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Application of Earned Value Analysis in Analysing Project Performance

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***Abstract*— Efficient Management of projects in construction industries are becoming a challenge with the passing time. It has become a concern for the project managers to make sure that the project is on schedule and within budget. EVA evaluates the project performance by integrating both cost and time aspects thereby measuring the overall progress. This paper discusses how EVA is introduced to a real time project on Road Works. It helps to identify the schedule and/or cost overruns beforehand and thereby giving an opportunity to managers in identifying and controlling problems. This study addresses both the costs and the benefits of earned value. The earned value concepts and the related criteria are considered.**

Keywords—EVA, Road Works, schedule overruns, cost overruns

I. INTRODUCTION

Feedback is critical to the success of any project. Timely and targeted feedback can enable project managers to identify problems early and make adjustments that can keep a project on time and on budget. Earned Value analysis is a method of performance measurement. Earned Value Management (EVM) has proven itself to be one of the most effective performance measurement and feedback tools for managing projects. It enables managers to close the loop in the plan-do-check-act management cycle. EVM has been called ‘‘management with the lights on’’ because it can help clearly and objectively illuminate where a project is and where it is going as compared to where it was supposed to be and where it was supposed to be going.EVM provides organizations with the methodology needed to integrate the management of project scope, schedule, and cost.

A. Concept of EVA

Earned Value Management (EVM) relies on three key data points:

- Planned Value
- Earned Value
- Actual Cost

Planned Value

Planned Value (PV) describes how far along project work is supposed to be at any given point in the project schedule.It is

Also known as Budgeted Cost of Work Performed (BCWP)

Earned Value

Earned Value (EV) is a snapshot of work progress at a given point in time. Also known as the Budgeted Cost of Work Performed (BCWP),it reflects the amount of work that has actually been accomplished to date (or in a given time period), expressed as the planned value for that work.

Actual Cost

Actual Cost (AC), also known as the Actual Cost of Work Performed (ACWP), is an indication of the level of resources that have been expended to achieve the actual work performed to date (or in a given time period).

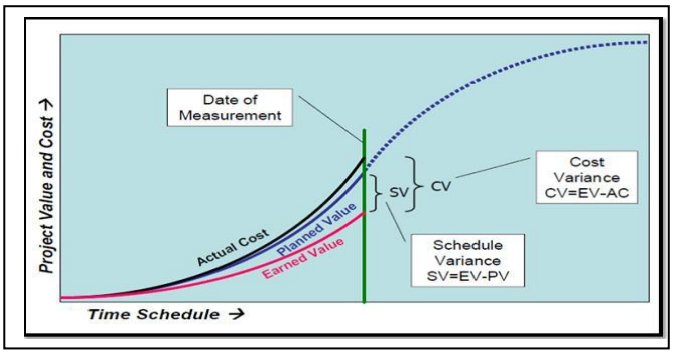

Fig 1 : Standard Earned Value Analysis Graph

Schedule Variance (SV) is the difference between the planned value of the work scheduled and the value of the work accomplished for the same time phase. It displays objectively how much the project is ahead or behind schedule.

$$SV = EV - PV \quad (1)$$

SV > 0, ahead of schedule

SV < 0, behind of schedule

Cost Variance (CV) is defined as the difference between the values of the work accomplished and the actual cost incurred to perform the work; and utilizing this parameter, the percentage of cost overrun or under run can be calculated.

$$CV = EV - AC \quad (2)$$

CV > 0, under budget

CV < 0, over budget

Schedule Performance Index (SPI) is an index showing the efficiency of the time utilized on the project.

$$SPI = EV/PV \quad (3)$$

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SPI > 1, efficiency in utilizing the time allocated to the project is good

SPI < 1, efficiency in utilizing the time allocated to the project is poor

Cost Performance Index (CPI) is an index showing the efficiency of the utilization of the resources allocated to the project.

CPI = EV/AC (4)

CPI > 1, efficiency in utilizing the resources allocated to the project is good

CPI < 1, efficiency in utilizing the resources allocated to the project is poor

Budget at Completion (BAC) is the cost of total estimated work in the plan, located at the end of the PV curve.

Estimate to Complete (ETC) is the estimated cost required to finish all the remaining work, calculated when the past estimating assumptions become invalid and a need revised estimates.

ETC = (BAC – EV) / CPI (5)

Estimate at Completion (EAC) is the projected final cost required to finish the complete work and based on a statistical prediction using the performance indices.

EAC = BAC / CPI

Variance at Completion (VAC) is the variance on the total budget at the end of the project. It is the difference between what the project was originally planned to cost, versus what it is now estimated to cost.

VAC = BAC – EAC (7)

Time Estimate at Completion (EACt)

(When are we likely to finish work?)

Using the Schedule Performance Index (SPI) and the average Planned Value (PV) per unit of time, the project team can generate a rough estimate of when the project will be completed, if current trends continue, compared to when it was originally supposed to be completed

EACt = (BAC/SPI)/ (BAC/months) (8)

To-Complete Performance Index (TCPI)

(How efficiently must we use our remaining resources?)

Another very useful index is the To-Complete Performance Index (TCPI), which helps the team determine the efficiency that must be achieved on the remaining work for a project to meet a specified endpoint, such as the Budget at Completion (BAC) or the team's revised Estimate at Completion (EAC).

II. OBJECTIVE

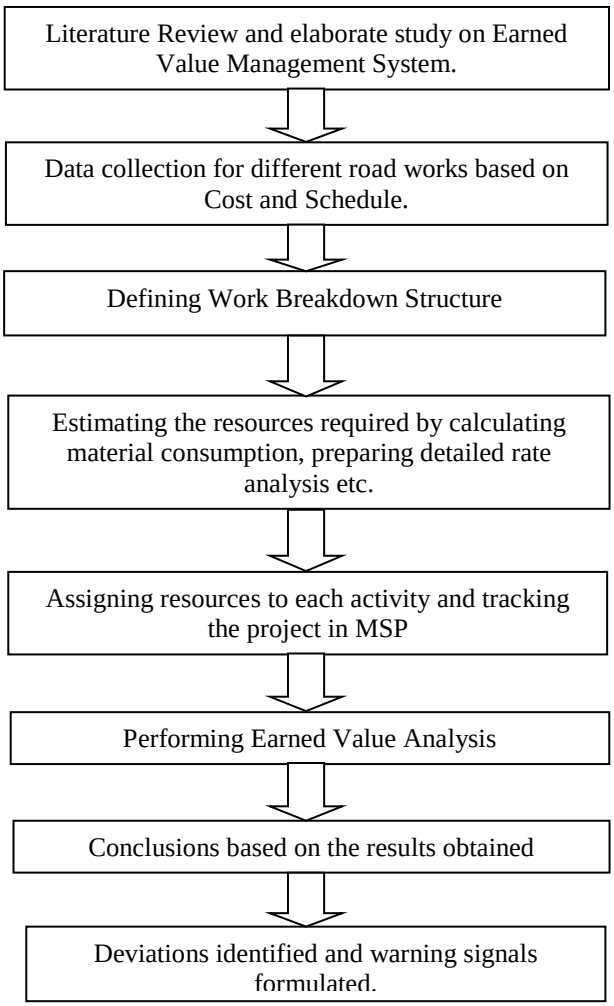
- To provide an efficient management control system for the firm whose projects are being considered for this thesis.
- To provide an opportunity for the PM to make sure that the project is on time and on budget.
- To determine if the cost, schedule, and work accomplished are progressing in accordance with the plan.
- To identify potential problem areas creating delays and cost over-runs and take necessary actions for their rectification.

II. SCOPE

- Paper focuses on the EVA done on a real time project on Road Works.
- Scope of the research is to throw light on the existing developed technique on EVA using MSP to measure and forecast project performance.
- Paper does not take in to consideration certain aspects like Risk Analysis, Quality or Technical Performance of project.
- EVA parameters, variances and indices helped the project perform better by providing "early warning" to detect deficient or endangered progress.

III. METHODOLOGY

The methodology of this paper is shown in the following flow diagram



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•The first step is collecting the existing research papers and analyzing in details the work done on earned value analysis also collecting maximum details about the same from the internet. Followed by an elaborate study.

•Second step includes visiting a reputed firm and collecting cost and schedule data of some ongoing projects required for this thesis work so that EVA could be done and conclusions useful for the firm could be drawn.

•Third step is defining the Work Breakdown Structure. This could be done with the help of BOQ obtained from the firm.

•Fourth step consist of preparing the Material Consumption sheet, Detailed Rate Analysis sheet etc. Help is taken from DSR, DAR and RA bills.

•Fifth step includes use of software called MSP.Activities are defined and durations are provided. Then Resources and related cost are assigned, Baselines are created and scheduling is done.

•Sixth step is the application of EVA so as to analyse the project performance.

•Seventh step consist of obtaining the results and drawing conclusions. It is identified whether the project is over or under budget, behind or ahead of schedule, good or poor performance.

•Last but not the least deviations are taken into consideration and PMs are given potential warnings so that necessary actions could be taken before it becomes too late.

IV. APPLICATION OF EVA

Earned Value Analysis is done on a road work project in Mumbai. The contract for this work is taken by a reputed firm named Swastik Infra Logics India Pvt Lmt.The work is in progress and earned value analysis is done at a certain point of time. Based on the analysis result, the efficiency with which the work is done and the rate at which the work will get completed is obtained. It also shows whether the firm will make profit or loss if work is continuing at the present manner with respect to what was originally planned.

A. Planning And Scheduling

The first stage of project is Planning. Proper planning consists of identifying each activities and assigning proper durations to each.

Duration = Total quantity of work

(Quantity of work done by labour, equipment, material)

Scheduling which is the second stage is the process of determining the sequential order of activities and assigning planned duration.

B. Detailed Rate Analysis And Material Consumption

Rate Analysis

In order to determine the rate of a particular item, the factors affecting the rate of that item are studied carefully and then finally a rate is decided for that item. This process of determining the rates of an item is termed as analysis of rates or rate analysis.

The rate of particular item of work depends on the following:

1. Specifications of works and material about their quality.
2. Quantity of materials and their costs.
3. Cost of labours and their wages.
4. Location of site of work and the distances from source and conveyance charges.
5. Overhead and establishment charges
6. Profit

Material Consumption Report

•Material consumption is calculated in order to determine the exact quantities of raw materials required for each items in the project and to determine the overall cost inquired by materials.

•The materials consumption report is a document used to summarize the goods used during a specific accounting period.

•This also helps in determining the percentage of cost that would be acquired by materials in the total budget of the required project .

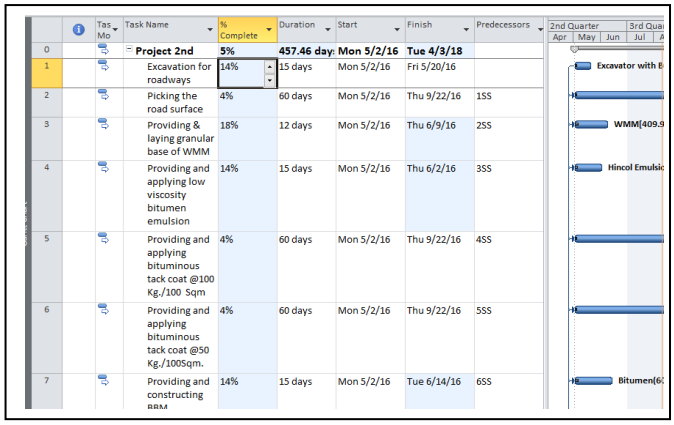
C. Detailed Application In Project

Name of work: Resurfacing of internal roads in Sectors – 1, 7, 8, 9, 10 & 13 at New Panvel (West), Navi Mumbai.

Estimated cost of Work as per Tender: Rs. 6, 39, 11,103.45

Completion Period: 15 months (Including monsoon)

a) Creating WBS, inputting activity durations, Start-Finish dates and Predecessors in MSP



	Task Mo	Task Name	% Complete	Duration	Start	Finish	Predecessors
0		Project 2nd	5%	457.46 days	Mon 5/2/16	Tue 4/3/18	
1		Excavation for roadways	14%	15 days	Mon 5/2/16	Fri 5/20/16	
2		Picking the road surface	4%	60 days	Mon 5/2/16	Thu 9/22/16	1SS
3		Providing & laying granular base of WMM	18%	12 days	Mon 5/2/16	Thu 6/9/16	2SS
4		Providing and applying low viscosity bitumen emulsion	14%	15 days	Mon 5/2/16	Thu 6/2/16	3SS
5		Providing and applying bituminous tack coat @100 Kg./100 Sqm	4%	60 days	Mon 5/2/16	Thu 9/22/16	4SS
6		Providing and applying bituminous tack coat @50 Kg./100Sqm.	4%	60 days	Mon 5/2/16	Thu 9/22/16	5SS
7		Providing and constructing	14%	15 days	Mon 5/2/16	Tue 6/14/16	6SS

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b) Preparing Detailed Rate Analysis and Material Consumption

Detailed Rate Analysis

Item No.	Description	Unit	Rate	Amount
1.	**Excavation for roadways in all types of soil, soft murum, hard murum, hard murum with boulders,**	Cum.		
	Excavator with bucket Hire (Considering an out put of **180 Cum** per day)			
	Rs.4,20,000/- per Month (25 Working Days)	Day	420,000.00	16,800.00
	Operator bhata	Day		500.00
	Costing for 180 Cum			17,300.00
	Completed Rate	**For 1 Cum.**		**96.11**
		Say		**96.00**
2.	**Picking the road surface** including sectioning and removing the thin soil layer & exposing B.T. surface etc. complete.	Sqm.		
	Labour charges	Sqm.		5.00
	Completed Rate	**Sqm**		**5.00**
		Say		**5.00**
3.	**Providing & laying granular base of Wet Mix Macadam (WMM)**			
	Rate of WMM - Rs.275/MT incl. transportation. (Rs.275/MT x density i.e. 2MT/cum=Rs.550 per cum)	Cum	275.00	550.00
	Levelling with JCB giving an Output of 100 cum/day i.e. JCB / day = Rs.8000 per day /100cum per day	Cum	8,000.00	80.00
	Vibratory Roller Charges (per day output of 100cum @ Rs.7500) = Rs.7500/ 100cum	Cum	7,500.00	75.00
	Labour charges	Cum		15.00
	Completed Rate	**Cum**		**720.00**
		Say		**720.00**

Item No.	Description	Unit	Rate	Amount
4.	**Providing and applying low viscosity liquid bituminous material such as bitumen emulsion**	Sqm.		
	Rate of HINCOL Emulsion : Rs.28,589 per MT	Kg	28.59	
	Transportation charges - Rs.625 per MT	Kg	0.63	
	Basic Bitumen Rate - Rate of Emulsion + Transportation		29.21	
	Application rate of 0.6 to 0.9 kg/ sqm i.e. 0.75kg/sqm = Basic Bitumen Rate x 0.75kg/sqm	Kg		21.91
	Completed Rate	**Sqm**		**21.91**
		Say		**22.00**
5.	**Providing and applying bituminous tack coat @**			
	a) @100 Kg./100 Sqm. over WBM surface	Sqm.		
	Rate of HPCL Bitumen 60/70 grade : Rs.29,969.46 per MT	Kg	29.97	
	Transportation charges - Rs.625 per MT	Kg	0.63	
	Basic Bitumen Rate - Rate of Bitumen 60/70 + Transportation		30.59	
	Bitumen (1kg per 1 Sqm) - Basic Bitumen Rate x 1kg/sqm	Kg		30.59
	Completed Rate	**Sqm**		**30.59**
		Say		**31.00**
5	b) @50 Kg./100 Sqm. Over B.T. surface	Sqm.		
	Rate of HPCL Bitumen 60/70 grade : Rs.29,969.46 per MT	Kg	29.97	
	Transportation charges - Rs.625 per MT	Kg	0.63	
	Basic Bitumen Rate - Rate of Bitumen 60/70 + Transportation		30.59	
	Bitumen (0.5kg per 1 Sqm) - Basic Bitumen Rate x 0.5kg/sqm	Kg		15.30
	Completed Rate	**Sqm**		**15.30**
		Say		**15.00**

6.	**Providing and constructing Bituminous Bound Macadam (BBM)**	Sqm.		
	40mm metal (9 cum per 100 sqm)-Rs 345/MT x density 1.7MT/cum x 0.09cum/sqm	Cum	345.00	52.79
	20mm metal (1.5 cum per 100 sqm)-345/MT x density 1.5MT/cum x 0.015cum/sqm	Cum	345.00	7.76
	12mm metal (1.8 cum per 100 sqm)-345/MT x density 1.5MT/cum x 0.018cum/sqm	Cum	345.00	9.32
	Rate of HPCL Bitumen 60/70 grade : Rs.29,969.46 per MT	Kg	29.97	
	Transportation charges - Rs.625 per MT	Kg	0.63	
	Basic Bitumen Rate - Rate of Bitumen 60/70 + Transportation		30.59	
	Bitumen (250 Kg per 100 sqm = 2.5kg/sqm x Rs.30.59)			76.49
	For heating charges (10% of Bitumen Rate) - 10% x Rs.76.49			7.65
	Labour charges - Rs.4000 per day i.e. Rs.4000 per 1500sqm = Rs.4000 / 1500sqm	Sqm	4,000.00	2.67
	Vibratory Roller Charges (per day -1500 Sqm @ Rs.7500/-) = Rs.7500 / 1500sqm	Sqm	7,500.00	5.00
	Paver Charges (per day - 1500Sqm @ Rs.14000/) = Rs.14000 / 1500sqm	Sqm	14,000.00	9.33
				171.00
	Completed Rate	**Sqm**		**171.00**
		Say		**171.00**
7.	**Providing and laying hot mix hot laid Dense Graded Bituminous Macadam (DBM)**	Cum.		
	Rate of HPCL Bitumen 60/70 grade : Rs.29,969.46 per MT	Kg	29.97	
	Transportation charges - Rs.625 per MT	Kg	0.63	
	Basic Bitumen Rate - Rate of Bitumen 60/70 + Transportation		30.59	
	Bitumen 4.5% x 1000 = 45 x Rs. 30.59 per kg			1,376.75
	LDO 5kg	Kg	60.00	300.00
	Aggregate 0.25 Br. x 850			212.50

	Transportation	MT		80.00
	Labour charges - Rs.4000 per day i.e. Rs.4000 per 250cum = Rs.4000 / 250cum	MT	4,000.00	16.00
	Vibratory Roller Charges (per day -250cum @ Rs.7500/-) = Rs.7500 / 250cum	MT	7,500.00	30.00
	Paver Charges (per day - 250cum @ Rs.14000/) = Rs.14000 / 250cum	MT	14,000.00	56.00
	A - Total Rate for 1MT of DBM			2,071.25
	A x Density of DBM 2.3 MT per Cum			4,763.88
	Completed Rate	**Cum**		**4,763.88**
		Say		**4,764.00**

8.	**Providing and laying hot mix hot laid Asphaltic Concrete/ Bituminous Concrete (AC/BC)**	Cum.		
	Rate of HPCL Bitumen 60/70 grade : Rs.29,969.46 per MT	Kg	29.97	
	Transportation charges - Rs.625 per MT	Kg	0.63	
	Basic Bitumen Rate - Rate of Bitumen 60/70 + Transportation		30.59	
	Bitumen 6% x 1000 = 60 x Rs. 30.59 per kg			1,835.67
	LDO 5kg	Kg	60.00	300.00
	Aggregate (0.25 Br. x 850)			212.50
	Transportation	MT		80.00
	Labour charges - Rs.4000 per day i.e. Rs.4000 per 250cum = Rs.4000 / 250cum	MT	4,000.00	16.00
	Vibratory Roller Charges (per day -250cum @ Rs.7500/-) = Rs.7500 / 250cum	MT	7,500.00	30.00
	Paver Charges (per day - 250cum @ Rs.14000/) = Rs.14000 / 250cum	MT	14,000.00	56.00
	B - Total Rate for 1MT of AC			2,530.17
	B x Density of AC 2.4 MT per Cum			6,072.40
	Completed Rate	**Cum**		**6,072.40**
		Say		**6,072.00**
9.	**Raising of frames** of various types of manholes including excavation, fixing in C.C. M-30 grade, curing etc. complete as directed by Engineer.			
	a) Circular Manhole (0.54 m. dia.)	No.		
	Concrete Qty =3.14*0.77*0.23*0.3= 0.167cum M-30 Grade	Cum	3,866.00	645.62
	Cement- for M-30= 8b/cum= 0.167*8b/cum	Cum	300.00	400.80
	Completed Rate	**No.**		**1,046.42**
		Say		**1,046.00**
9.	b) Rectangular Manhole (0.90 m. x 0.60 m.)	No.		
	Concrete Qty =1*(1.36*1.06- 0.9*0.6)*0.3= 0.27cum M-30 Grade	Cum	3,866.00	1,043.82
	Cement- for M-30= 8b/cum= 0.27*8b/cum	Cum	300.00	648.00
	Completed Rate	**No.**		**1,691.82**
		Say		**1,692.00**

9.	c) Scrapper Manhole (1.22 m. x 0.90 m.)	No.		
	Concrete Qty M-30- 1*(1.68*1.36- 1.22*0.9)*0.3=0.356cum	Cum	3,866.00	1,376.30
	Cement- for M-30= 8b/cum= 0.356*8b/cum	Cum	300.00	854.40
	Completed Rate	**Rmt**		**2,230.70**
		Say		**2,231.00**
10.	**Disposal of surplus excavated materials upto 3.00 km. lead and all lifts** including loading, unloading, stacking and spreading as directed by Engineer etc. complete beyond initial lead of 50m.	Cum.		
	Dumper (Hyva) Capacity 7 Cum per trip			
	Loose Excavated Material 7 Cum per Trip & 10 Trips per Day = 70 Cum/Day @ Rs.5000/- per Day	Day	5,000.00	71.43
	Completed Rate	**Cum**		**71.43**
		Say		**71.00**

Material Consumption

Item no	Description	Tender quantity	Unit	Material	Constant	Total Quantity	Unit
Road work							
3	Wet Mix Macadam	803.00	Cum	W.M.M	1.0000	803.00	Cum.
4	Providing and applying low viscosity liquid bituminous material such as bitumen emulsion	8024.00	Sqm	Hincol Emulsion	0.7500	6,018.00	Kg
5	Bituminous tack coat @ 100kg/100m2	86918.00	Sqm	Bitumen 60/70	1.0000	86,918.00	Kg
	Bituminous tack coat @ 50kg/100m2	86775.00		Bitumen 60/70	0.5000	43,387.50	Kg
6	Bituminous Bound Macadam	8024.00	Sqm	Bitumen 60/70	2.5000	20,060.00	Kg
				CA 40	0.0900	722.16	Cum.
				CA 20	0.0150	120.36	Cum.
				CA 10	0.0180	144.43	Cum.
7	DBM	3987.00	Cum	DBM	1.0000	3,987.00	Cum.
8	BC/AC	2212.00	Cum	BC (60/70)	1.0000	2,212.00	Cum.
9	Raising height of Circular Manhole	250.00	Nos.	Cement	1.3360	334.00	bags
				Natural Sand	0.0710	17.74	Cum.
				CA 10	0.0468	11.69	Cum.
				CA 20	0.0952	23.80	Cum.
	Raising height of Rectangular Manhole	50.00	Nos.	Cement	2.1600	108.00	bags
				Natural Sand	0.1148	5.74	Cum.
				CA 10	0.0756	3.78	Cum.
				CA 20	0.1539	7.70	Cum.
	Raising height of Scrapper Manhole	30.00	Nos.	Cement	2.8480	85.44	bags
				Natural Sand	0.1513	4.54	Cum.
				CA 10	0.0997	2.99	Cum.
				CA 20	0.2029	6.09	Cum.

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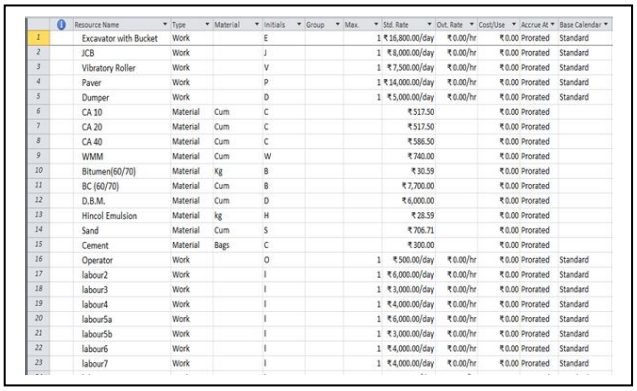
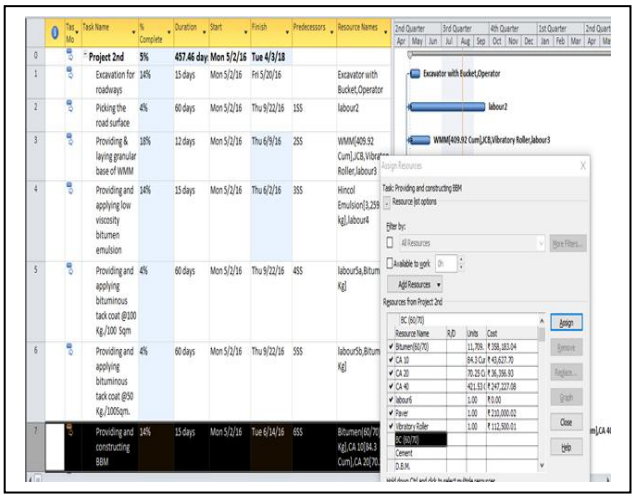
c) Identifying and Assigning the resources and expenses to each tasks



	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate	Ovt. Rate	Cost/Use	Accrue At	Base Calendar
1	Excavator with Bucket	Work		E		1	₹ 16,800.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard
2	JCB	Work		J		1	₹ 8,000.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard
3	Vibratory Roller	Work		V		1	₹ 7,500.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard
4	Paver	Work		P		1	₹ 14,000.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard
5	Dumper	Work		D		1	₹ 5,000.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard
6	CA 10	Material	Cum	C			₹ 517.50		₹ 0.00	Prorated	
7	CA 20	Material	Cum	C			₹ 517.50		₹ 0.00	Prorated	
8	CA 40	Material	Cum	C			₹ 586.50		₹ 0.00	Prorated	
9	WMM	Material	Cum	W			₹ 740.00		₹ 0.00	Prorated	
10	Bitumen(60/70)	Material	Kg	B			₹ 30.59		₹ 0.00	Prorated	
11	BC (60/70)	Material	Cum	B			₹ 7,700.00		₹ 0.00	Prorated	
12	D.B.M.	Material	Cum	D			₹ 6,000.00		₹ 0.00	Prorated	
13	Hincol Emulsion	Material	kg	H			₹ 28.59		₹ 0.00	Prorated	
14	Sand	Material	Cum	S			₹ 706.71		₹ 0.00	Prorated	
15	Cement	Material	Bags	C			₹ 300.00		₹ 0.00	Prorated	
16	Operator	Work		O		1	₹ 500.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard
17	labour2	Work		I		1	₹ 6,000.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard
18	labour3	Work		I		1	₹ 3,000.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard
19	labour4	Work		I		1	₹ 4,000.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard
20	labour5a	Work		I		1	₹ 6,000.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard
21	labour5b	Work		I		1	₹ 3,000.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard
22	labour6	Work		I		1	₹ 4,000.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard
23	labour7	Work		I		1	₹ 4,000.00/day	₹ 0.00/hr	₹ 0.00	Prorated	Standard



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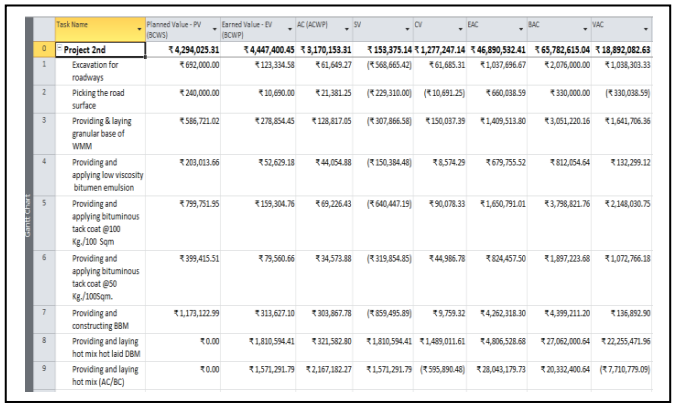
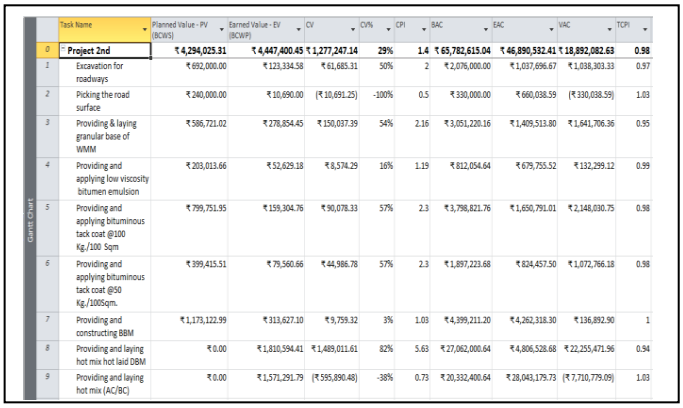
1		Excavation for roadways	14%	15 days	Mon 5/2/16	Fri 5/20/16		Excavator with Bucket,Operator
2		Picking the road surface	4%	60 days	Mon 5/2/16	Thu 9/22/16	1SS	labour2
3		Providing & laying granular base of WMM	18%	12 days	Mon 5/2/16	Thu 6/9/16	2SS	WMM[409.92 Cum],JCB,Vibratory Roller,labour3
4		Providing and applying low viscosity bitumen emulsion	14%	15 days	Mon 5/2/16	Thu 6/2/16	3SS	Hincol Emulsion[3,259 Kg],labour4
5		Providing and applying bituminous tack coat @100 Kg./100 Sqm	4%	60 days	Mon 5/2/16	Thu 9/22/16	4SS	labour5a,Bitum Kg]
6		Providing and applying bituminous tack coat @50 Kg./100Sqm.	4%	60 days	Mon 5/2/16	Thu 9/22/16	5SS	labour5b,Bitum Kg]
7		Providing and constructing BBM	14%	15 days	Mon 5/2/16	Tue 6/14/16	6SS	Bitumen(60/70 Kg],CA 10[84.3 Cum],CA 20[70

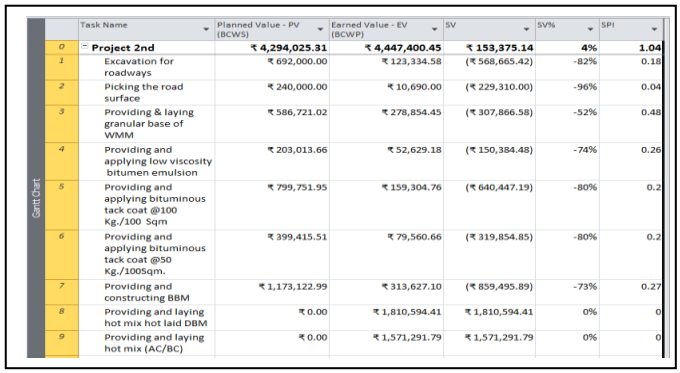
d) Performing Earned Value Analysis



	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	AC (ACWP)	SV	CV	EAC	BAC	VAC
0	Project 2nd	₹ 4,294,025.31	₹ 4,447,400.45	₹ 3,170,153.31	₹ 153,375.14	₹ 1,277,247.14	₹ 46,890,532.41	₹ 65,782,615.04	₹ 18,892,082.63
1	Excavation for roadways	₹ 692,000.00	₹ 123,334.58	₹ 61,649.27	(₹ 568,665.42)	₹ 61,685.31	₹ 1,037,696.67	₹ 2,076,000.00	₹ 1,038,303.33
2	Picking the road surface	₹ 240,000.00	₹ 10,690.00	₹ 21,381.25	(₹ 229,310.00)	(₹ 10,691.25)	₹ 660,038.59	₹ 330,000.00	(₹ 330,038.59)
3	Providing & laying granular base of WMM	₹ 586,721.02	₹ 278,854.45	₹ 128,817.05	(₹ 307,866.58)	₹ 150,037.39	₹ 1,409,513.80	₹ 3,051,220.16	₹ 1,641,706.36
4	Providing and applying low viscosity bitumen emulsion	₹ 203,013.66	₹ 52,629.18	₹ 44,054.88	(₹ 150,384.48)	₹ 8,574.29	₹ 679,755.52	₹ 812,054.64	₹ 132,299.12
5	Providing and applying bituminous tack coat @100 Kg./100 Sqm	₹ 799,751.95	₹ 159,304.76	₹ 69,226.43	(₹ 640,447.19)	₹ 90,078.33	₹ 1,650,791.01	₹ 3,798,821.76	₹ 2,148,030.75
6	Providing and applying bituminous tack coat @50 Kg./100Sqm.	₹ 399,415.51	₹ 79,560.66	₹ 34,573.88	(₹ 319,854.85)	₹ 44,986.78	₹ 824,457.50	₹ 1,897,223.68	₹ 1,072,766.18
7	Providing and constructing BBM	₹ 1,173,122.99	₹ 313,627.10	₹ 303,867.78	(₹ 859,495.89)	₹ 9,759.32	₹ 4,262,318.30	₹ 4,399,211.20	₹ 136,892.90
8	Providing and laying hot mix hot laid DBM	₹ 0.00	₹ 1,810,594.41	₹ 321,582.80	₹ 1,810,594.41	₹ 1,489,011.61	₹ 4,806,528.68	₹ 27,062,000.64	₹ 22,255,471.96
9	Providing and laying hot mix (AC/BC)	₹ 0.00	₹ 1,571,291.79	₹ 2,167,182.27	₹ 1,571,291.79	(₹ 595,890.48)	₹ 28,043,179.73	₹ 20,332,400.64	(₹ 7,710,779.09)



	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	CV	CV%	CPI	BAC	EAC	VAC	TCPI
0	Project 2nd	₹ 4,294,025.31	₹ 4,447,400.45	₹ 1,277,247.14	29%	1.4	₹ 65,782,615.04	₹ 46,890,532.41	₹ 18,892,082.63	0.98
1	Excavation for roadways	₹ 692,000.00	₹ 123,334.58	₹ 61,685.31	50%	2	₹ 2,076,000.00	₹ 1,037,696.67	₹ 1,038,303.33	0.97
2	Picking the road surface	₹ 240,000.00	₹ 10,690.00	(₹ 10,691.25)	-100%	0.5	₹ 330,000.00	₹ 660,038.59	(₹ 330,038.59)	1.03
3	Providing & laying granular base of WMM	₹ 586,721.02	₹ 278,854.45	₹ 150,037.39	54%	2.16	₹ 3,051,220.16	₹ 1,409,513.80	₹ 1,641,706.36	0.95
4	Providing and applying low viscosity bitumen emulsion	₹ 203,013.66	₹ 52,629.18	₹ 8,574.29	16%	1.19	₹ 812,054.64	₹ 679,755.52	₹ 132,299.12	0.99
5	Providing and applying bituminous tack coat @100 Kg./100 Sqm	₹ 799,751.95	₹ 159,304.76	₹ 90,078.33	57%	2.3	₹ 3,798,821.76	₹ 1,650,791.01	₹ 2,148,030.75	0.98
6	Providing and applying bituminous tack coat @50 Kg./100Sqm.	₹ 399,415.51	₹ 79,560.66	₹ 44,986.78	57%	2.3	₹ 1,897,223.68	₹ 824,457.50	₹ 1,072,766.18	0.98
7	Providing and constructing BBM	₹ 1,173,122.99	₹ 313,627.10	₹ 9,759.32	3%	1.03	₹ 4,399,211.20	₹ 4,262,318.30	₹ 136,892.90	1
8	Providing and laying hot mix hot laid DBM	₹ 0.00	₹ 1,810,594.41	₹ 1,489,011.61	82%	5.63	₹ 27,062,000.64	₹ 4,806,528.68	₹ 22,255,471.96	0.94
9	Providing and laying hot mix (AC/BC)	₹ 0.00	₹ 1,571,291.79	(₹ 595,890.48)	-38%	0.73	₹ 20,332,400.64	₹ 28,043,179.73	(₹ 7,710,779.09)	1.03



	Task Name	Planned Value - PV (BCWS)	Earned Value - EV (BCWP)	SV	SV%	SPI
0	Project 2nd	₹ 4,294,025.31	₹ 4,447,400.45	₹ 153,375.14	4%	1.04
1	Excavation for roadways	₹ 692,000.00	₹ 123,334.58	(₹ 568,665.42)	-82%	0.18
2	Picking the road surface	₹ 240,000.00	₹ 10,690.00	(₹ 229,310.00)	-96%	0.04
3	Providing & laying granular base of WMM	₹ 586,721.02	₹ 278,854.45	(₹ 307,866.58)	-52%	0.48
4	Providing and applying low viscosity bitumen emulsion	₹ 203,013.66	₹ 52,629.18	(₹ 150,384.48)	-74%	0.26
5	Providing and applying bituminous tack coat @100 Kg./100 Sqm	₹ 799,751.95	₹ 159,304.76	(₹ 640,447.19)	-80%	0.2
6	Providing and applying bituminous tack coat @50 Kg./100Sqm.	₹ 399,415.51	₹ 79,560.66	(₹ 319,854.85)	-80%	0.2
7	Providing and constructing BBM	₹ 1,173,122.99	₹ 313,627.10	(₹ 859,495.89)	-73%	0.27
8	Providing and laying hot mix hot laid DBM	₹ 0.00	₹ 1,810,594.41	₹ 1,810,594.41	0%	0
9	Providing and laying hot mix (AC/BC)	₹ 0.00	₹ 1,571,291.79	₹ 1,571,291.79	0%	0

e) Results and conclusions

Parameters	Results
C.V (Rs)	12,77,247.14
C.V %	29
S.V (Rs)	1,53,375.14
S.V %	4
CPI	1.4
SPI	1.04
BAC (Rs)	6,57,82,615.04
EAC (Rs)	4,68,90,535.41
VAC (Rs)	1,88,92,082.63
EAC(t) (month)	14.43
TCPI	0.98

•This Project has a favorable C.V % = 29%.This means that the project is 29% under budget for the work performed.

•The Project has a favorable S.V% = 4%.This indicates that the project is 4% ahead of schedule.

•The Project has a favorable CPI of 1.4. This means that for every rupee spent, 1.4 rupee in earned value is accomplished.

•This Project has a favorable SPI of 1.04. This means that for every rupee worth of project planned to accomplished, 1.04 rupee worth of work is accomplished.

•The project is estimated to get completed in 14.43 months if the current consistence of work is followed.

•VAC is Rs.18892082.63 which is the profit the contractor is predicted to make.

•Then project has a TCPI of 0.98 which means that the remaining resources must be used at an efficiency of 0.98 worth of every one rupee spent.

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V. CONCLUSION

Practicing Earned Value Management (EVM) can help project stay on time and on budget. It often produces valuable insight to organizations. However, many find it difficult to empirically quantify the financial benefit of implementing EVMS.For a project controls organization, EVMS can provide valid benefits like the integration of work, schedule, and cost; early warning signals through CPI and SPI; and an index-based method to forecast the final cost of the project.

Some of the benefits of EVA needed for effective project management which we can understand from this thesis are:

• Biggest benefit to implementing EVM is that it is a single system that can track the project in terms of work, time and money; Project managers do not have to learn multiple systems.

• EVM can measure the amount of work actually completed; forecast the cost and completion date; compare the actual performance of the project versus the plan; and track the project's budget in real time.

• Variance is an examination used in EVM of what caused a difference between the projected baseline and the actual performance.

• The variance can show how far away the project is from "normal." It can also help track down the root of the problem.

• Performance Indices helps determine the current status of the project, be early warning signals if the project goes off track and estimate the total cost and time frame.

• The SPI measures all of the work completed on the project and calculate whether the project will meet, beat or miss its planned finish date.

• The CPI measures cost efficiency for the work completed. Simply put, it can tell you if your project is under or over budget at any point during the process.

• When the results obtained show that changes are needed, the project manager can adjust the work or budget to help bring the future performance of the project back in line with projections.

• EVM allows for changes to be made in a flexible, timely manner at any point during the project's development and implementation.

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