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EARNED VALUE ANALYSIS OF RESIDENTIAL BUILDING FOR PROJECT TRACKING

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Abstract:
Earned Value Management helps to analyze the project's performance and predict the forecast. It shows the current status of the project, tracks actual progress with the planned progress, answers various performance related queries such as whether projects are under budget or over budget or whether you are ahead of schedule or behind schedule, etc. The technique helps in comparison of budgeted cost of work to actual cost. EVA is a powerful tool to plan project and analyse cost performance. EVA provides an integrated schedule (time), progress, and cost management, related to scope and procurement, quality, and risks.
The present study deals with the scheduling and project monitoring process along with it also discuss main parameters involves in the calculation of Earned Value Analysis in cost management of construction projects. MSP 2016 software is used for EVM calculations of project. The main objective of project to track the existing project and perform analysis for effective scheduling and cost benefit analysis. In this project use of Earned Value Analysis has proven to be useful for cost management and rescheduling of the work. Also it is used for better project tracking.
Key words – Earned Value Management, Actual Cost, Project Monitoring, Cost Analysis

INTRODUCTION

Construction industry is one of the important sectors in India and is facing challenges day by day. The industry contributes to the growth of our economy to a large extent. One of the main problems that the industry faces is project delay. This can be caused due to various reasons like deviation from the initial plan, scarcity of resources, poor planning, poor execution, natural calamities etc. This causes the project to go over the expected budget and fails to complete within the scheduled time. The construction itself becomes costlier.
Hence it is important that there is a systematic and scientific approach to project management to ensure that the project is completed within the constraints of time and resources. EV analysis is an important tool to measure the performance of a project. It is a program management technique that uses "work in progress" to indicate what will happen to the work in future. It compares the actual work performed against a baseline plan. In this way, the analysis helps in setting a standard for performance evaluation and controls the time and cost constraints. It also helps in identifying the critical activities which maybe noted down and taken care of during further progress of the project. It acts as an early warning to the project manager to spot and control potential problems that may arise so as to maximise profits and minimize delays.

AIM - Application of Earned Value Analysis for small scale residential building in Pune for better project tracking using MSP.

OBEJTIVES –
1) To study earned value analysis and its implementation in Residential project.
2)To identify different causes for cost overrun through literature survey and case study.
3)To perform earned value analysis using MSP for residential building.

SCOPE -The scope of this project is to study how earned value analysis can effectively help to overcome cost overrun problem in construction project using MSP.

LIMITATION - Earned value analysis for project tracking will be perform using MSP software only.

LITERATURE REVIEW

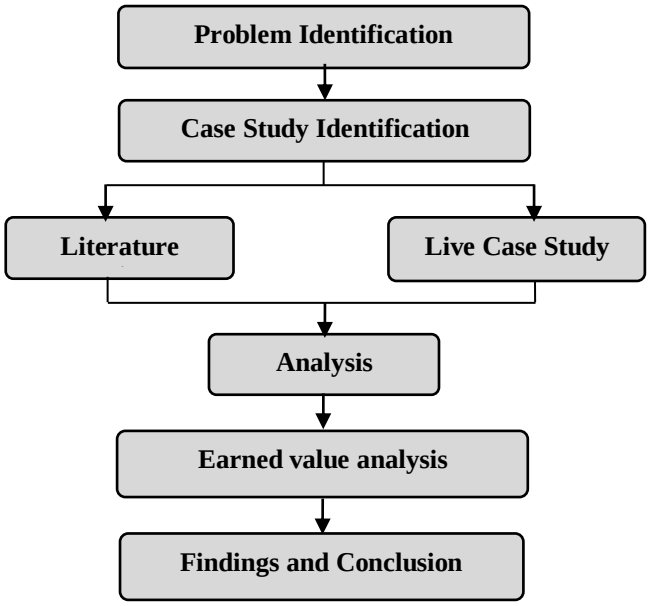
In the past several researchers have studied, the importance of Earned Value Analysis for project tracking.

A paper by Sangram M. Patil, D. B. Desai, Dr. A. K. Gupta- **Earned Value Analysis in Construction Industry** (March 2015) - Construction industry an important industry at both the global level and national level. It is second largest sector in India. It provides huge employment to the people and plays very significant role in country economy. Project delay is most common problems in the construction industry. Project overruns due to time and cost result in delays during project execution. In developing countries project overruns is a serious where implementation of project faces many uncertainties. It results in wastage of scare financial resources, delays in providing facilities, development and also make construction costlier. EVA is the process of measuring performance of project work against a baseline plan. EVA application helps in providing performance standard for the evaluation of progress report of project and it also act as a control device to take care of time and cost schedule. It provide better performance picture of project and gives better forecast of the final completion cost. Earned Value is an enhancement over traditional process of cost accounting.

Sagar K. Bhosekar, GayatriVyas - **Cost Controlling Using Earned Value Analysis in Construction Industries** (April 2012) - Most of the construction projects suffer from cost and time overruns due to a multiplicity of factors. Earned value management (EVM) is a project performance evaluation technique that has origins in industrial engineering, but which has been adapted for application in project management. The earned value analysis gives early indications of project performance to highlight the need for eventual corrective action. This study is to present and discuss the main parameters involved in the calculation of Earned Value Analysis (EVA) in the cost management of civil construction projects. The purpose of this dissertation is in 3-fold. Firstly, Earned Value Analysis software is developed in Visual studio, Next Comparison of selected parameters between M.S Project 2007, Primavera P6 and developed software is done. Therefore, it can be concluded that the software could be used in a wide range of projects for Earned Value Analysis calculation.

Mohd Faris Khamidi, Waris Ali Khan1, AraziIdrus - **The Cost Monitoring of Construction Projects Through Earned Value Analysis** (2011) - This paper discusses the applications of Earned Value Analysis (EVA) for cost management of construction projects in Malaysia. Besides traditional approach, EVA is a three-dimensional technique that compares the budgeted value of work scheduled with the earned value of physical work completed and the actual cost of work completed. Therefore, cost management by EVA is an objective measure of actual work performed. This paper uses a case study, an example application of EVA as a cost monitoring tool. This case study reaffirms the benefits of using EVA for project cash flow analysis and forecasting.

METHODOLOGY



CASE STUDY

Case Study 1: Niwara Residence

It is a residential project located in Chinchwad. It is a Construction of Basement + Parking + 2floors residential building of 1673 Sq. m. The residential building has parking in the basement and at the ground floor. At the first and second floor four flats, each of 94 Sq. m. area are designed. The duration for completion of the work is 10 months.

The owner and contractor of the building is the same private firm called “Gravity Engineers and Contractors” located in Chinchwad.

Work done in MSP

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Project scheduling is done by collecting schedule and cost data. After developing a suitable MSP file, tracking of the project starts and the progress of the project has been analyzed.

The sequence of activities, their duration, start dates, finish dates and the free slack of the project are shown in Figures below.

	Task Mode	Task Name	Start	Finish	Late Start	Late Finish	Free Slack	Total Slack
0		EVA MSP PROJECT	Wed 15/03/17	Thu 25/01/18	Wed 15/03/17	Thu 25/01/18	0 days	0 days
1		EXCAVATION	Wed 15/03/17	Wed 05/04/17	Wed 15/03/17	Thu 25/01/18	294 days	294 days
2		PCC	Wed 05/04/17	Fri 07/04/17	Wed 05/04/17	Fri 07/04/17	0 days	0 days
3		FOOTING	Sat 08/04/17	Thu 20/04/17	Sat 08/04/17	Thu 20/04/17	0 days	0 days
4		BACKFILLING	Fri 21/04/17	Fri 28/04/17	Fri 21/04/17	Thu 18/05/17	0.57 days	19.57 days
5		RCC (GROUND FLOOR)	Sat 29/04/17	Tue 23/05/17	Sat 29/04/17	Mon 12/06/17	0.57 days	19.9 days
6		2ND SLAB (FIRST FLOOR SLAB)	Wed 24/05/17	Tue 13/06/17	Wed 24/05/17	Mon 03/07/17	1 day	20.14 days
7		3RD SLAB (SECOND FLOOR SLAB)	Wed 14/06/17	Fri 07/07/17	Wed 14/06/17	Thu 25/01/18	200.29 days	200.29 days
8		4TH SLAB (TERRACE FLOOR SLAB)	Sat 08/07/17	Thu 27/07/17	Sat 08/07/17	Thu 27/07/17	0 days	0 days
9		BLOCK WORK	Fri 28/07/17	Mon 14/08/17	Fri 28/07/17	Mon 14/08/17	0 days	0 days
10		ELECTRICAL WALL CONDUCTING & SWITCH BOARD FIXING	Tue 15/08/17	Thu 31/08/17	Tue 15/08/17	Thu 31/08/17	0 days	0 days
11		INTERNAL PLATER	Fri 01/09/17	Wed 04/10/17	Fri 01/09/17	Wed 04/10/17	0 days	0 days
12		DOORS	Thu 05/10/17	Mon 23/10/17	Thu 05/10/17	Thu 25/01/18	93.57 days	93.57 days

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Fig 1: MSP scheduling

10		ELECTRICAL WALL CONDUCTING & SWITCH BOARD FIXING	Tue 15/08/17	Thu 31/08/17	Tue 15/08/17	Thu 31/08/17	0 days	0 days
11		INTERNAL PLATER	Fri 01/09/17	Wed 04/10/17	Fri 01/09/17	Wed 04/10/17	0 days	0 days
12		DOORS	Thu 05/10/17	Mon 23/10/17	Thu 05/10/17	Thu 25/01/18	93.57 days	93.57 days
13		INTERNAL PLUMBING WORK	Tue 24/10/17	Fri 10/11/17	Tue 24/10/17	Fri 10/11/17	0 days	0 days
14		WATERPROOFING	Sat 11/11/17	Mon 27/11/17	Sat 11/11/17	Mon 27/11/17	0 days	0 days
15		TILING	Thu 05/10/17	Mon 25/12/17	Thu 05/10/17	Thu 25/01/18	31 days	31 days
16		ALUMINIUM WINDOW FIXING	Fri 01/09/17	Thu 07/09/17	Fri 01/09/17	Thu 07/09/17	0 days	0 days
17		EXTERNAL PLASTER	Tue 19/12/17	Thu 04/01/18	Tue 19/12/17	Thu 04/01/18	0 days	0 days
18		EXTERNAL PAINT	Fri 05/01/18	Mon 22/01/18	Fri 05/01/18	Thu 25/01/18	2.43 days	2.43 days
19		COMPOUND WALL	Fri 05/01/18	Thu 25/01/18	Fri 05/01/18	Thu 25/01/18	0 days	0 days

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Fig 2: MSP scheduling

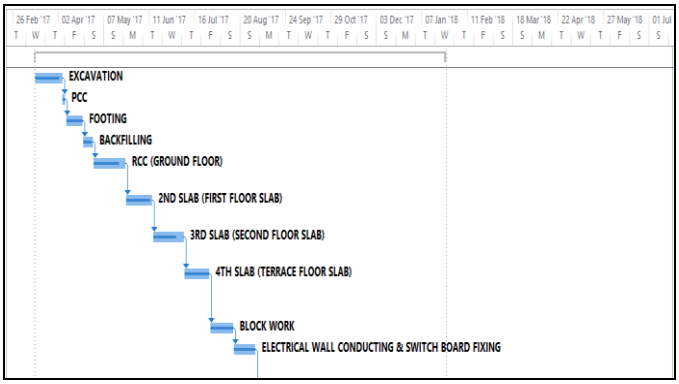

Fig 3: MSP scheduling

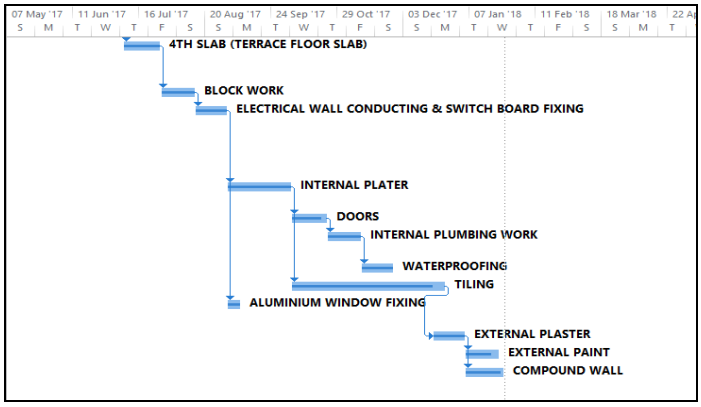

Fig 4: MSP scheduling

COST ANALYSIS

Cost analysis of the project is shown in Figures below.

	Task Name	Fixed Cost	Fixed Cost Accrual	Total Cost	Baseline	Variance	Actual	Remaining
0	EVA MSP PROJECT	Rs 0.00	Prorated	Rs 7,656,147.69	Rs 7,475,830.24	Rs 180,317.45	Rs 6,801,626.64	Rs 854,521.05
1	EXCAVATION	Rs 0.00	Prorated	Rs 246,500.00	Rs 246,500.00	Rs 0.00	Rs 216,920.00	Rs 29,580.00
2	PCC	Rs 0.00	Prorated	Rs 56,375.00	Rs 56,375.00	Rs 0.00	Rs 56,375.00	Rs 0.00
3	FOOTING	Rs 0.00	Prorated	Rs 145,120.00	Rs 145,120.00	Rs 0.00	Rs 145,120.00	Rs 0.00
4	BACKFILLING	Rs 0.00	Prorated	Rs 728,460.00	Rs 728,460.00	Rs 0.00	Rs 604,621.80	Rs 123,838.20
5	RCC (GROUND FLOOR)	Rs 0.00	Prorated	Rs 893,965.20	Rs 893,965.20	Rs 0.00	Rs 706,232.51	Rs 187,732.69
6	2ND SLAB (FIRST FLOOR	Rs 0.00	Prorated	Rs 557,764.32	Rs 557,764.32	Rs 0.00	Rs 524,298.46	Rs 33,465.86
7	3RD SLAB (SECOND	Rs 0.00	Prorated	Rs 697,205.40	Rs 697,205.40	Rs 0.00	Rs 522,904.05	Rs 174,301.35
8	4TH SLAB (TERRACE FLOOR SLAB)	Rs 0.00	Prorated	Rs 522,904.05	Rs 522,904.05	Rs 0.00	Rs 522,904.05	Rs 0.00
9	BLOCK WORK	Rs 0.00	Prorated	Rs 334,636.38	Rs 334,636.38	Rs 0.00	Rs 334,636.38	Rs 0.00
10	ELECTRICAL WALL CONDUCTING & SWITCH BOARD FIXING	Rs 0.00	Prorated	Rs 134,531.32	Rs 134,531.32	Rs 0.00	Rs 134,531.32	Rs 0.00
11	INTERNAL PLATER	Rs 0.00	Prorated	Rs 142,511.67	Rs 142,511.67	Rs 0.00	Rs 142,511.67	Rs 0.00

TIMELI... GANTT CHART

Fig 5: Cost Analysis In MSP

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TIMELINE

Start | April | May | June | July | Sun 20/08/17 | August | September | October

3RD SLAB

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	Task Name	Fixed Cost	Fixed Cost Accrual	Total Cost	Baseline	Variance	Actual	Remaining
9	BLOCK WORK	Rs 0.00	Prorated	Rs 334,636.38	Rs 334,636.38	Rs 0.00	Rs 334,636.38	Rs 0.00
10	ELECTRICAL WALL CONDUCTING & SWITCH BOARD FIXING	Rs 0.00	Prorated	Rs 134,531.32	Rs 134,531.32	Rs 0.00	Rs 134,531.32	Rs 0.00
11	INTERNAL PLATER	Rs 0.00	Prorated	Rs 142,511.67	Rs 142,511.67	Rs 0.00	Rs 142,511.67	Rs 0.00
12	DOORS	Rs 0.00	Prorated	Rs 1,277,500.00	Rs 1,277,500.00	Rs 0.00	Rs 1,098,650.00	Rs 178,850.00
13	INTERNAL PLUMBING	Rs 0.00	Prorated	Rs 127,500.00	Rs 127,500.00	Rs 0.00	Rs 127,500.00	Rs 0.00
14	WATERPROOFI	Rs 0.00	Prorated	Rs 24,600.00	Rs 24,600.00	Rs 0.00	Rs 24,600.00	Rs 0.00
15	TILING	Rs 0.00	Prorated	Rs 784,126.85	Rs 723,809.40	Rs 60,317.45	Rs 721,396.70	Rs 62,730.15
16	ALUMINIUM WINDOW	Rs 0.00	Prorated	Rs 43,500.00	Rs 43,500.00	Rs 0.00	Rs 43,500.00	Rs 0.00
17	EXTERNAL PLA	Rs 0.00	Prorated	Rs 187,544.00	Rs 187,544.00	Rs 0.00	Rs 187,544.00	Rs 0.00
18	EXTERNAL PAI	Rs 0.00	Prorated	Rs 111,403.50	Rs 111,403.50	Rs 0.00	Rs 85,780.70	Rs 25,622.80
19	COMPOUND WALL	Rs 0.00	Prorated	Rs 640,000.00	Rs 520,000.00	Rs 120,000.00	Rs 601,600.00	Rs 38,400.00

Fig 6: Cost Analysis In MSP

EARNED VALUE ANALYSIS

Earned value analysis of the project is shown in Figure below.

	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	AC (ACWP)	SV	CV	EAC	BAC	VAC	CPI	SPI
0	EVA MSP PROJECT	Rs 7,475,830.24	Rs 6,583,229.82	Rs 6,731,455.21	(Rs 892,600.42)	Rs 148,225.39)	Rs 7,644,153.24	Rs 7,475,830.24	(Rs 168,323.00)	0.98	0.88
1	EXCAVATION	Rs 246,500.00	Rs 216,920.00	Rs 216,920.00	(Rs 29,580.00)	Rs 0.00	Rs 246,500.00	Rs 246,500.00	Rs 0.00	1	0.88
2	PCC	Rs 56,375.00	Rs 56,375.00	Rs 56,375.00	Rs 0.00	Rs 0.00	Rs 56,375.00	Rs 56,375.00	Rs 0.00	1	1
3	FOOTING	Rs 145,120.00	Rs 145,120.00	Rs 145,120.00	Rs 0.00	Rs 0.00	Rs 145,120.00	Rs 145,120.00	Rs 0.00	1	1
4	BACKFILLING	Rs 728,460.00	Rs 604,621.80	Rs 604,621.80	(Rs 123,838.20)	Rs 0.00	Rs 728,461.24	Rs 728,460.00	(Rs 1.24)	1	0.83
5	RCC (GROUND FLOOR)	Rs 893,965.20	Rs 706,232.51	Rs 706,232.51	(Rs 187,732.69)	Rs 0.00	Rs 893,965.20	Rs 893,965.20	Rs 0.00	1	0.79
6	2ND SLAB (FIRST FLOOR SLAB)	Rs 557,764.32	Rs 524,298.46	Rs 524,298.46	(Rs 33,465.86)	Rs 0.00	Rs 557,764.65	Rs 557,764.32	(Rs 0.33)	1	0.94
7	3RD SLAB (SECOND FLOOR SLAB)	Rs 697,205.40	Rs 522,904.05	Rs 522,904.05	(Rs 174,301.35)	Rs 0.00	Rs 697,205.40	Rs 697,205.40	Rs 0.00	1	0.75
8	4TH SLAB (TERRACE FLOOR SLAB)	Rs 522,904.05	Rs 522,904.05	Rs 522,904.05	Rs 0.00	Rs 0.00	Rs 522,904.05	Rs 522,904.05	Rs 0.00	1	1
9	BLOCK WORK	Rs 334,636.38	Rs 334,636.38	Rs 334,636.38	Rs 0.00	Rs 0.00	Rs 334,636.38	Rs 334,636.38	Rs 0.00	1	1
10	ELECTRICAL WALL CONDUCTING & SWITCH	Rs 134,531.32	Rs 134,531.32	Rs 134,531.32	Rs 0.00	Rs 0.00	Rs 134,531.32	Rs 134,531.32	Rs 0.00	1	1
11	INTERNAL PLATER	Rs 142,511.67	Rs 142,511.67	Rs 142,511.67	Rs 0.00	Rs 0.00	Rs 142,511.67	Rs 142,511.67	Rs 0.00	1	1
12	DOORS	Rs 1,277,500.00	Rs 1,098,650.00	Rs 1,098,650.00	(Rs 178,850.00)	Rs 0.00	Rs 1,277,500.00	Rs 1,277,500.00	Rs 0.00	1	0.86
13	INTERNAL PLUMBING WORK	Rs 127,500.00	Rs 127,500.00	Rs 127,500.00	Rs 0.00	Rs 0.00	Rs 127,500.00	Rs 127,500.00	Rs 0.00	1	1
14	WATERPROOFING	Rs 24,600.00	Rs 24,600.00	Rs 24,600.00	Rs 0.00	Rs 0.00	Rs 24,600.00	Rs 24,600.00	Rs 0.00	1	1
15	TILING	Rs 723,809.40	Rs 665,904.65	Rs 721,396.70	(Rs 57,904.75)	(Rs 55,492.05)	Rs 784,127.32	Rs 723,809.40	(Rs 60,317.92)	0.92	0.92
16	ALUMINIUM WINDOW FIXING	Rs 43,500.00	Rs 43,500.00	Rs 43,500.00	Rs 0.00	Rs 0.00	Rs 43,500.00	Rs 43,500.00	Rs 0.00	1	1
17	EXTERNAL PLASTER	Rs 187,544.00	Rs 187,544.00	Rs 187,544.00	Rs 0.00	Rs 0.00	Rs 187,544.00	Rs 187,544.00	Rs 0.00	1	1
18	EXTERNAL PAINT	Rs 111,403.50	Rs 85,780.70	Rs 85,780.70	(Rs 25,622.81)	Rs 0.00	Rs 111,403.50	Rs 111,403.50	Rs 0.00	1	0.77
19	COMPOUND WALL	Rs 520,000.00	Rs 438,695.24	Rs 531,428.57	(Rs 81,304.76)	(Rs 92,733.33)	Rs 629,920.11	Rs 520,000.00	(Rs 109,920.11)	0.83	0.84

Fig 7: Earned value Analysis In MSP

RESULTS AND DISCUSSION

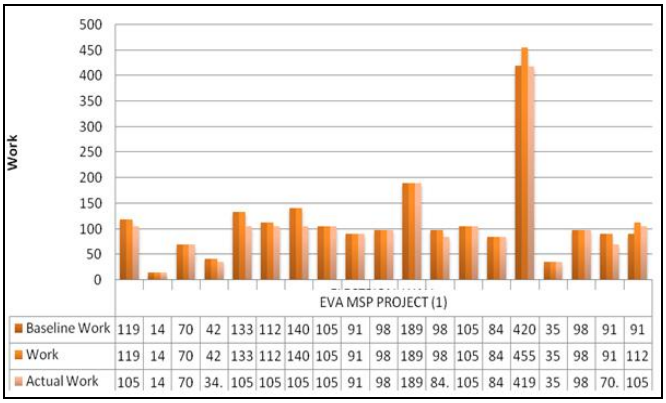

Fig 8: Baseline Work Report

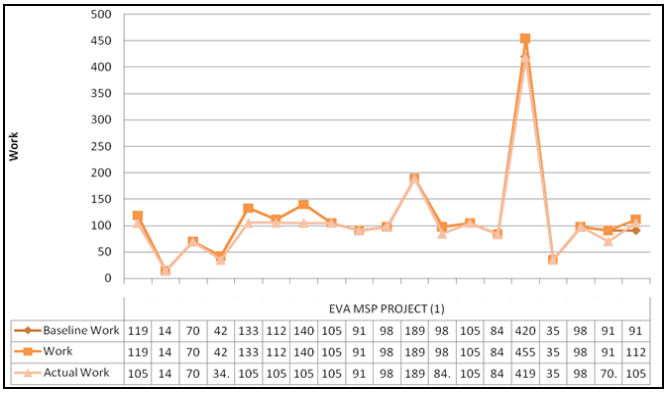

Fig 8: Baseline Work Report

The above graphs show the comparison of the various activity of the project. The comparison of baseline work, work, and actual work was done in MSP. This graph shows how the activity varies in the parameter of work. In some activity we can see a slight variation in the baseline work and the actual work where as in some activity there is a high variation in it. By using this information changes can be made in the project like rescheduling, proper allocation of labors etc. These graphs also help in tracing of the project. As MSP is commonly used in Construction Project EVA will be very helpful for project to be successful.

CONCLUSION

The studies have concluded that EVA provides a relevant contribution to the cost management in construction projects. The results obtained from EVA ascertained the gaps in the schedule which helped to reschedule the activities. The record and reporting method offer easy regularity analysis of data. Wrong data was easily identified and fixed.

EVA made the recording and reporting of data easy. EVA helped in determining the errors in the project and thus allowing to improve the practices and also provide support for decision making.

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