

Analysis of Construction Project Using Earned Value - A Case Study

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ABSTRACT: Construction activity has been in existence since the cave man started building his dwelling. In India construction sector is second largest, but many construction projects go through from price overrun and plan delay. Analysis of project performance using earned value method which has been followed for software program in challenge management. The dissertation goal is to discover the idea of earned value, its technique and metrics in overall performance measurement and forecasting project progress. The effectiveness of making use of earned value project management in real project, Construction of residential apartment that's taken as a part of Case Study. MS Project is used for Project Planning, Scheduling and Earned Value Calculation. The present study offers with the planning, scheduling and Project overall performance dimension the use of Earned Value Parameters such as Variances, Performance Indices, and Forecasting project progress. The result obtained from this calculation the paper concludes the importance of project performance measuring with the aid of Earned Value evaluation in improving project performance of a construction projects.

KEYWORDS: Project Management, Construction planning, co-ordination, control, Earned Value Analysis, Project scheduling, Earned Value Management, Schedule Variance, Cost Variance.

I. INTRODUCTION

A project is planned set of reticulate tasks to be performed over a hard and fast amount and among bound value and alternative limitations. Project Management is that the overall designing, co-ordination, and management of a undertaking proper from abstract element to the mission clean-up phase. Project Management is that the application of information, skills, equipment and method to project activities to satisfy the task needs. several of the equipment and techniques to mission for managing comes are unique to task management. (PMBOK, 4th Edition, 2008).

Earned Value Management (EVM) is a assignment control methodology which integrates the technique of making plans and measuring the performance of a assignment in opposition to a baseline agenda in terms of task scope, time schedule and value objectives for overall performance on a given date. In India, construction sector is second largest after agriculture, which employees and contributes to economic growth.

B. Scope of the project

The objective of the project is to control the project cost's overrun and schedule overrun. This can be effectively achieved by adopting earned value management (EVM). Monitoring the daily activities and by tracing come to know the actual accomplishment of the project. Planning and programing is completed mistreatment MS-project software package earned price parameters are calculated accurately and provides early warning to project manager to form corrective actions, to finish the task within estimated time and inside budget.

C. Objective of the project

The main aim of this dissertation is to offer improved cost management control by implementing EVM technique for construction project. This objective is achieved by following steps.

1. To provide a concise and timely view of project's cost and schedule performance.
2. To analyze the work progress at site with respect to set standards of baseline.
3. To analyze variance, performance indices and forecasting of project.
4. To permit for early indication of expected final prices and schedule completion.
5. To facilitate accountable call primarily by providing a legitimate, timely & extra control system.

6. Planning and scheduling is done using MSP software.

II. Concept of EVM

A. Introduction

Earned rate management can be a management observe for institution movement scope, time, cost for activity task performance progress, and for prediction mission outcome. By making use of EV in initial segment of mission making plans which contributes the value in cost and time table baseline which provides exceptional base in undertaking scope assumption. Once the baseline is set further which is used in project performance measuring during execution of work.

Based on the real performance in phrases of price and schedule is observed against baseline which gives response of project stats and the data can be utilized to predict the outcomes and provide management with effective decision making using the data.

B. Earned Value Parameters

Planned value (PV)

It is the amount of cash budgeted to be spent at a singular purpose of your time.

Planned value are computed at the same time as hourly price multiplied by way of overall hours planned or schedule.

Earned value (EV)

It is the amount of work in phrases of cost that is certainly finished at a particular factor of time with apprehend to the planned value.

Earned value are calculated as baseline value multiplied by percentage of job actually completed.

Actual cost (AC)

It is the important quantity of money spent for the corresponding planned and earned price.

Actual price calculated as hourly charge multiplied by using total hours spent.

Schedule variance (SV)

The deviance between Earned Value & Planned Value.

$$SV = EV - PV.$$

Schedule performance index (SPI)

It's miles the quantitative relation among Earned value and Planned price. It indicated what percentage ahead or past due the project is at a specific motive of it slow.

$$SPI = EV / PV$$

Cost variance (CV)

The deviance between Earned Value and Actual Cost.

$$CV = EV - AC.$$

Cost performance index (CPI)

It's far the ratio among Earned price and actual charge. If CPI extra than 1 then the assignment is beneath rate range and CPI a whole lot a good deal much less than 1, then the undertaking is over rate variety.

$$CPI = EV / AC.$$

Budget at completion (BAC)

Overall budget of undertaking it manner that sum of all budgets allocated to the assignment scope. Budget at completion price that identical to state-of-the-art revised estimate of the assignment.

Estimate to complete (ETC)

Estimate to complete calculate that the difference between the finances at of completion and earned cost than that difference price need to be divided via cost overall performance index.

$$ETC = (BAC-EV) / CPI.$$

Estimate at completion (EAC)

It should be objective price estimate for last legal work. Estimate at completion may be finding out by using adding actual price to the estimate to finish of the project.

$$EAC = AC + ETC.$$

III. Case Study

Selected project is one of the attractive, famous and approved residential apartment. It has been provided with luxuries comfortable modern living days accommodation, it has been designed for the art of living style and the building is at the extension of Mysore city with all nearest facility which are required for the present living pattern. The Symphony has been provide with conveniences that are gymnasium, rooftop swimming pool, library, seepage treatment plan, storm water tank, Wi-Fi, basketball ground, adopted rain water harvesting, environmental management and high safety standards.

Table1: The Project Information

1	Name of the project	BRIGADE SYMPHONY
2	Location	Mettagalli, KRS road, Falcon Tyre, Mysuru
3	Site Area	3 Acre
4	Build-up Area of Block D	3375.63 Sqmt
5	Building Type	Residential Apartment
6	No of floors Block D	G+7
7	No of flats in Block D	36
8	Total No of Blocks / floors	3 blocks, 7 floors (2B+G+7F)
9	Total No of Apartments	89
10	Type of Apartment	56 Nos. of 2BHK, 33 Nos. 3BHK
11	Lifts	8 Numbers
12	No of car parking	94
13	Overall Duration of Project	16 Months

IV. Research Methodology and Analysis

A. General

The task duration, Work Breakdown Structure (WBS) and tasks are labored out and a scheduling is done using MSP software, which is widely used in India. The project duration is tracked and monitored by weekly. Earned value (EV) analysis parameters are obtained.

In order to achieve EVM effectively firstly have to understand the concept thoroughly from the literature papers. In order to implement EVM have to search a project facing schedule delay and cost overrun. Symphony project in Mysore, facing schedule delay and cost over, due to lack of resources.

EVM is efficiently achieved by carefully observing the everyday tasks and tracing the project and updating in MSP software. EVM provides the precise data regarding the project and benefits the project manager to take corrective actions to mitigate schedule delay and cost overrun.

B.Steps to be followed in MS-project

- WBS of the project have to be create.
- Under WBS activities have to be create. Duration for each activity should to be assigned.
- Relationship for activities should be assigned.
- Resources should be assigned for each activities.

- Baseline should be create.
- Cost for each activities should be assigned.
- Monitoring the activities daily as per the baseline schedule.
- Tracking the project weekly and update in the software.
- EVM parameters are calculated.

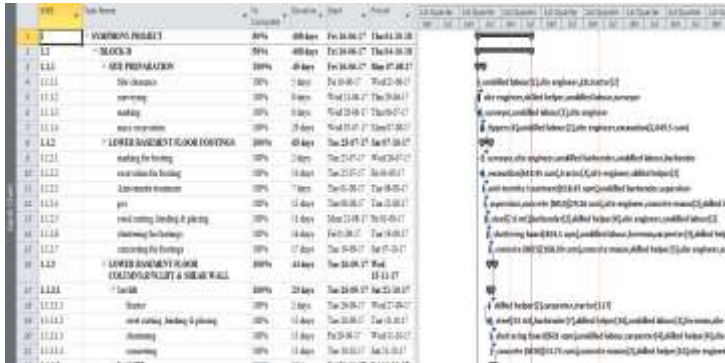


Figure 1: Schedule Of The Project In MSP

Task Name	Planned Value (PV)	Actual Value (AV)	EV	CV	SI	SV	SI	SI	SI
SYNOPSIS PROJECT	\$ 6480499.20	\$ 42,133,333.02	\$ 42,133,333.02	\$ 22,474,823.08	\$ 784,133.04	\$ 40,867,424.07	\$ 41,884,891.02	\$ 1,312,734.84	
BLK 4	\$ 6480499.20	\$ 42,133,333.02	\$ 42,133,333.02	\$ 22,474,823.08	\$ 784,133.04	\$ 40,867,424.07	\$ 41,884,891.02	\$ 1,312,734.84	
SITE PREPARATION	\$ 104,520.00	\$ 854,828.04	\$ 1,045,200.00	\$ 0.00	\$ 488,790.00	\$ 1,045,200.00	\$ 854,828.04	\$ 488,790.00	
Site clearance	\$ 142,700.00	\$ 142,700.00	\$ 142,700.00	\$ 0.00	\$ 0.00	\$ 142,700.00	\$ 142,700.00	\$ 0.00	
surveying	\$ 2,400.00	\$ 2,400.00	\$ 2,400.00	\$ 0.00	\$ 0.00	\$ 2,400.00	\$ 2,400.00	\$ 0.00	
staking	\$ 1,500.00	\$ 7,800.00	\$ 7,800.00	\$ 0.00	\$ 0.00	\$ 7,800.00	\$ 7,800.00	\$ 0.00	
site excavation	\$ 90,320.00	\$ 86,728.04	\$ 90,320.00	\$ 0.00	\$ 2,200.00	\$ 90,320.00	\$ 86,728.04	\$ 2,200.00	
LOWER GROUND FLOOR CONCRETE	\$ 1,816,428.00	\$ 1,914,428.00	\$ 2,061,728.00	\$ 0.00	\$ 144,990.00	\$ 2,061,728.00	\$ 1,914,428.00	\$ 144,990.00	
waiting for footing	\$ 4,200.00	\$ 4,200.00	\$ 4,200.00	\$ 0.00	\$ 0.00	\$ 4,200.00	\$ 4,200.00	\$ 0.00	
excavation for footing	\$ 121,700.00	\$ 121,700.00	\$ 121,700.00	\$ 0.00	\$ 0.00	\$ 121,700.00	\$ 121,700.00	\$ 0.00	
cast concrete foundation	\$ 41,900.00	\$ 41,900.00	\$ 41,900.00	\$ 0.00	\$ 0.00	\$ 41,900.00	\$ 41,900.00	\$ 0.00	
gun	\$ 181,900.00	\$ 181,900.00	\$ 181,900.00	\$ 0.00	\$ 0.00	\$ 181,900.00	\$ 181,900.00	\$ 0.00	
rod cutting, binding & placing	\$ 188,700.00	\$ 188,700.00	\$ 188,700.00	\$ 0.00	\$ 0.00	\$ 188,700.00	\$ 188,700.00	\$ 0.00	
checking for binding	\$ 238,900.00	\$ 238,900.00	\$ 238,900.00	\$ 0.00	\$ 0.00	\$ 238,900.00	\$ 238,900.00	\$ 0.00	
checking for footing	\$ 712,000.00	\$ 712,000.00	\$ 712,000.00	\$ 0.00	\$ 0.00	\$ 712,000.00	\$ 712,000.00	\$ 0.00	
LOWER GROUND FLOOR COLUMN, PART & SHEAR WALL	\$ 5,250,798.00	\$ 5,250,798.00	\$ 5,250,798.00	\$ 0.00	\$ 0.00	\$ 5,250,798.00	\$ 5,250,798.00	\$ 0.00	
cast	\$ 2,061,728.00	\$ 2,061,728.00	\$ 2,061,728.00	\$ 0.00	\$ 0.00	\$ 2,061,728.00	\$ 2,061,728.00	\$ 0.00	
form	\$ 1,000.00	\$ 1,000.00	\$ 1,000.00	\$ 0.00	\$ 0.00	\$ 1,000.00	\$ 1,000.00	\$ 0.00	
rod cutting, binding & placing	\$ 1,020,000.00	\$ 1,020,000.00	\$ 1,020,000.00	\$ 0.00	\$ 0.00	\$ 1,020,000.00	\$ 1,020,000.00	\$ 0.00	
checking	\$ 100,000.00	\$ 100,000.00	\$ 100,000.00	\$ 0.00	\$ 0.00	\$ 100,000.00	\$ 100,000.00	\$ 0.00	

Figure 2: Over All Budget of The Project In MSP

C. Measuring Project Performance Using Earned Value Parameters

The performance size baseline is used to compare real undertaking schedule and price overall performance to determine the prevailing fame of a assignment. Data collected from site tracking is fed into MS-Project software through scheduling and progresses tracing the PV, EV and AC for every week are obtained. Earned value analysis is accomplished for task overall performance by manner of calculating variances, overall performance indices and forecasting.

D. Earned Value Calculation

The instance has been taken to calculate earned value is first floor slab column and walls.

- PV = 15,82,342.08
- AC= 16,62,341.84
- % completed = 100%

$$1. EV = PV \times \% \text{ completed}$$

$$= 15,82,342.08 \times 1.0$$

$$= 15,82,342.08$$

$$2. \quad SV = EV - PV$$

$$= 15,82,342.08 - 15,82,342.08$$

$$= 0$$

$$3. \quad CV = EV - AC$$

$$= 15,82,342.08 - 16,62,341.84$$

$$= -79,999.76$$

$$4. \quad SPI = EV / PV$$

$$= 15,82,342.08 / 15,82,342.08$$

$$= 1$$

$$5. \quad CPI = EV / AC$$

$$= 15,82,342.08 / 16,62,341.84$$

$$= 0.95$$

$$6. \quad \text{Estimate at completion}$$

$$(EAC) = AC + (BAC - EV) / CPI$$

$$= 43,196,268.56 + (64,884,690.02 - 42,410,133.52) / 0.95$$

$$= 6,68,53,696.45$$

$$7. \quad \text{Estimate to complete}$$

$$(ETC) = EAC - AC$$

$$= 6,68,53,696.45 - 16,62,341.84$$

$$= 6,51,91,354.61$$

$$8. \quad \text{Variance at completion}$$

$$(VAC) = BAC - EAC$$

$$= 64,884,690.02 - 6,68,53,696.45$$

$$= -19,69,006.43$$

$$9. \quad \text{Time Estimate at completion EAC (t)}$$

$$EAC (t) = BAC / SPI$$

$$= 64,68,53,696.45 / .44$$

$$= 24 \text{ months}$$

Table 2: PV, EV, & AC for 15 Weeks

Week Nos.	DATE	Planned Value (PV)	Earned Value (EV)	Actual Cost (AC)
1	18-12-2017	64842	64842	70613
2	25-12-2017	128905	128905	142183
3	01-01-2018	186758	156126	172090
4	08-01-2018	244254	213623	241094
5	15-01-2018	305090	274458	315379
6	22-01-2018	365925	304876	352521
7	29-01-2018	529673	401509	465153
8	05-02-2018	1599854	1061935	1101159
9	12-02-2018	3705439	2436681	2440801
10	19-02-2018	4798255	2912844	2902316
11	26-02-2018	5225373	3048786	3048900
12	05-03-2018	5769187	3094269	3097474
13	12-03-2018	6081670	3132171	3137951
14	19-03-2018	6578082	3154913	3162238
15	26-03-2018	7237340	3179038	3190402

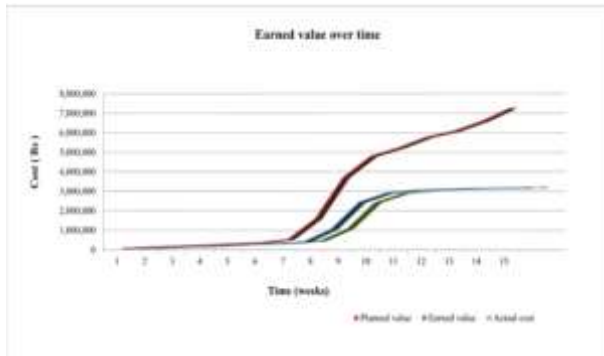


Figure 3: Earned Value Over Time

Table 3: EV Parameters for 15 Weeks

Week Nos.	DATE	Schedule Variance (SV)	Schedule Performance Index	RESULT
1	18-12-2017	0	1	On time
2	25-12-2017	0	1	On time
3	01-01-2018	-30632	0.84	Behind Schedule
4	08-01-2018	-30632	0.87	Behind Schedule
5	15-01-2018	-30632	0.9	Behind Schedule
6	22-01-2018	-61049	0.83	Behind Schedule
7	29-01-2018	-128164	0.76	Behind Schedule
8	05-02-2018	-537919	0.66	Behind Schedule
9	12-02-2018	-1268758	0.66	Behind Schedule
10	19-02-2018	-1885411	0.61	Behind Schedule
11	26-02-2018	-2176587	0.58	Behind Schedule
12	05-03-2018	-2674918	0.54	Behind Schedule
13	12-03-2018	-2949498	0.52	Behind Schedule
14	19-03-2018	-3423169	0.48	Behind Schedule
15	26-03-2018	-4058302	0.44	Behind Schedule

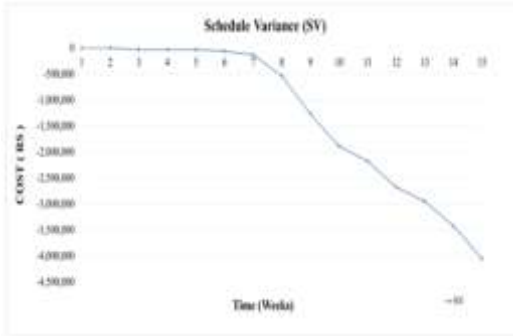


Figure 4: SV



Figure 5: SPI

Table 4: EV Parameters for 15 Weeks

Week Nos.	DATE	Cost Variance (CV)	Cost Performance Index (CPI)	RESULT
1	18-12-2017	-5771	0.92	Over Budget
2	25-12-2017	-13278	0.91	Over Budget
3	01-01-2018	-15964	0.91	Over Budget
4	08-01-2018	-27471	0.89	Over Budget
5	15-01-2018	-40921	0.87	Over Budget
6	22-01-2018	-47645	0.86	Over Budget
7	29-01-2018	-63643	0.86	Over Budget
8	05-02-2018	-39224	0.96	Over Budget
9	12-02-2018	-4120	1	On Budget
10	19-02-2018	10529	1	On Budget
11	26-02-2018	-115	1	On Budget
12	05-03-2018	-3205	1	On Budget
13	12-03-2018	-5780	1	On Budget
14	19-03-2018	-7325	1	On Budget
15	26-03-2018	-11364	1	On Budget

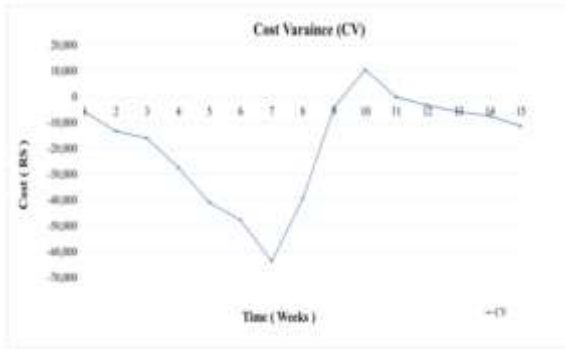


Figure 6: CV

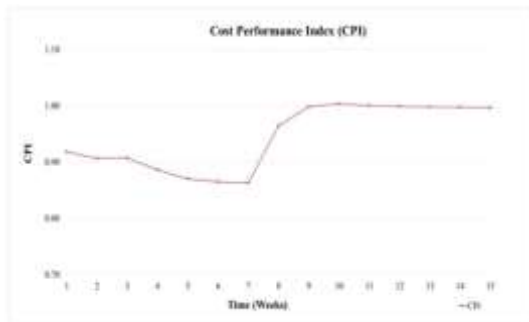


Figure 7: CPI

V. Results and Discussion

The Construction was started on 16-06-2017. Duration of Project as per baseline Schedule is 408 days. Tracking start date is 18-12-2017 till 28-03-2018 revealed 50% of total project is completed. The details are furnished in Figure 1.

The Schedule Variance, Cost Variance and CPI moreover to SPI were genuinely indicated thru Earned Value Analysis. Shown in Figure 2.

1. Fig 3. Represents the behavior of EV with respect to time. Analysis of 8th - 15th week depicts that the value as Planned (PV) in the initial stages is significantly high when compared to EV.
2. The Graph drawn in Fig 4. Reveal that the task suffers from Negative Schedule Variance (SV) 4,058,302 this is the challenge is lagging from its Schedule.
3. Fig 5. Represents the graph of SPI. The desired value of SPI for the project to be in balance with schedule is "1" with the average SPI of 0.44.
4. Fig 6. The graph suggests the task has a Negative Cost variance of 11,363 which means the undertaking is over budget.
5. Fig 7. Represents the graph of CPI. From the graph it's far evident that the project to be in balance with baseline except for 1st – 8th week. The common CPI value of "1" might inform us that the project is on price range for planned and actual cost.
6. Performance based on project completion as per EAC is 6,68,53,696.45.
7. Cost Estimate required for completion of remaining work ETC is 6,51,91,354.61.
8. VAC shows the deviation in the total cost from the expected cost. VAC ₹19,69,006.43. Thus it is evident that the cost of project is over budgeted at that particular period.

6. Conclusion

1. The outcomes of this dissertation expose the importance of assignment overall performance measuring technique like EVM in enhancing the performance of a construction challenge.
2. Through this analysis, we tend to might compare the potency in prediction varied parameters relating to the standing of the project.
3. The end result can gain the project manager to know the prevailing state of affairs of the assignment so we can control the challenge expenditure in the great way and thereby enhancing the challenge performance

VI. Future Scope of Work

1. EVM can also be applied to infrastructure projects such as highway and bridges.
2. Role of EVM in Projects with incorporating Risk and Delay Analysis can be carried out and analysis the changes or savings in cost and time as per planned costs and schedule.
3. In the present study, EVM has been incorporated and interpreted in terms of cost. Time factor can also be considered in future works and result can be interpreted in terms of Earned schedule.

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