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Tracking a Typical Apartment Construction using Earned Value Management

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Abstract - *Construction companies are already one of the largest industries and require enormous resources and time to complete successfully. Therefore, with such large-scale projects, companies face the problem of project evaluation. Several techniques have addressed this issue. In this paper, we examine Earned Value Method for evaluating project performance by tracking. It is a systematic project management process designed to identify project variances based on a comparison of completed work versus planned work. EVM is used to manage costs and deadlines and is very useful for project forecasting. It contains the items and performance indicators used to track projects, benefit project managers, and ultimately lead to project success. It also shows how revenue amounts for project budget and project schedule deviations serve as indicators of variance and performance.*

Key Words: **Actual Cost, Planned Value, Earned Value, Schedule Performance Index, Cost Performance Index.**

1. INTRODUCTION

The construction industry plays a key role in economic growth by having multiple impacts on the economy as a whole, but due to the implicit nature of the construction business, information gleaned from planning, scheduling and tracking construction projects are rarely shared. Construction work includes not only physical activities using human resources, materials and equipment, but also the proper management of human resources, equipment and materials through proper planning using project management tools. Construction projects suffer huge losses due to project delays. Timeouts are a serious problem when project development faces many challenges and uncertainties. Timeouts occur when a project exceeds the budget or planned time calculated at the beginning of the project. A cost overrun occurs when the actual value or cost of a project exceeds the budgeted value. Project management is the skill and task of managing power and preparing, organizing, and directing an individual's efforts to use natural materials for their personal growth needs. However, cost overruns are a common problem in large projects. For example, the construction of the International Space Station was initially planned at a budget of US$36.75 billion, but the final cost was US$105 billion, 186% higher than expected. It was also completed six years behind schedule. No project manager wants to be on the front lines of a disastrous project that fails. Then turn to the discipline of project management to find a solution. Earned value management is a proven method that helps solve this problem.EVM emerged as a specialized area of financial analysis for US government programs in the 1960s, and the government established regulations for the installation of EVM systems by contractors. Since then it has become an important area of project management and cost planning. A project management study investigating his EVM contribution to project success shows a moderately strong positive association. EVM implementations scale to projects of any size and complexity. Tracking is necessary to know the progress of a construction project. Tracking helps identify project status and future development. Revenue value analysis is the most commonly used method for tracking project progress. Project delivery time and cost measurement can be done together through earned value analysis.

1.1 Project Management

A project is a time-bound effort with a planned sequence of tasks from the beginning to the end of the project. They are interrelated and must be implemented within given time, budget and resources. Construction projects have various constraints such as duration, cost and resources. Management is understood as the process of successfully completing a task professionally, jointly or through others. Project management is the use of information, skills, equipment, and technology to conduct project activities that meet or exceed the needs and expectations of stakeholders for the project.

This project management is divided into phases as in figure 1

- Project initiation
- Project definition
- Project Execution

- Project performance
- Project closure

Fig -1: Phases of Project Management

1.2 Tracking

Tracking is the most important aspect of any construction project. Project compares progress between the project plan and the actual project. The project tracking method provides a highly harmonized automated accounting system. With project tracking, you can effectively manage your time and activities and stay on top of your budget. Tracking is a method of tracking various construction activities to ensure that construction is completed on time. Activity completion delays can be analysed through tracking. Deviations from schedules and plans may be found. Tracking helps you see the current status of your development and sales work. Necessary precautions have been taken to adhere to the schedule. The project tracking process helps identify all the activities required to complete the project efficiently and in a timely manner.

1.3 Earned Value Management

Earned Value Management is a systematic process designed to measure project performance at various points in the project lifecycle. EVM helps project managers and project managers generally determine whether a project is on schedule, over budget, or under budget. EVM also allows you to compare the actual work performed with the project's estimated and planned work at any point in the project. EVM can also be used to predict predictive performance. EVM is a technique that has at least some applicability to project management in all industries and contractual approaches.

EVM measures project progress and performance by the integrated management of three fundamental elements of project management, cost, schedule and scope which make up the Project Management Triangle as in figure 2.

Fig-2: Triangle of Project Management

1.4 Basic elements of earned value

- **Planned value (PV):** - Planned value is the authorized budgeted cost which is planned before commencing the project. Overall planned value of the project is identified as budget at completion (BAC). Planned value can be designed by the subsequent formula, Planned value (PV) = (BCA) X % Completed planned activities

- **Earned value (EV):** - Earned value is the value of work finished in terms of approved budget for that work. It is the amount of work done to date. Earned value is also turnover per day. Earned value is a total cost of project completed / performed work. Earned value can be calculated by following formula, Earned value (EV) = (BCA) X % Completed work'

- **Actual cost (AC):** - Actual cost is the overall cost actually incurred for work performed to date. Actual cost is called as actual cost of work performed. The actual cost is the total cost that is taken to complete the work in specified date. The formula for Actual cost, Actual cost (AC) = overall cost spent to date d. Earned value performance indicators Project performances in the conditions of cost and duration, and it is resolute by differentiating the planned value, earned value and actual cost, product will be the subsequent performances.

- **Schedule variance (SV):** - Schedule variance is the difference between the planned work and the actually executed work or it is the comparison between earned value and planned value. By schedule variance we can clearly know whether the project is on the schedule or behind the schedule. The schedule variance is computed by following formula,

- **Cost variance (CV):** - Schedule variance is comparing the money that is spent to the finished work to the amount of budget that was actually planned to do it. It is the distinguished between the earned value and actual

cost. Mathematically cost variance is represented as, Cost variance (CV) = Earned value (EV) – Actual cost (AC). If the cost variance shows the project is +ve then it under run from the planned cost and if the project shows –ve cost variance, then it is overrun from the planned cost and loss may occur.

- **Schedule performance index (SPI):** - Schedule performance index is the ratio between the costs of work performed to the cost approved for the work that was planned before or it is the ration the earned value and planned value. Schedule performance index can be represented as, SPI = Earned value / Planned value If the ratio of schedule performance index is greater than one then the project is ahead than the planned schedule, if the SPI is less than one than the project is behind than the planned schedule and if SPI is equal to one than the project is on schedule.

- **Cost performance index (CPI):** - It is the ratio of cost approved for the performed work to the actually spent cost. It is also distinguished as the ratio between earned values by actual cost. Cost performance index can be represented by consecutive formula, CPI = Earned value / Actual cost.

- Analyzing and fore casting project status and performance. They show the progress of work over time and form a historical record of project trends and variations. Most common uses of S- curves are progress and performance evaluation. We can see the graphical representation of EVA with the help of s curve. S curve is very effective because with the help of S-curve the progress of project to be tracked visually over time and graphical representation of progress and performance through S-curve allow managers to quickly identify project growth, slippage and problems that adversely impact on the project if corrective action is not taken. Earned Value Parameters as shown in the figure 3

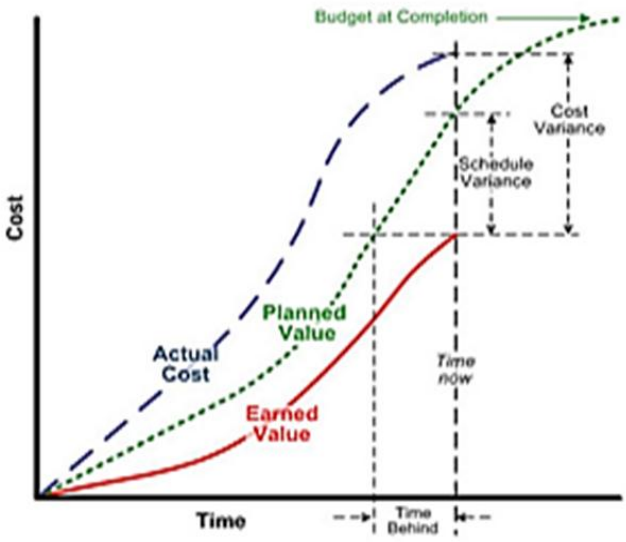


Fig 3 Earned Value Parameters

The parameters in Figure 3 can be seen in a visual representation. It can be useful to have the numbers translated into something visual for a more simple understanding of the status of the ongoing project. Most of the necessary information can be found in the graph and visually it can be seen in the figure that:

- **Actual Cost (AC)** of the project is above the predetermined
- **Planned Value (PV)** that had been established.
- **Earned Value(EV)** of work completed is lower than the Planned Value
- By comparing the gaps between the **Actual Cost** and **Earned value** the **Cost Variance** of the project can be found. According to this figure the project is above the pre-approved budget
- By comparing the gaps between the **Planned Value** and **Earned value** the **Schedule Variance** of the project can be found. According to this figure the project is behind schedule

The graphical representation of the cost with respect to time. It shows the expected budget and how there is a variation of actual cost from this expected budget earned planned value.

Table 1 contains formulae used in Earned Value Analysis.

Measure	Definition	Calculation
Planned Value (PV)	Planned Value is the approved value of the work to be achieved in a given time.	PV = Percent Complete (planned) x Task's Budget
Earned Value (EV)	Earned Value is the value of the work completed to date.	EV = Percent Complete (actual) x Task's Budget
Actual Cost (AC)	Actual Cost is the total cost incurred for the work completed to date.	AC = Actual Cost of the Task
Schedule Variance (SV)	Schedule Variance focuses on the time consumption in the project.	SV = EV – PV SV < 0 task is behind schedule SV = 0, the task is on schedule SV > 0, the task is ahead of schedule
Schedule Performance Index (SPI)	Schedule Performance Index provides deviation in time consumed and estimated time.	SPI = EV / PV
Cost Variance (CV)	Provides information about how far the task is over or under budget.	CV = EV – AC CV < 0, project is over budget CV = 0, project is on budget CV > 0, project is under budget
Cost Performance Index (CPI)	Indicates if the project is over or under budget.	CPI = EV / AC CPI < 1, project is over budget CPI = 1, the project is on budget CPI > 1, the project is under budget
Budget at Completion (BAC)	The budget of all tasks.	BAC = Project Budget
Estimate at Completion (EAC)	What would the overall budget be if the project progresses as per the plan?	EAC = BAC / CPI EAC = AC + (BAC – EV) EAC = AC + [(BAC – EV) / (SPI x CPI)] EAC = AC + ETC
Estimate to Complete (ETC)	How much money must be spent from this point forward to complete the project?	ETC = EAC – AC
Variance at Completion (VAC)	It provides information about the forecasted Cost Variance (CV).	VAC = BAC – EAC VAC < 0, more money is required to complete the project VAC > 0, the project has a surplus and can be completed without any hiccups
To Complete Performance Index (TCPI)	It is the required efficiency to complete the remaining project to make up for past negative variances.	TCPI = (BAC – EV) / (BAC – AC) TCPI = (BAC – EV) / (EAC – AC)

2. METHODOLOGY

- Data collection
- Opening the MS project and create new project
- Organizing of work break down structure
- Assigning of activities in the project
- Adding relationship to the activities
- Baseline creation
- Updating the project with Actual Duration, material and labor cost
- Earned Value Analysis

3. PROJECT CASE STUDY

The case study for the Project is an Apartment building, the building is RCC framed structure. It is a Residential Apartment named as the pebble park. The useful information has been taken from actual project such as Bill of Quantities and abstract sheets provides necessary data for the project cost and scheduling activities, and is used in Micro soft Project. The apartment typical floor plan is as in figure 4.

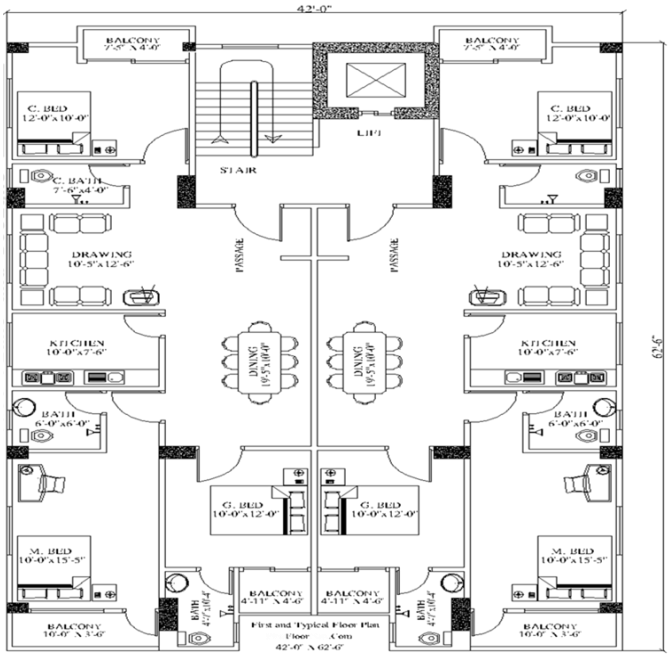


Fig 4 Plan of the Building

3.1 Schedule of the building

Construction scheduling organizes activities and their sequence in a construction project. It's a project management process that acts as a blueprint for how the project will be executed. It not only organizes the activities and tasks but the overall timeframe for the project, including milestones. A construction schedule is a timeline for every task and event in a construction project. The construction schedule is a fundamental part of the project planning phase, as it also defines the resources needed and the teams responsible for each task in the construction process. Other items included in a construction schedule include deliverables, resource management, asset allocation, tasks, dependent tasks, task duration and deadline, as well as the budget and related costs of all that work. Schedule of the building is as shown in figure 5.

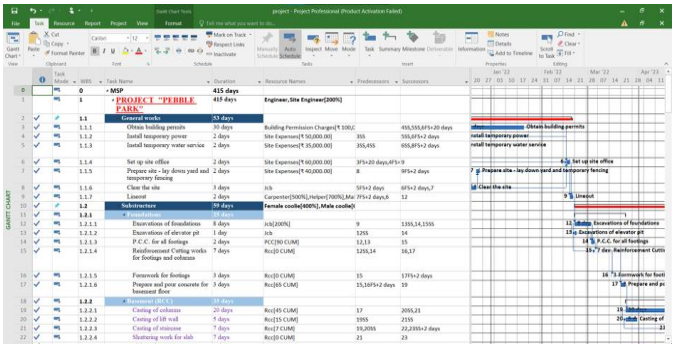
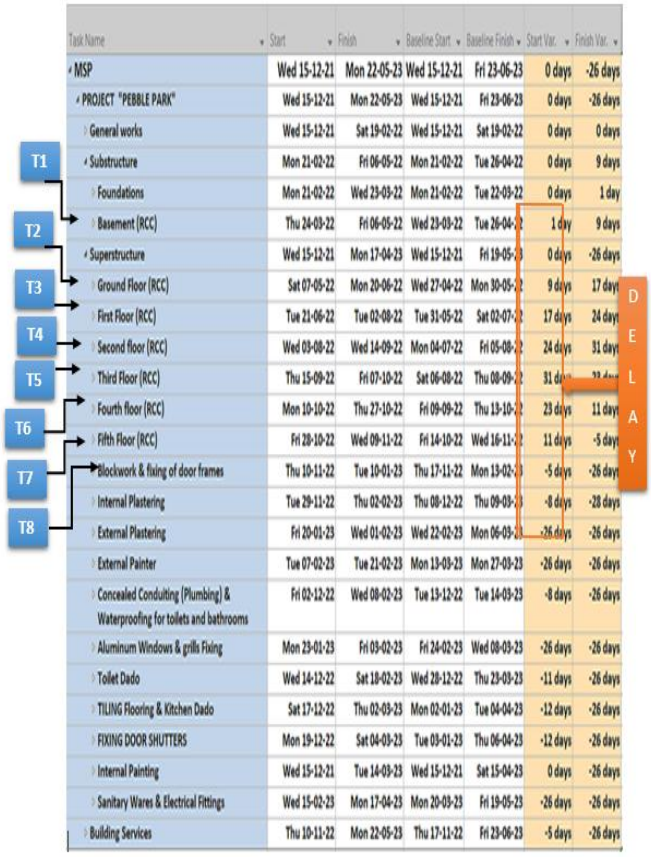


Fig -5 Schedule of the building

3.2 Target and Delays

Earned Value Analysis required both the baseline completion date which we also refer as the completion date as mentioned in the master schedule and the actual completion at which actual work had been completed on the site. As it helps us to know that our project is running as per the master schedule or not. This tells us that which activities take more time and which are the most critical activities and according to this the further catch-up plan was prepared to bring the project within the dates mentioned in the master schedule. [T-Track]

Table 2: Delay chart of the Project



Task Name	Start	Finish	Baseline Start	Baseline Finish	Start Var.	Finish Var.
MSP	Wed 15-12-21	Mon 22-05-23	Wed 15-12-21	Fri 23-06-23	0 days	-26 days
PROJECT "PEBBLE PARK"	Wed 15-12-21	Mon 22-05-23	Wed 15-12-21	Fri 23-06-23	0 days	-26 days
General works	Wed 15-12-21	Sat 19-02-22	Wed 15-12-21	Sat 19-02-22	0 days	0 days
Substructure	Mon 21-02-22	Fri 06-05-22	Mon 21-02-22	Tue 26-04-22	0 days	9 days
Foundations	Mon 21-02-22	Wed 23-03-22	Mon 21-02-22	Tue 22-03-22	0 days	1 day
Basement (RCC)	Thu 24-03-22	Fri 06-05-22	Wed 23-03-22	Tue 26-04-22	1 day	9 days
Superstructure	Wed 15-12-21	Mon 17-04-23	Wed 15-12-21	Fri 19-05-23	0 days	-26 days
Ground Floor (RCC)	Sat 07-05-22	Mon 20-06-22	Wed 27-04-22	Mon 30-05-22	9 days	17 days
First Floor (RCC)	Tue 21-06-22	Tue 02-08-22	Tue 31-05-22	Sat 02-07-22	17 days	24 days
Second floor (RCC)	Wed 03-08-22	Wed 14-09-22	Mon 04-07-22	Fri 05-08-22	24 days	31 days
Third Floor (RCC)	Thu 15-09-22	Fri 07-10-22	Sat 06-08-22	Thu 08-09-22	31 days	
Fourth floor (RCC)	Mon 10-10-22	Thu 27-10-22	Fri 09-09-22	Thu 13-10-22	23 days	11 days
Fifth Floor (RCC)	Fri 28-10-22	Wed 09-11-22	Fri 14-10-22	Wed 16-11-22	11 days	-5 days
Blockwork & fixing of door frames	Thu 10-11-22	Tue 10-01-23	Thu 17-11-22	Mon 13-02-23	-5 days	-26 days
Internal Plastering	Tue 29-11-22	Thu 02-02-23	Thu 08-12-22	Thu 09-03-23	-8 days	-28 days
External Plastering	Fri 20-01-23	Wed 01-02-23	Wed 22-02-23	Mon 06-03-23	-26 days	-26 days
External Painter	Tue 07-02-23	Tue 21-02-23	Mon 13-03-23	Mon 27-03-23	-26 days	-26 days
Concealed Conduiting (Plumbing) & Waterproofing for toilets and bathrooms	Fri 02-12-22	Wed 08-02-23	Tue 13-12-22	Tue 14-03-23	-8 days	-26 days
Aluminum Windows & grills Fixing	Mon 23-01-23	Fri 03-02-23	Fri 24-02-23	Wed 08-03-23	-26 days	-26 days
Toilet Dado	Wed 14-12-22	Sat 18-02-23	Wed 28-12-22	Thu 23-03-23	-11 days	-26 days
TILING Flooring & Kitchen Dado	Sat 17-12-22	Thu 02-03-23	Mon 02-01-23	Tue 04-04-23	-12 days	-26 days
FIXING DOOR SHUTTERS	Mon 19-12-22	Sat 04-03-23	Tue 03-01-23	Thu 06-04-23	-12 days	-26 days
Internal Painting	Wed 15-12-21	Tue 14-03-23	Wed 15-12-21	Sat 15-04-23	0 days	-26 days
Sanitary Wares & Electrical Fittings	Wed 15-02-23	Mon 17-04-23	Mon 20-03-23	Fri 19-05-23	-26 days	-26 days
Building Services	Thu 10-11-22	Mon 22-05-23	Thu 17-11-22	Fri 23-06-23	-5 days	-26 days

3.2 Tracking the Project Progress

Project tracking is a project management method used to track the progress of tasks in a project. By tracking your project, you can compare actual to planned progress, and identify issues that may prevent the project from staying on schedule and within budget.

Project tracking helps project managers and stakeholders know what work has been done, the resources that have been used to execute those tasks, and helps them create an earned value analysis by measuring project variance and tracking milestones. Key to project tracking is the use of project tracking tools and project management techniques. For example, a Gantt chart allow managers to track project progress by providing an overview of tasks, workload and milestones at any point of the project life cycle. Other types of project reports like status reports can gather extra details that provide further insight into deliverables, risks and performance. This data can then be distributed to the project team and stakeholders to keep them updated. Project tracker is useful even before the execution phase of a project. During project planning, it can help you manage the resources you'll need to complete the tasks. The software allows to see if your actual progress matches where you planned to be at that time.

The project is tracked from 15th Dec 2021 to 10th Jan 2023 in total 8 tracks as follows;

3.2.1 Track 1 [15th Dec 2021 to 6th May 2022]

A. Earned Value over Time

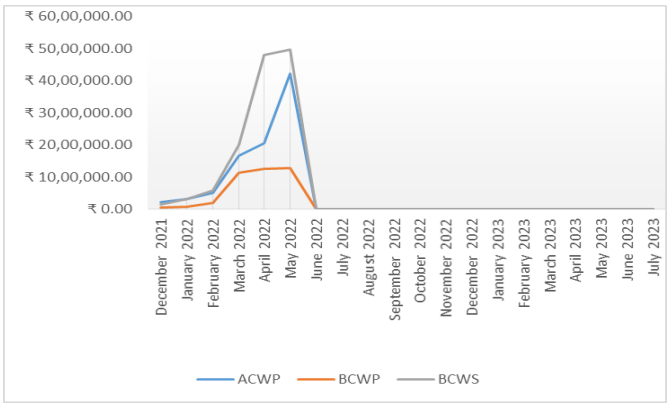


Fig -6 Earned value over time for track 1

The project's earned value based on the status date. As actual cost (ACWP) is higher than earned value (BCWP), the project is over budget. As planned value (BCWS) is higher than earned value, the project is behind schedule.

B. Variance over Time

Fig -7 Variance over time for track 1

Cost and schedule variances for the project based on status date. As CV is negative, the project is over budget. As SV is negative, the project is behind schedule.

C. Indices over Time

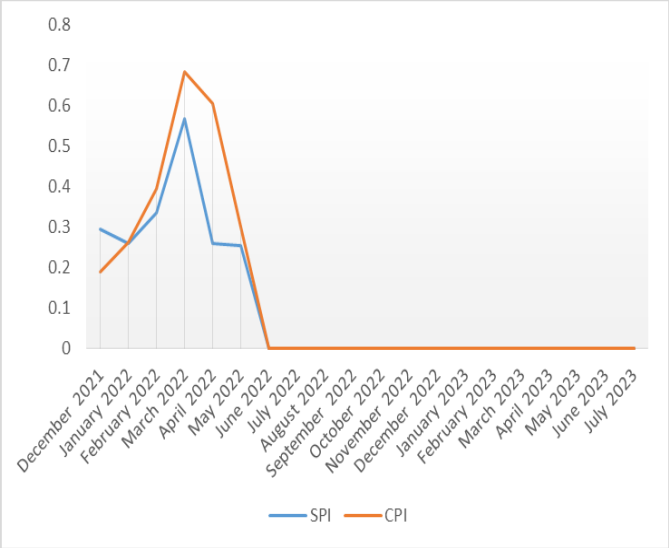


Fig -8 Indices over time for track 1

D. Cash Flow

Cost and schedule performance indices for the project based on status date. The greater the performance index, the more on schedule and cost saving the project.

The Table shows cost information for all top-level tasks.

Table 3: EVM analysis for track 1

Actual Cost	Baseline Cost	Remaining Cost	Cost Variance
□ 42.20,338.93	□ 3,75,89,700.00	□ 3,34,93,189.64	□ 1,23,828.57

ACWP	BCWP	BCWS
₹ 3,935,338.93	₹ 3,874,038.15	₹ 4,974,778.57

Terminology	Value
CV	-□ 61,300.78
SV	-□1100740.42
CPI	0.98
SPI	**0.78**

The same is repeated to all the trials and the respective

Earned value over time, Variance over time, Indices over time and cash flow is noted.

4 RESULTS AND DISCUSSION

The Result/Output obtained from the MSP software after analyzing and tracking the project from time to time on regular interval. Usually the projects are tracked on a weekly basis and reports of the progress is submitted, But as the project building taken for the case study is of smaller magnitude and also the weekly reports and their graphs will make this report a bit lengthy and clutter up. So in order to avoid such confusion I have included the graphs and progress report on alternate month's basis.

The result/output obtained from the MSP is shown in the graphical form and three types of graphs (analysis) have been shown/done to see how the project is performing in actual in terms of schedule (time) and cost to that of planned and the following analysis shows the same:

- Earned Value Analysis
- Performance Indices
- Variance Analysis

The project was tracked and monitored for a period of about 9 months on every month and scheduled in the MSP. Finally the result obtained from the MSP for the Earned Value Analysis is tabulated.

4.1 Earned Value Analysis

Table 4: PV, EV and AC of the Project

Planned Value, Earned Value and Actual Cost of all trials;

Trial	Duration	ACWP(Actual Cost)	BCWP(Earned Value)	BCWS(Planned Value)
1	6th May 2022	3935338.93	3874038.15	4974778.57
2	20th June 2022	6746551.11	6676739.57	7941528.57
3	2nd August 2022	9455740.86	9376250.51	10801414.2
4	14th September 2022	12059740.8	11974901.3	15971300.0
5	7th October 2022	14663740.8	14585028.4	16386471.4
6	27th October 2022	17267740.8	17198644.5	19021935.7
7	9th November 2022	19871740.8	19816328.9	19175442.8
8	10th January 2023	26,937,909	26,902,140	26,787,809

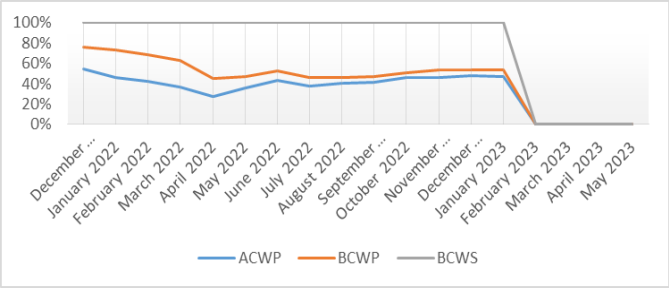


Fig-9 PV, EV and AC of the Project

After getting the output data from the MSP and analyzing the PV, EV and AC; it can be seen that until Oct 2022, the project

was running behind as the EV and AC is lesser than PV which indicates that the project is not proceeding as per the planned schedule but after the month of Nov 2023 there was an improvement in the performance of work as the EV and AC are more than PV which indicates that the project is ahead of the planned schedule

4.2 Performance Indices

Performance indices show the percentage of variation, between planned and actual performance, for the current period, cumulative to date, and at the completion of a task. The Schedule Performance Index and the Cost Performance Index are calculated to provide an efficiency factor for the work accomplished in either the current period or a cumulative timeframe. Now the result obtained from the MSP for the Performance Indices is tabulated.

Table 5: SPI and CPI of the project

Performance Indices of all activities of the project was done for the alternate months and is represented graphically as in figure 8

Trial	Duration	CPI	SPI
1	6th May 2022	0.98	0.78
2	20th June 2022	0.99	0.84
3	2nd August 2022	0.99	0.87
4	14th September 2022	0.99	0.75
5	7th October 2022	0.99	0.89
6	27th October 2022	1.0	0.9
7	9th November 2022	1.0	1.03
8	10th January 2023	1.0	1.0

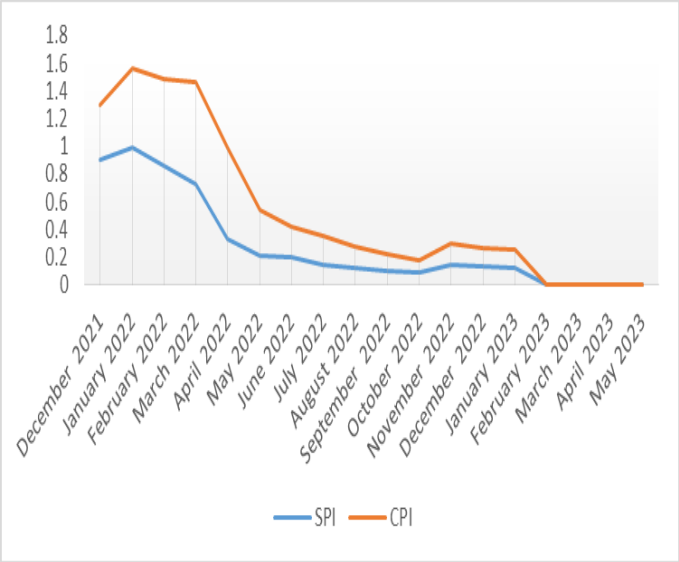


Fig -10 SPI and CPI of the Project

Schedule Performance Index (SPI) of 1.0 indicates that the project is on schedule and performing at 100% efficiency. An SPI greater than 1.0 shows an ahead of schedule situation, while one below 1.0 reflects a behind schedule condition.

Similarly CPI measures the cost efficiency with which work has been accomplished. A CPI of 1.0 indicates that for every actual Rupee spent, a Rupee's worth of work was accomplished. A CPI above 1.0 indicates a cost under run or higher efficiency, while an index below 1.0 reflects performance below what was expected.

After getting the output data from the MSP and analyzing, visually it can be seen that until the month of October 2022, the project was running behind the planned schedule and performance was also very poor but after the month of November 2022 there was a significant improvement in the performance of work and hence it resulted into project running behind schedule to project to be on time (apparently we can even say ahead of schedule).

4.3 Variance Analysis

It is safe to say that no plan, schedule or estimate is exact and thus variances are certain to occur. A variance is the difference between the planned, scheduled, or actual costs. The presence of significant variance notifies management that something needs to be examined and proper corrective action taken.

With earned value analysis, two main variances i.e. Schedule Variance (SV) and Cost Variance (CV) can be determined, and the result obtained from the MSP for the Variance Analysis is tabulated.

Table 6: Table of CV and SV of the project

Trial	Duration	Cost variance(CV)	Schedule Variance(SV)
1	**6th May 2022**	-₹ 61,300.78	-₹1100740.42
2	**20th June 2022**	-₹ 69,811.54	-₹1264789.00
3	**2nd August 2022**	-₹79,490.35	-₹1425163.78
4	**14th September 2022**	-₹ 84839.55	-₹3996398.69
5	**7th October 2022**	-₹ 78712.41	-₹1801442.98
6	**27th October 2022**	-₹ 69096.29	-₹1823291.14
7	**9th November 2022**	-₹ 55411.90	₹640886.10
8	**10th January 2023**	-₹ 35768.97	₹1100740.54

Variance Analysis of all activities of the project was done for the alternate months and is represented graphically as in figure 9

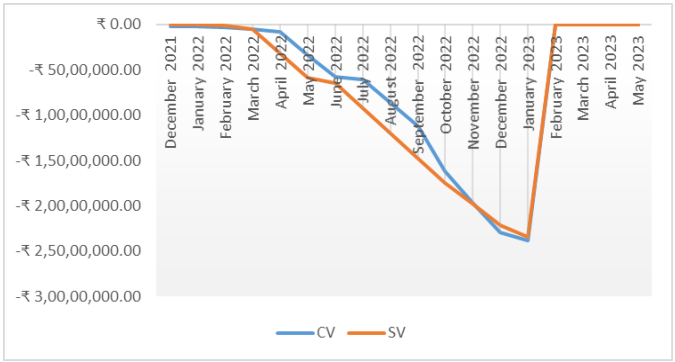


Fig -11 CV and SV of the Project

As it was explained in the Chapter-3 that Schedule variance (SV) provides a representation of schedule status, indicating whether budgeted work is being accomplished as planned. A positive SV indicates the project is ahead of schedule and a negative SV means behind schedule. Cost Variance (CV) is the difference between the cost that was planned for a given work and the cost that was actually incurred in performing

that work. A positive CV indicates the project is under budget and a negative CV means over budget.

After getting the output data from the MSP and analyzing, similarly as it has happened in Performance Indices analysis, it can be seen that until the month of November 2022 the project was running behind the schedule and in performance but after the month of December 2022 it improved which resulted the project to be on time and within the budget.

After carrying out the Earned Value analysis, Performance Indices analysis and Variance analysis we have almost got the result that how is the performance of the project in terms of cost and time. However, in order to sum up the result and to conclude this Chapter let have a look at the Schedule % Cumulative percent Complete and Cumulative cost as in fig 10.

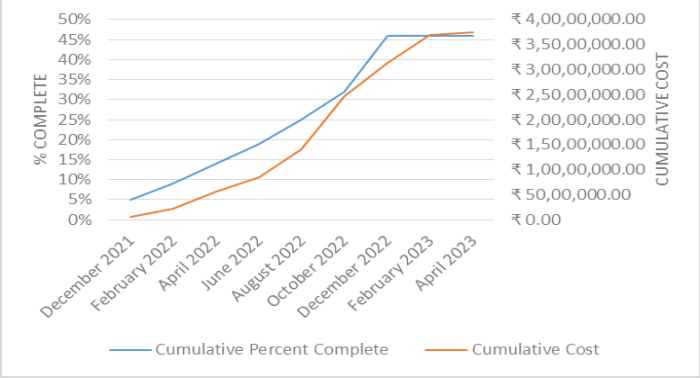


Fig-12 Percentage complete of the Project

The graph shows that the performance of the project was not proceeding as it was supposed and was lagging behind the planned schedule in the initial few months of the start of project (until November 2022). As the work proceeded further the performance was improved and project was on the schedule (or we can say ahead of schedule) as per the planned schedule (after November 2022).

5. CONCLUSION

After tracking the project using earned value management in MSP, it leads to the following conclusion below:

- The actual construction of the project is delayed more than a week when tracked on the day of trial 1.
- The output from the workers is also at slower rate during the initial days of the commencement of project which eventually affected the project's planned schedule.
- After analysis it can be seen that, in the month of May, the project has an SPI of 0.78 and as learnt in the previous chapters that, if a project has an Schedule Performance Index(SPI) SPI<1 indicates it is behind the schedule.
- Also in the month of May, the project has a Cost Performance index (CPI) of 0.98 and if a project has a CPI<1 indicates the project is over budgeted.
- As the project is delayed initially and impact of this has affected the project for the next few months; due to this the project was behind the schedule until October 2022. However the impact of delay on the project cost is noticed regularly by tracking using Earned Value Management in Microsoft Project.
- Tracking the project at regular intervals helped to know the project status and guided the constructors to make necessary changes for the proper and effective progression of the project construction.
- After the implication of necessary changes and fastening the construction works, from the month of November 2022 the project is on schedule and also the project is under the budget.
- The analysis showed that the maximum Schedule Performance Index of the project is 1.03 during the month of November 2022, which indicates that during this month the efficiency of the project was highest which made the project to be ahead of the schedule.
- Also the analysis showed that the maximum Cost Performance Index of the project is 1.0 during the month of November 2022, which indicates that during this month, the resources are used most efficiently which resulted the project to be under budget.
- Further the project is tracked for two more times until January 2023, the values of SPI and CPI remained above 1 indicating project to be on schedule and budget.
- The above results Concludes that Earned Value Management is a powerful tool that can assist in the management of construction projects. It enables the project team to identify problems and trends at an earlier stage, thereby allowing appropriate action to be taken. While it cannot be viewed as a solution to all project issues, it does provide a means to manage a project in an efficient way.
- Earned Value Analysis is a better method of program/project management because it integrates cost and schedule, can be used to forecast future performance and project completion dates.

- Earned value Management is an "early warning" program/project management tool that enables managers to identify and control problems before they become insurmountable. It allows projects to be managed better on time and on budget.

6 FUTURE SCOPE

- Earned value management (EVM) is a technique for monitoring and tracking project completion dates, involving Earned Schedule and Earned Duration.
- It eliminates cost data in scheduling and uses time-based data for progress indicators.
- EVM decouples schedule and cost performance measures, creating indices to assess progress and efficiency at any project level.
- It requires no new data collection processes and provides updated formulas for predicting project completion dates using time-based measures.

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