a main part of a nation's foundation and modern growth. Even construction industry is the second biggest industry in India, the development of this industry has been differential the country over. Project cost and time is the critical factor as its overrun /under run which is directly impact on total project duration and cost. So, main preference wants to give for cost & time. For this, one of the best tools for analysing and measuring the efficiency of construction projects. Earned Value Management (EVM) is best method to tracking the progress in the construction project.*

Earned Value Management (EVM) is a system to extent performance and progress for your project. The basic principle of Earned Value is that the cost is relative to the work. It reflects time and cost factors to evaluate the efficiency and estimate completion time and costs. The main aim of our study is evaluating the cost and schedule for a commercial building by using earned value management. The present study deals with the project tracking process of "Earn Value Management", a thirteen storeyed (G+12) commercial building whose construction is in progress at Pune. By using this process it can capable to find and control the delays and serious issues regarding time and cost. Primavera p6 is used in this analysis of cost, schedule & tracking of a project. Comparing to manual calculation, Primavera-P6 is an effective way to calculate Earned Value Analysis for the projects. It confirms whether our project is on schedule and on time, on budget.

Keywords: - EVM, Cost Performance Index, Schedule Performance Index, Primavera-P6

1. INTRODUCTION

As a developing country India, so much competition in the construction sector. So in order to stand in the market we have to follow the promises of client & customers to completion of the project within time and budget. So we have to do our work in a more sustainable way. Project cost and time is the critical factor in construction industry as its over-run or under-run which directly impact on total project time and cost. So, main priority wants to give for cost & time. When we go through traditional way of cost estimation we consider only planned cost and actual cost of the project. But in our case, we consider third variable i.e. EARN VALUE. So, Earn value is used to measure project performance and progress against work, time and cost baseline (performance measurement baselines). Earned value management is a tracking and monitoring system. Earned value management is used to know how our projects are progressing according to the planned or not. With the help of Earned Value Analysis (EVA), project managers get sufficient help to understand potential risk areas. So understanding risk areas, managers can create risk mitigation plans based on actual cost, time and technical progress of the work. Earned value management is very beneficial to stakeholders which is part of the project. In EVM, at any phase of project we can get actual cost, remaining cost and EVA calculations.

1.3 What is Earned Value Management (EVM)

Earned Value Management is the tool which integrates the project work, time and cost. Thus, a single tool makes a lot of useful information for a project manager to make decisions. EVM uses Performance Measurement Baseline to compare it with actual cost and time performance. Thus, the primary requirement to perform Earned Value Analysis is to obtain Performance Measurement Baseline.

1.4 Importance of EVM in Construction Project:

- Earned Value Management (EVM) is a method of performance and progress measurement. EVM is an efficient approach to the integration and measurement of cost, time, and technical (work) ongoing project or task.
- It provides both the client and contractors the ability to inspect detailed schedule information, critical program and technical milestones, and cost data.
- EVM was originally developed for cost management and forecasting the project.

- To check whether the project is on schedule/earlier schedule/ahead of schedule.
- Is the project going on budget/over budget/under budget?
- To predict project is finished on time and within budget.
- It helps to decide variances from the plan and also predicts the future performance based on present data from on-going work.
- It also helps to define the problem areas and how to get the project back on track.

3. Methodology

The purpose of this research is to know the performance measurement of schedule and cost analysis using the earned value method for a commercial building.
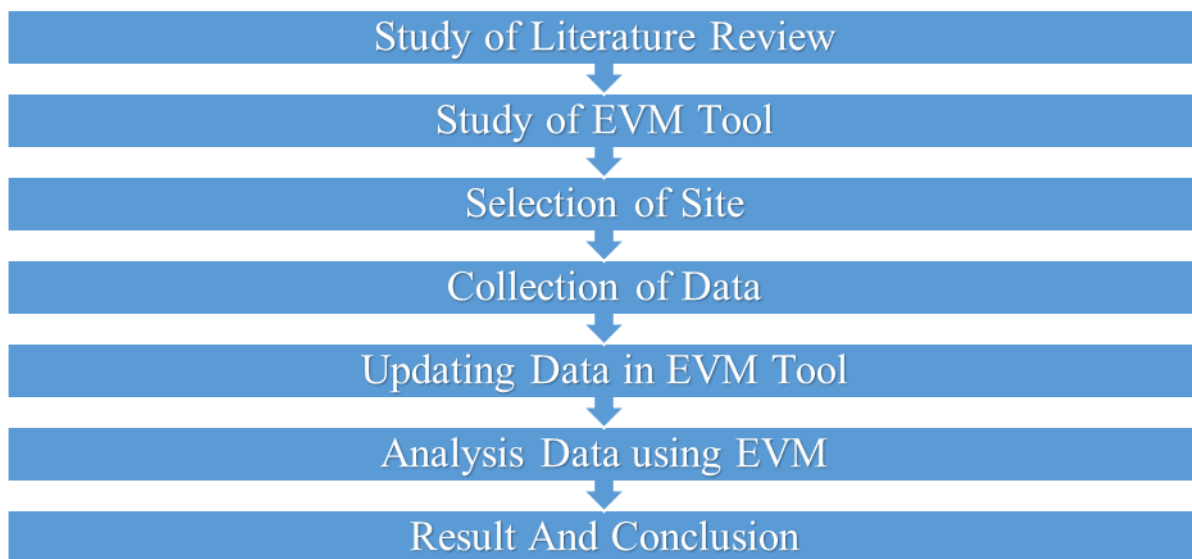
Fig.1 Flow chart for the project

3.1 Study of literature review
First I was studied no of research paper which comes from reputed journals. All the research
Papers are directly concerned with Earned Value Management

3.2 Study of EVM tool
I was learned Primavera-P6 as EVM tool. Primavera (P6) is an enterprise project portfolio management software which is very useful to calculate Earned Value Analysis of the project. It is the most powerful strong and easy handling software which is used worldwide for organizing, planning, managing, and execution of project, programs and portfolios. Primavera P6 can be Used for all sizes of programmers or projects from small companies to large scale projects.

3.3 Selection of site
For implementing earned value Management concept, it is required to select under construction site For more accuracy work completed of site should be between 10 to 80%. If above requirements are satisfied, then accurate forecasting of ongoing site can be made. For this study 2B+G+12 commercial site is selected which are located in Baner. This site is in phase of under construction. Work completed on site still start of November 2019 is nearly 55% which is very suitable for this study.

3.4 Collection of data
Data Collection is measure and important step in this study. Ongoing projects should be selected is necessary condition for analysis of earn value concept. To implement on value concept case study object (2B+G+12) for commercial building is taken. Earned value management overall budget of project must be known including all direct and indirect cost. Budget of each activity with their start and end date duration is required. When Exhibition of actual project start, updates should be made in the sheet. Actual costs spent on each activity must be mentioned. Actual time taken by each activity should updated in sheet.
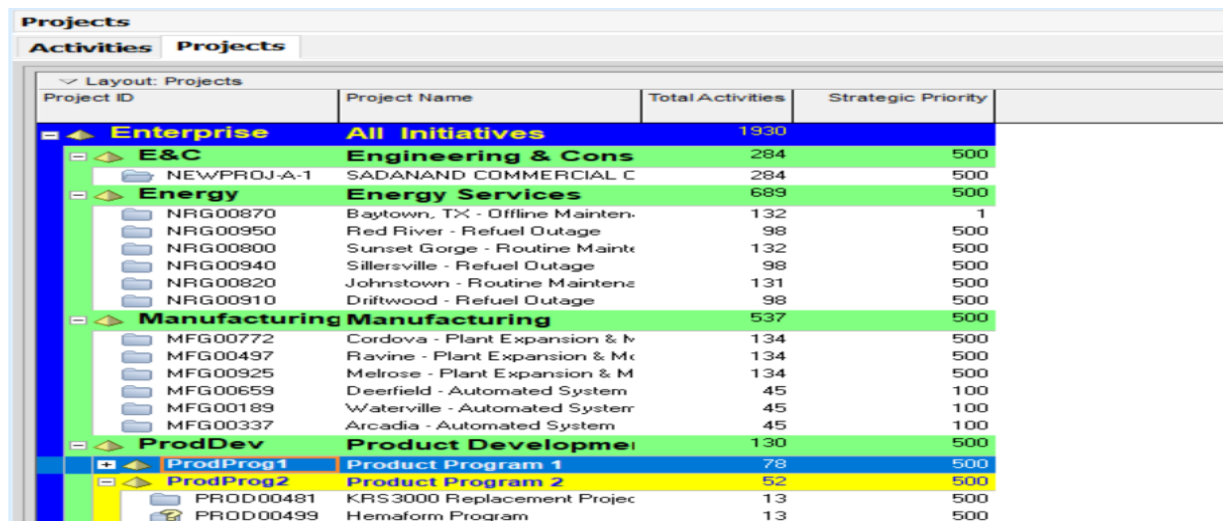
3.5 Updating data in EVM tool

Collected data must be put in management tool for calculation and make update periodically for this study we have chosen the Primavera-P6 as management told. The procedure of updating data in EVM is mentioned later in this thesis.

3.6 Analysis using EVM

After updating the scheduling at particular time interval the next focus will be on creation of earn value table can be formed after creating new baseline to compare how much of work executed till report date in monetary unit
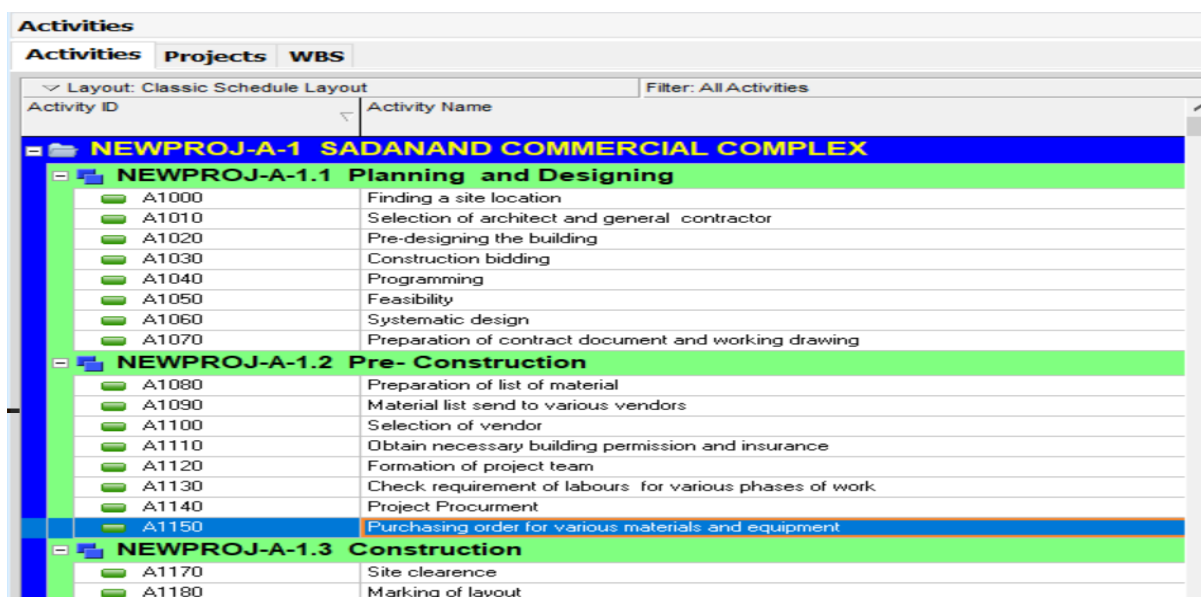
Result and Conclusion

The result obtained after applying Earned Value Concept. Earned Value parameter are obtained in Primavera-P6 which will helpful to know the current status of ongoing work and helps to calculate final duration.

The Fig.2 explains the creation of EPS (Enterprise Project Structure) in Primavera-P6 software. It describes the hierarchy of the project structure. It tells us the levels and structure of the company EPS depends on the scope of the project and how you want to summarize the data.


The Fig.3explains the creating of WBS (Work Breakdown Structure) in the P6. It is defined as the process of subdividing project deliverables & project work into smaller, more manageable components. Each WBS detail may additionally include more detailed WBS stages or activities or both.
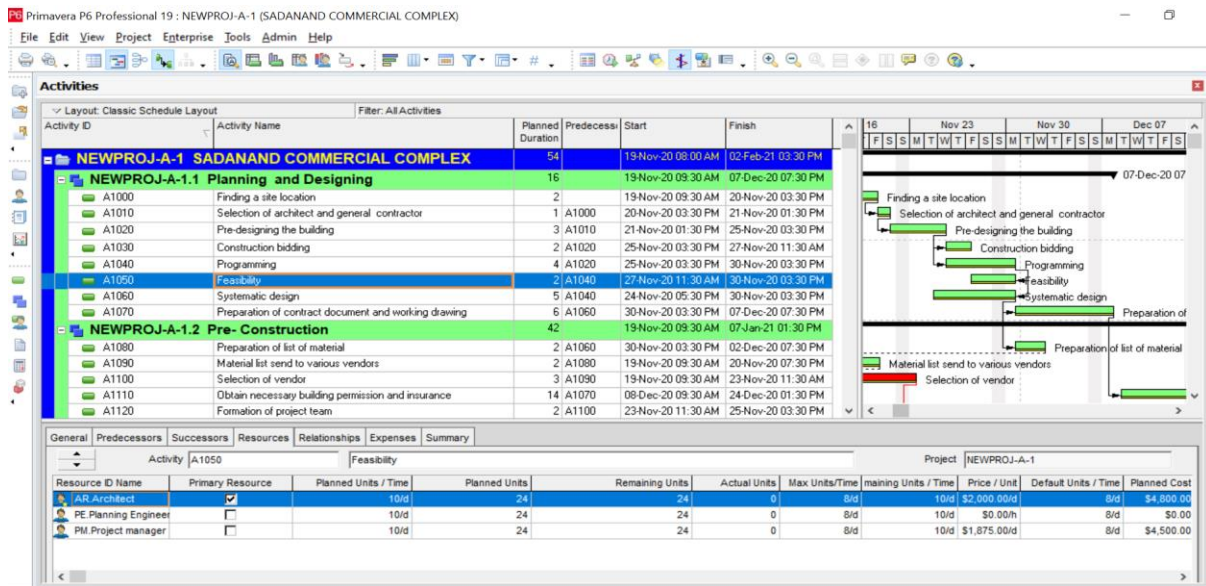
The Fig.4 explains the creating activities under each WBS and also assigning predecessor and successor relationships and resources for every activity. It also contains some features like roles, expenses, activity codes, resources codes and project codes. After the creation of activities, the assignment of the calendar is also done. The original duration for these activities is also given according to work planned and it will automatically take the actual duration, similarly, activity dates will be taken by giving the start date of the project. While creating resources, labour, non-labour and material cost are given after that assigning of resources is done for every activity.
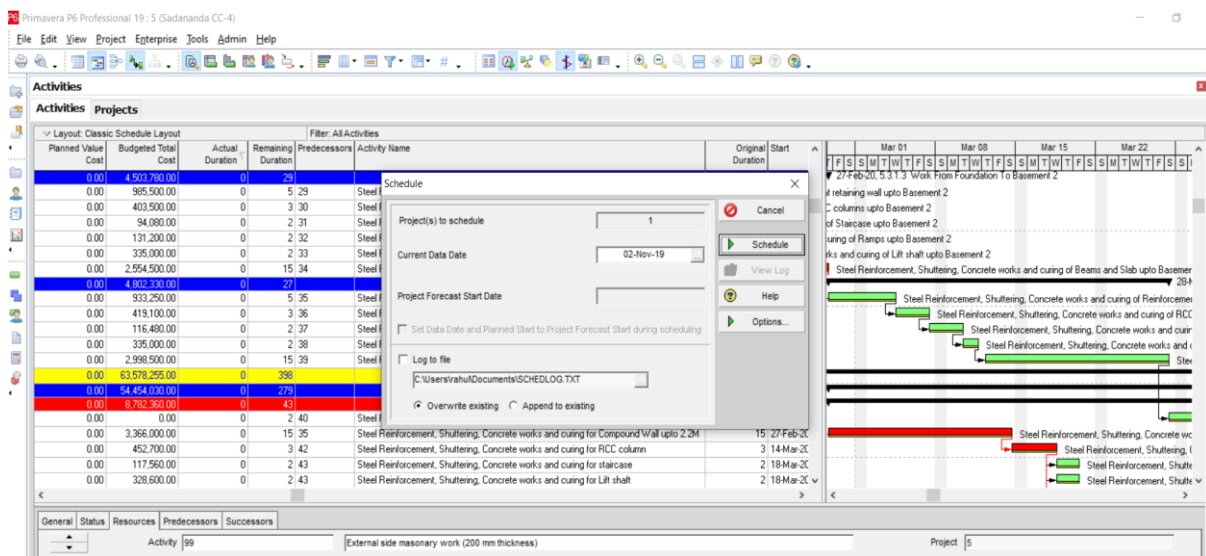
The Fig.5 explains the scheduling of activities in primavera. Scheduling shortcuts in primavera is F9. While scheduling, critical path method is applied in P6.
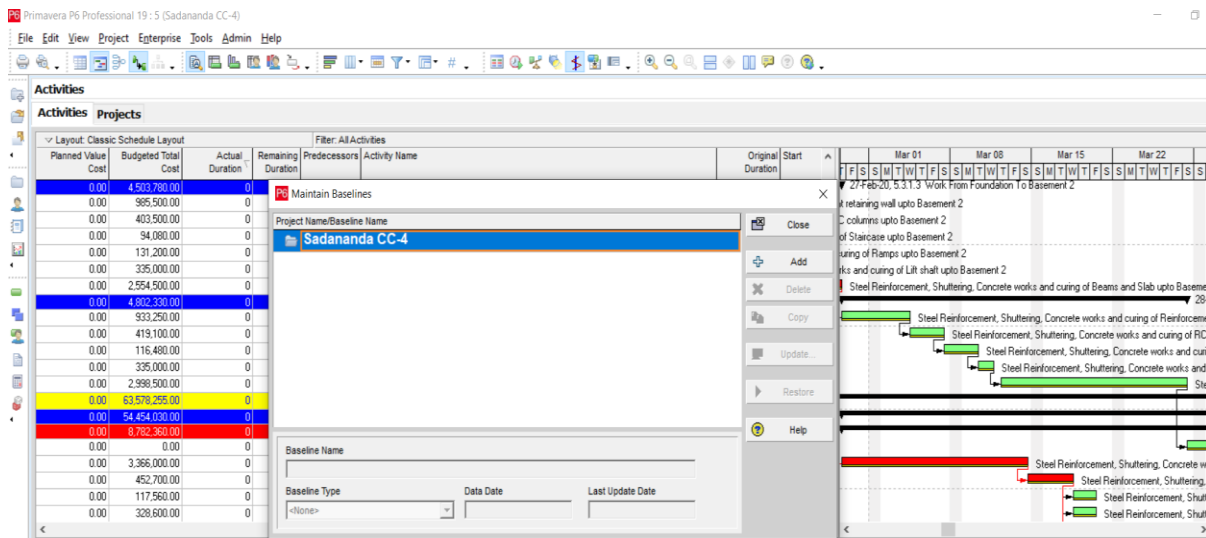
The Fig.6 describes assigning of baselines in P6 software. Creating a baseline is done before updating a schedule. A baseline is a snapshot of the original schedule. It gives aim/objective against which, project's performance, cost, and schedule are tracked.
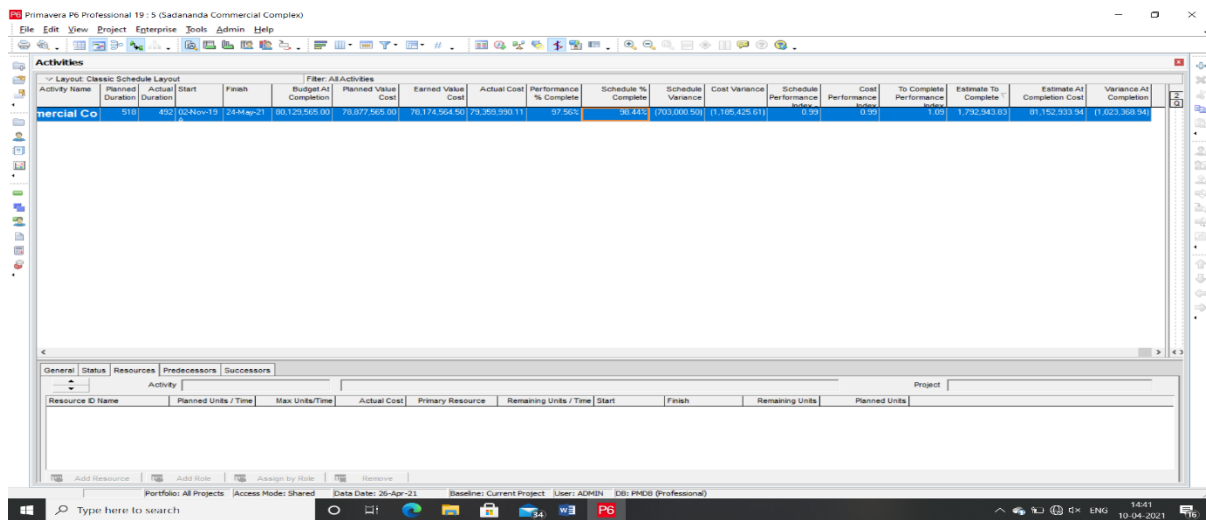

Fig.7 shows the earned value analysis results for the project. Here I had applied filters so that current project status is seen or observed.

EVM/EVA measures the basic / input elements, output elements and forecasting element and the EVM analysis concepts are mention in the table

EVM Parameter	First Tracking	Second Tracking	Third Tracking
Tracking Date	10-Apr-20	17-Oct-20	26-Apr-21
Project Duration (Expected)	880	880	880
Track Duration	159	349	540
Budgeted Total Cost	8,01,29,565.00	8,01,29,565.00	8,01,29,565.00

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Planned Value	2,47,74,243.00	6,23,61,028.00	7,88,77,565.00
Earned Value	2,45,39,890.00	6,17,80,777.00	7,81,74,564.00
Actual Cost	2,50,99,143.00	6,27,54,632.00	7,93,59,990.00
Scheduled Performance Index (SPI)	0.990540458	0.990695295	0.99108744
Scheduled Variance	-2,34,353.00	-5,80,251.00	-7,03,001.00
Cost Performance Index (CPI)	0.977718243	0.984481544	0.985062675
Cost Variance	-5,59,253.00	-9,73,855.00	-11,85,426.00
Performance % Complete	30.64%	77.10%	97.56%
Budget At Completion	8,01,29,565.00	8,01,29,565.00	8,01,29,565.00
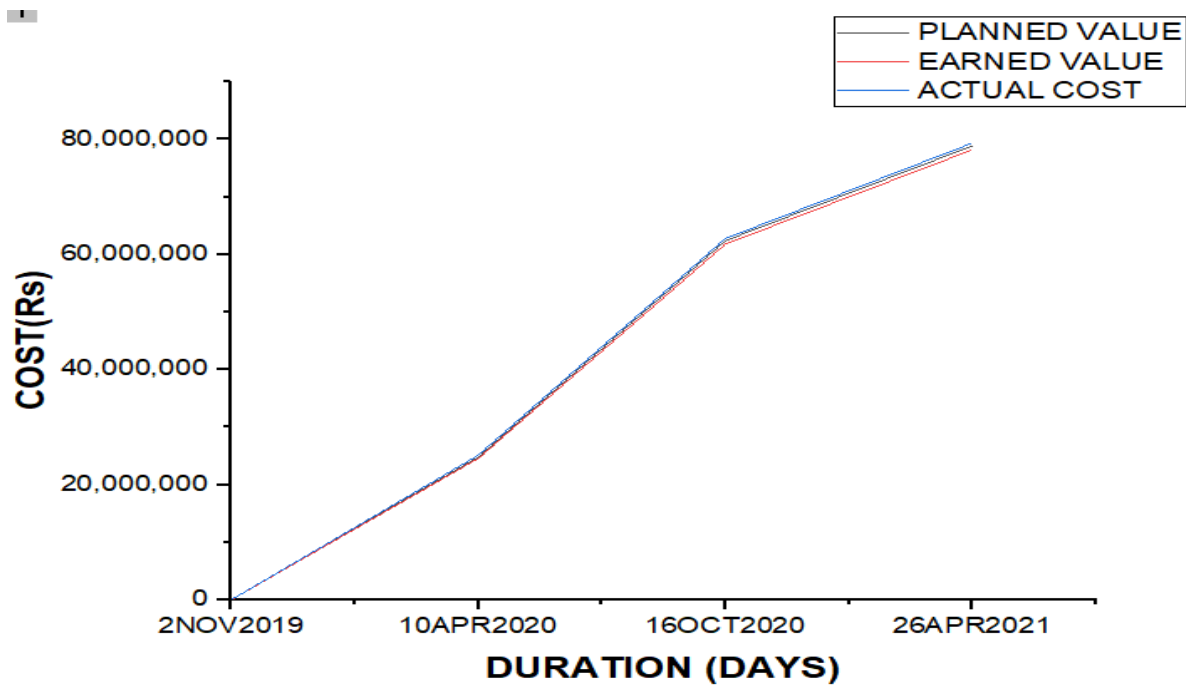
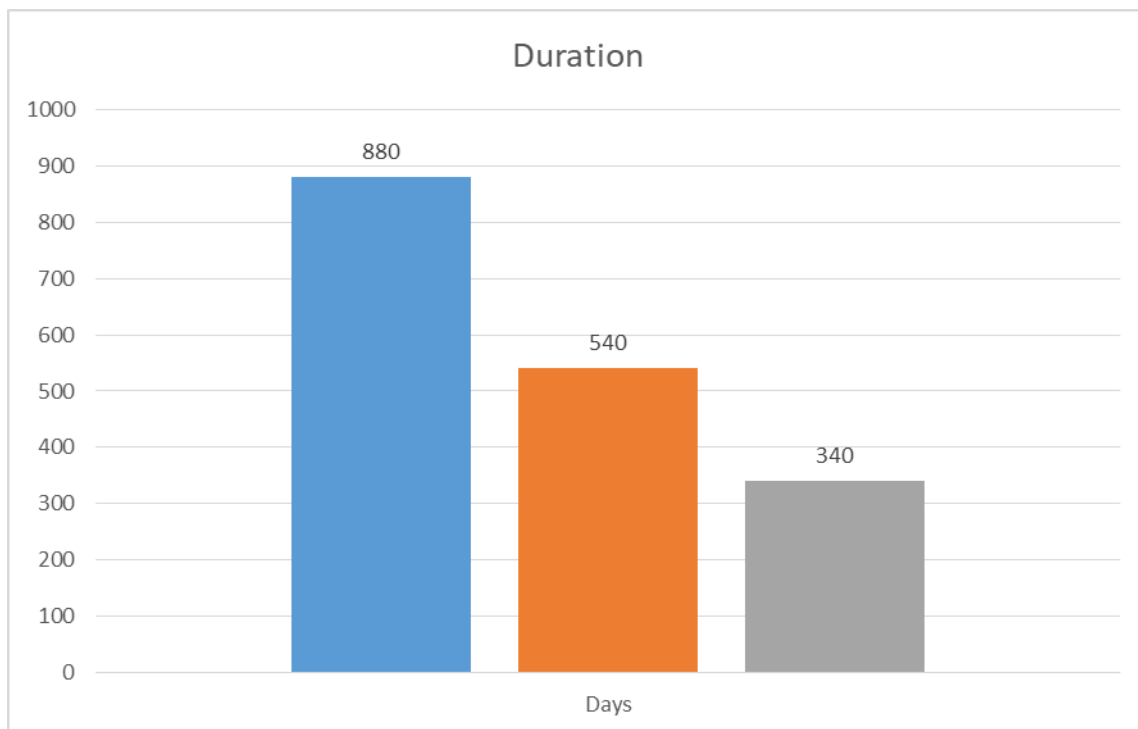Fig.8 Cost Vs. duration graph between PV, EV, AC.

Fig. 9 Duration graph of the project.

Conclusions

Earned Value Management is best method to control and manage huge constructions. Earned Value Method gives actual work in monetary units. Earned Value Method is suitable for the project which are in execution phase. If work done is between 10-80 % then Earned Value concept can be used to track the project progress and predict future of the project.

- Earned Value Management is better method of project management as it's integrates cost, time and work.
- Earned Value Management can act as early warning tool that enables project managers to identify and problems in early stages of the project.
- Earned Value Management is also helpful to forecast final duration with the help of Earned Value parameter like Earned Value, Scheduled Variance, Cost Variance, Scheduled Performance Index and Cost Performance Index
- Selected site 2B+G+13 Commercial Building having total project duration is 880 days, out of which 540 days had been completed according to schedule.
- In the next 340 days, these are the activities planned to finish the project within schedule and on cost. Activities planned for the next month's / few days are interior works like flooring, painting, electrical, sanitary, and carpentry and exterior works and landscaping works.
- By using primavera software time can be saved and easily calculated. Based on the new ETC the project is going to be on a budget. EVA can be changed for different reporting periods and depends on project performance. The status of the case study tells project performance concerning duration and cost. In the future, delays can be minimized and controlled as per project performance. Overall Earned, Value Analysis method tells us, constructor, to measure the performance of the work concerning the duration and cost more effective and efficient way.

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