

PROJECT COST MONITORING USING EARNED VALUE ANALYSIS (EVA)-by evaluating components of cost variance

Ar. Meghana Sawant-Parab

Architecture, Pillai HOC College of Architecture, Maharashtra, India

Corresponding Author: archmeghanasawant@gmail.com

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ABSTRACT

Nowadays interior projects hold lots of stakes, but due to haphazard management in the number of tasks, it suffers cost and time deviances. These deviations are problems (Variances) that can be caused due to unsystematic management in scheduling, resource management, and interruption in cost flow. Earned Value analysis is single valuable method, to monitor and manage time, as well as cost (schedule and budget). EVA is mainly a performance measuring technique used for Construction Projects. Using EVA as a data collection and analysis method for interior projects from early stages can restrict cost variances and time deviation. The purpose of study is to develop a structured methodology, to point out components for variances by which cost variances can be minimized during an ongoing project.

KEYWORDS: Earned value analysis (EVA), Variances, Components, Cost controlling and monitoring, Excel Module

1. INTRODUCTION

Satisfaction of consumers or customer is getting critical day by day. Due to various-available options in the market, the customer's demand is increasing regarding the overall scope of work. Successful job completion is not only the final product it's mainly the combination of time, cost, and final product with the effective use of resources. The major concern is to minimize the deviations occurring in any form during the project's life cycle.

To achieve all set milestones for providing a successful project an implementation of a system is required. That is possible with the help of monitoring and controlling different aspects of the project at given time intervals. At the same time, this helps in achieving the desired scope by managing most of the resources. As known cost and time are mainly affected aspects/resources for most of the projects. If a system is adopted as a managing and controlling tool the process becomes easy as the discrepancies can be flagged during the

execution. This is beneficial for the future course of the work to avoid any possible deviations.

Earn value analysis is a technique that produces results based on a comparative analysis of current data and projected data. The EVA technique offers wholesome and accurate data concerning the time and cost of an ongoing project. Application of Earned Value Analysis (EVA) in monitoring and controlling the progress of a project, enhances the view of the project's progress.

1.1. AIM:

To find out micro-level cost variances and implement an Earn Value Analysis method for an interior project with a high cost and prolonged time schedule to enhance the controlling and monitoring system to complete successful final results. This will control the scope of work concerning cost flow and other resources. Any deviations, delays, or discrepancies that occur

during the analysis will be flagged and considered as Variances.

The worksheet Excel module will produce Components extracted by using EVA and Variances method. The module will contain a comparison between actual and projected data, based on aspects of the project. If there is inconsistency in compared data regarding the given aspects, then the event is considered a Component of Variances which will be flagged by using indicators in a worksheet so to avoid inconvenience in the future.

1.2. INTRODUCTION TO EVA:

1.2.1 Concept

For more than 30 years, EVA considered as less-used project management technique. As an effective project management tool Earned Value Analysis helps in assessing the progress and performance of a project. It provides valuable insights into how effectively a project is utilizing its resources and meeting its objectives. It is an effective tool to administrate and managing new systems. Applying EVA requires a well-defined systematically staged project. so, the results can be measured from 1-100 % of the project lifecycle.

EVA allows project managers to identify variances between planned and actual performance, providing early warnings of potential issues and enabling corrective actions to be taken promptly. It helps answer critical questions such as whether the project is on schedule, within budget, and delivering the planned value. EVA is a combination of quantity for scope, schedule and cost to appraise project accomplishments and progress which makes it a useful project management technique. By using metrics like cost at completion, cost performance index and cost variances, project managers can estimate cost which is required to complete the project. This estimation helps in making informed decisions regarding budget allocation, resource management, and safety measures.

1.2.2 Application of EVA in Project Management

To apply EVA as a project management tool as suggested the project needs to be well planned .it should be separated into tasks and activities which can be easily allocated, monitored, and completed.

Afterwards, a specific task needs to have its starting date and its ending date well known. Each task has to be well defined so to get exact time can be hour-wise likely to be spent on each. Information collection is extremely important for application of method;

- the preference in relations among tasks,
- min. time required to complete task
- clearances noncritical tasks,

- list of available resources,
- analysis of risk, and
- Contingency planning

The data on the actual cost to the percentage of completion of individual tasks should be collected to use EVA for ongoing projects. Considering that the tasks that have not started will have both values fixed to zero, this implies that once a task is initiated (started), it falls into one of the two categories: completed or not completed.

Methodology to apply EVA by using following five steps:

1.	WBS - work break down structure	Dividing the project into multiple stages, assigning costs, and estimating the needed time for specific activity.
2.	Categorizing the multiple components part of activities in the project. Basic frame structure provided due to WBS helps in identifying the components of project.	
3.	Identifying the resources and usage of resources. Detecting and allocating costs to an individual activity. The usage can be stated in work hours or monetary unit.	
4.	Evaluating the final timeline for individual task along with expended resources.	
5.	Finalizing the allocation of resources (mainly cost and material) at every step during the activities.	

The EVA 5-point check list: pointer's to be considered for Earned Value Analysis Applications;

1. Detailed out scope of work for the project with a WBS.
2. Scheduling and planning of project scope.
3. Planned budget ready for an execution.
4. Establish and maintain a performance baseline.
5. Monitoring and finalizing results or data obtained at last.

1.2.3 Elements to be Considered in EVA – while preparing the schedule of work

BASIC TERMS USED IN EARNED VALUE ANALYSIS:

EV	Earn Value
ES	Earn schedule
PV (BCWS)	Planed value, work schedule for Budgeted cost
EV (BCWP)	Earned value, of work performed for Budgeted cost

AC (ACWP)	Actual cost, Actual cost of work scheduled
BCWS	work scheduled for Budgeted cost of
CV	Cost variance
CPI	Cost performance index

Definitions:

- a. Budgeted Cost of Work Scheduled (BCWS) or Planned Value (PV) – summed budgeted cost for total work planned to be completed within a specified time period. - includes previous work cost and date in time
- b. Budgeted Cost of Work Performed (BCWP), also known as Earned Value (EV) – is a budgeted cost to the estimated value of the work actually completed at a specific point in time.
- c. Actual Cost of Work Performed (ACWP) or Actual Cost (AC) – the cost actually earned and recorded in work accomplished on a project up to a specific point in time. It provides an actual measure of the expenses associated with the project tasks and deliverables.
- d. Budget At Completion (BAC) –it represents the overall budgeted cost projected for the entire project planned in certain time period.
- e. Schedule Variance (SV) – it is calculated as subtraction of the work actually performed (BCWP) and the work scheduled (BCWS). That measures the variance between the planned schedule and the actual progress of a project.
- f. Cost Variance (CV) – Cost Variance (CV) is a project management metric that measures the variance between the projected expenditure to the completion of work and the earned value (EV) and the actual cost (AC) or actual cost of work performed (ACWP). CV provides an indication of whether the project is under budget, on budget, or over budget.

In this case, the variable to be considered is Cost Variance as this particular paper concentrates on streamlining the budget of the project.

1.2.4 Cost variance in brief

Types Of cost Variances:

- a. Direct cost variance
- b. Indirect Cost variance

Causes of cost variances in the cost structure of construction project

- 1. Direct Cost variances
- 2. Cost variances –Material, Labour, Equipment

Cost variances states the realistic measurement of cost performance in a particular project. This in fact helps project managers to identify what is happening in and to the project, in terms of the cost is concerned, and to establish whether budget allocations are being overspent.

Components of cost variances- (Integration of cost variance)

(Carr 1993) Explains this integration theory as;

While using EVA the project which is divided into components like rate, quantity, productivity, and resource variances can be concluded to provide component schedule variances and cost variances. The incorporation of the EVA at the individual components level is equivalent at the project level.

The factors of cost variances are created considering rate, productivity, start, quantity and resource variances. By calculating different discrepancies (variances) related to element quantity, rate, productivity, start, and resource can be present as earned value analysis an overall picture of the quantity, rate, productivity, start, and resource variances.

Any small variation in any of these elements may lead the project into cost overrun or underrun which will ultimately affect the finance of the project (Budgeted Cost). To simplify the process of integration to extract cost variances components involved in the activity then can be converted into elements.

Carr tried to simplify the elements of the project by converting them into variables also he derived a few formulas to find out Quantity i.e., output for budgeted and actual, and then rated for both same for productivity and resources. Carr also stated that combining productivity, rate, start and resource variances can be summed as total cost variances. If one can segregate and link back to all of the above components and if any of the element changes including duration, that he considered as the START of the project; the cost shows deviation.

2. TABLES AND FORMULAS USED FOR METHODOLOGY:

2.1 List of variables

In his paper, Carr highlights the straight operations but also incorporates discrete methods that cannot be controlled easily. He divided the activities into elements and to simplify the calculations then he converted the elements into variables.

Table No.1 (2.1) List and Short Form

Resources - working hours or equipment usage in hours	R
Like meters or cubic meters for Output units	U
Considered time period for work like days	D
A required construction cost with considered unit (rupees)	C
Budgeted	b
Scheduled	s
Actual	a
Projected	p
Start	S
Percent Complete	P

Table No.2 (2.1) terms and description of elements used in EVA based on variables

Term	Description	Interpretation
PV (BCWS)	-Planned value -The budgeted cost (scheduled work)	What is the assessed value of work scheduled to be done?
EV (BCWP)	- Earned value or - The budgeted cost (performed work)	What is the assessed value of work completed?
AC (ACWP)	- Actual cost - Actual cost of work Performed	What is the actual cost earned?
CV	Cost variance	Over budget is -ve Under budget is +ve

2.1.1 List of formulas derived from a list of variables

Considering Table 1(2.1) – we can form variables like required to be completed an operation;

Rb	Budgeted Resources
Ub	Budgeted Outcome
Db	Budgeted Time period
Ss	start day for Scheduled plan
Sa	start day of Actual Plan
Ds	NO. of days to date that is scheduled
Da	NO. of days to date that is actual start

Table No.3 (2.1.1) Formula

Variables	Formula
Da (actual date) total number of days till date from the actual start day of project	$Ds - (Sa - Ss)$
Us (Unit Scheduled) units planned to be formed to date	$Ub \times \frac{Min}{(Ds, Db)}$ Db
Rs (resources scheduled) the resources planned to date	$Rs \times \frac{Min}{(Ds, Db)}$ Db
Ps (% complete scheduled) Completion in % of schedule	$Us = \frac{Min}{(Ds, Db)}$ Ub Db
Pa (actual % complete) the actual percentage of work completion	Ua Up
Pb (Budgeted % complete) The Complete percentage measured by the budgeted quantity	Ua Ub

The Above formulas give background material for calculating cost variances and variances for other mention elements.

Known costs can be differentiated from the budget as the quantity of productivity is different. Also, the price/unit of output changes from the budgeted value. The cost and quantity generated or adjusted during the project are considered as projected costs. So, for cost variances, adjustable components of variation between the scheduled cost of a project and its real cost equals their respective cost variances to the date distributed by percentage of completion of a project Pa (actual % of completion). So basically, the calculation of the projected cost variances is anticipated from their cost variance to the date total.

Then the projected cost quantity matches with projected cost varices and cost variance to date, in addition to difference among the strategic cost of a project and its actual cost. Here if the projected cost resource variance added to the projected cost productivity variance, then it equals to the projected cost rate variance.

2.2 Formulas to Calculate Components of Variances

Formulas used to calculate the results: base data for the calculation of components of variances. The formulas considered for calculations of components of variances are referred from the paper by Robert Carr.

Table No.4 (2.2) List of Components

PRODUCTIVITY	Output / (duration in hrs. no. labours)
BUDGETED DAYS	Budgeted quantity/assumed productivity
PRODUCTIVITY/ DAY	Budgeted productivity/ a pair of labour (no.2)
LABOUR COST WITH MATERIAL/PAIR/DAY	Rate X productivity/ day
COST FOR TOTAL NO. OF LABOUR	No. of labours X labour cost with material/pair/day
TOTAL COST OF LABOUR + MATERIAL BUDGETED QUANTITY AND DAYS	No. of days X cost for total no. of labour
TOTAL COST	Cost with res. to quantity + total cost of labour + material budgeted quantity and days

Table No.5 (2.2)

Title	Short form	Formula
EARNED VALUE	EV	$U_a/U_b \times BCWP$
Cost variance	CV	$EV - AC$
Quantity variance	QVt	$C_b U_a (1/U_a - 1/U_b)$
Resources variance	RVr	$C_b (R_a/R_b) - ACWP$
Rate variance	RVp	$C_b P_b - C_a$
Productivity variance	PV	$C_b P_b - C_b (R_a/R_b)$
% of work complete	% W	$(U_a/U_b) * 100$

As discussed in the previous pointer causes of variance are number of variables that, are directly and indirectly related to the cost and working structure of the project. These variables are converted into short terminologies to reduce the complication during the determination of formulas. Following a are few tables stating terminologies related to EVA and Cost variance.

3. METHODOLOGY:

- Cost monitoring methods like EVA and variance method etc. will be studied with respect to activities as initial planning necessary for monitoring and controlling cost variances and components behind the cost variances.
- Primary data will also be collected for the project through the meeting with the team.

- A high-value short-term project will be considered for the case study.
- Periodic monitoring will be done to collect data related to costing procedures during project activities.
- Data collection, Configuration of formulas related to EVA, and analysis will be done during monitoring which is required for the formulation of the worksheet module.
- Formulation of the worksheet model will be done on the basis of analyzed data to find out cost variances related to particular activities.
- Emerged components will be then highlighted with the help of proper reasoning (in calculation format).
- The worksheet model will also be stating the components behind the variances which will help in upgrading the monitoring system for future projects.

4. RESULT AND DISCUSSION WITH EXAMPLE: STEPWISE CALCULATIONS

STEP 1: Calculating productivity based on data obtained from the live site.

Example: Data from activity PAINTING

Cognized Information from BOQ. Calculating productivity based on BOQ and information obtained from the site for 1 month.

ACTIVITY	PAINTING
Duration	30 Days
Budgeted Quantity in sq. ft	113021.99
Budgeted Cost	31,48,469.8 Rs.
Actual Quantity in sq. ft.	113974.86
Actual Cost	36,45,017.2

LEGEND:

QT. = Quantity	Lb. 1= No. pair of labour
QT. Sq. ft = Quantity in Square Ft.	Lb = No. of labour in total
A. Rate = Actual Rate	R. Rate = Revised Rate

The following Table contains productivity based on information gathered from periodic monitoring of the live site.

Table No.6 (Step 1)

ACTUAL QUANTITY											
1 MONTH	E1	QT.	Qtr.'s. ft	A. Rate	R. Rate	Cost	Days	Hrs	Lb.l	Lb.	Productivity
	1	375	4036.5	35	40	1,61,460	6	72	3.5	5	672.75
	2	380	4090.32	35	40	1,63,612.80	6	72	3	6	681.72
	3	390	4197.96	35	40	1,67,918.40	6	72	4.5	7	699.66
	4	385.33	4147.69	35	40	1,65,907.60	6	72	5	7	691.28
	5	378.54	4074.60	35	40	1,62,984	6	72	3.5	5	679.10
		20547.08			8,21,883	30			30		3424.51

The above table only reflects the productivity related to BOQ obtained from the site i.e., the quantity, and rate is all budgeted. Also, this activity is budgeted to complete in 1-month duration.

Both tables consist of productivity based on quantity which is the Scope for particular activity with respect to time and other factors.

STEP 2: Calculate week-wise break up to get the final total cost/ week based on data obtained from the live site. (Worksheet Model)

Table No. 7 (Step 2)

BUDGETED BOQ														
ACTUAL BOQ														
ACTIVITY	productivity assumed	Actual days	Actual QUANTITY in sq.mt	Actual QUANTITY in sq.ft.	Actual productivity	labour with material rate/sq.ft.	total no. of labours in pair (2 person/pair)	productivity / pair /day	total actual rate as per quantity	labour cost with material/pair/day	Actual cost for total no. of labour/day	total cost of labour+material budgeted quantity and days	TOTAL COST	
1 month	E1	10010	6	375.00	4036.50	672.75	40.00	5	336.38	161460.00	13455.00	67275.00	403650.00	565110.00
	E2	10010	6	380.00	4090.32	681.72	40.00	6	340.86	163612.8	13634.40	81806.40	490838.40	654451.20
	E3	10010	6	390.00	4197.96	699.66	40.00	7	349.83	167918.4	13993.20	97952.40	587714.40	755632.80
	E4	10010	6	385.33	4147.69	691.28	40.00	7	345.64	165907.68	13825.64	96779.48	580676.90	746584.58
	E5	10010	6	378.54	4074.60	679.10	40.00	5	339.55	162984.18	13582.02	67910.08	407460.46	570444.64
				30	20547.08			30			68490.26		2470340.15	3292223.22
	week 1		6		4036.50			30		161460.00		403650	403650.00	565110.00
	week 2		6		4090.32			36		163612.8		490838.4	490838.40	654451.20
	week 3		6		4197.96			42		167918.4		587714.4	587714.40	755632.80
	week 4		6		4147.69			42		165907.68		580676.90	580676.90	746584.58
	week 5		6		4074.60			30		162984.18		407460.46	407460.46	570444.64

Table No. 8 (Step 2)

At this step, The Microsoft Excel worksheet can be prepared to generate data as per variables to calculate components of cost variances by using the formulas specified in **Table No. 5 (2.2)**

2. TABLES AND FORMULAS USED FOR METHODOLOGY

STEP 3: Week-wise Components of variances

30 days are observed and calculated week-wise for convenience; E.g.

Table No. 9 (Step 3)

BUDGETED QUANTITY										
1 MONTH	E1	QT. Sq. Ft	QT. Ft	Rate/Ft	Cost	Days	Hrs	Lb.l	Lb.	Productivity
	1	375	4036.5	35	1,41,277.50	6	72	3	6	672.75
	2	375	4036.5	35	1,41,277.50	6	72	3	6	672.75
	3	375	4036.5	35	1,41,277.50	6	72	3	6	672.75
	4	375	4036.5	35	1,41,277.50	6	72	3	6	672.75
	5	375	4036.5	35	1,41,277.50	6	72	3	6	672.75
	TOTAL	20182.5			7,06,387.50	30			30	3363.75

FOR ACTIVITIES E1 WEEK 1			PAINTING	
BUDGETED INPUT		b		
budgeted cost	Cb (BCWP)	565110.00		
scheduled duration in days	Db	6	1/ua	0.0002
Scheduled Resources	Rb	36	1/ub	0.0002
budgeted unit output in sq.ft	Ub	4036.50		
% of work perform	Pb			
ACTUAL INPUT		a	Pb=Ua/Ub	1.0000
Actual cost	Ca (ACWP)	565110.00	cost/cum	140.0000
Actual duration in days	Da	6		
Resources used	Ra	30	Work(cum)completed	4036.50
actual unit produced	Ua	4036.50	total actual cost	565110.00
% of work perform	Pa		over budget	0.00
EARNED VALUE		EV	Ua/Ub x BCWP	565110
Total VARIANCES		v	FORMULA	
Cost variance	CV	BCWP - ACWP	0	
Quantity variance (SCOPE)	QVt	CbUa(1/Ua - 1/Ub)	-1.23657E-10	
Resources variance (LABOUR + MATERIAL)	Rvr	Cb(Ra/Rb) - ACWP	-94185	
Rate variance (TOTAL COST)	Rvp	CbX(Ua/Ub)-Ca	0.00	
Productivity variance	PV	CbPb-Cb(Ra/Rb)	94185.00	
% of work complete	%W	(Ua/Ub)*100	100	0

Table No. 10 (Step 3)

FOR ACTIVITIES E2 WEEK 2			PAINTING	
BUDGETED INPUT		b		
budgeted cost	Cb (BCWP)	565110.00		
scheduled duration in days	Db	6	1/ua	0.0002
Scheduled Resources	Rb	36	1/ub	0.0002
budgeted unit output in sq.ft	Ub	4036.50		
% of work perform	Pb			
ACTUAL INPUT		a	Pb=Ua/Ub	1.01
Actual cost	Ca (ACWP)	654451.20	cost/cum	160.00
Actual duration in days	Da	6		
Resources used	Ra	36	Work(cum)completed	3531.94
actual unit produced	Ua	4090.32	total actual cost	654451.20
% of work perform	Pa		over budget	-89341.20
EARNED VALUE		EV	Ua/Ub x BCWP	572644.8
Total VARIANCES		v	FORMULA	
Cost variance	CV	BCWP - ACWP	-89341.2	
Quantity variance (SCOPE)	QVt	CbUa(1/Ua - 1/Ub)	-7534.8	
Resources variance (LABOUR + MATERIAL)	Rvr	Cb(Ra/Rb) - ACWP	-89341.2	
Rate variance (TOTAL COST)	Rvp	CbX(Ua/Ub)-Ca	-81806.40	
Productivity variance	PV	CbPb-Cb(Ra/Rb)	7534.80	
% of work complete	%W	(Ua/Ub)*100	101.3333333	1.333333333

Week wise cost variance with reference to activity:

Table No.11 (Step 3)

MONTH			
PAINTING	E1	Budgeted Cost	Actual cost
	week 1	565110.00	565110.00
	week 2	565110.00	654451.20
	week 3	565110.00	755632.80
	week 4	565110.00	746584.58
	week 5	565110.00	570444.64
TOTAL		2825550.00	3292223.22
			Cost variance
			466673.22

The table stated above gives the total cost variance for every activity but as already stated the considered variations are in %. The following table will give a detailed idea about the % of variances in detail;

STEP 4: Calculation for % of variances

Up till step 3 one has to consider each task individually to get over % of variances in the overall project. The same technique should be followed to extract

components of cost variances to get the final cost variance for the whole project.

Table No.12 (Step 4)

% OF VARIANCES				
ACTIVITY	CIVIL	CARPENTRY	PAINTING	TOTAL
BUDGETED	24,21,900.0	36,59,760.0	28,25,550.00	89,07,210.0
ACTUAL	90,25,448.4	89,69,559.0	32,92,223.22	2,12,87,230.6
Variance	66,03,548.45	53,09,798.97	4,66,673.22	1,23,80,020.63
	2,726,598,309	1,450,859,884	0,165,161,905	1,389,887,589
	272,659,8309	145,085,9884	16,516,19048	138,988,7589
% variance/activity	273	145	17	139

Table No.13 (Step 4)

Considering each activity completed at 100% the total % of variances occur during completion.

CIVIL	100%	273%
CARPENTRY	100%	145%
PAINTING	100%	17%
TOTAL	100%	151%

The above table shows difference between % of the cost in budgeted and actual cost. For comparison, the % for each activity is considered as 100 %. Because in this research; the assessment is based on individual activity, considering 100 % as cost contribution in budgeted is easy to compare with the variance to actual

STEP 5: Graphical Representation of % of variances; (Compressed data for projection)

- Graphical Distribution of Actual and Budgeted Costs,

Fig. 1 (Step 5)

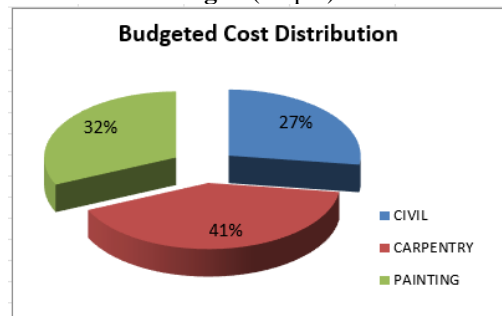
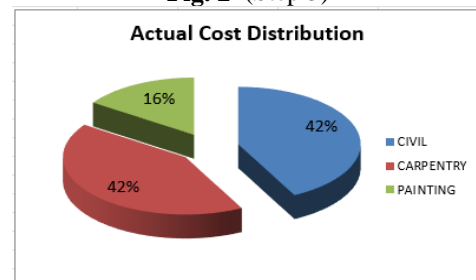
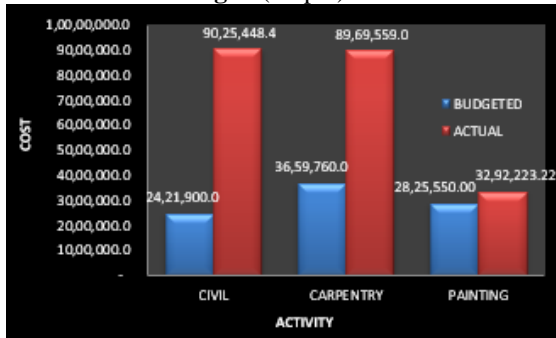


Fig. 2 (Step 5)



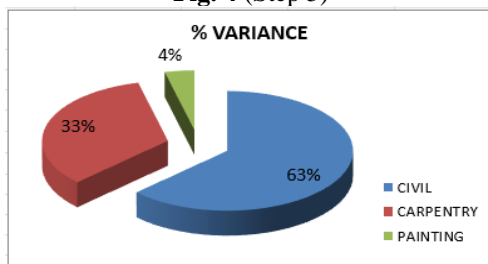
- Graphical Analysis of Actual and Budgeted Cost,

Fig. 3 (Step 5)



● **Graphical representation - % of Cost Variances,**

Fig. 4 (Step 5)



Summary:

To generate the worksheet module the data required is calculated as per these 5 steps. This process helps in calculating Components of cost variances at the stage of the activity/ week. This phenomenon gives a clear idea for further planning.

5. CONCLUSION:

To measure work progress and performance of project Earned Value Analysis (EVA) is considered as an enhanced project management technique. Because it combines budgets, work timeline and scope of work which can be used to estimate the project’s forthcoming performance. It anticipates potential risk and issues giving project managers an opportunity to recognize and limit the problems before they become obdurate. This permits projects to be managed well on time, and on budget. EVA is considered as effective project managing method’ by collecting and analysing the data obtained from various sources; this method can identify and present a project with information which is not available with any other management tool. EVA simplifies the cost structure of the project by comparing planned value to actual value to date one can get Earned Value till date and also gives the cost variances i.e., the pockets and problems in cost structure till date.

EVA is a method that can be applied from the beginning to the completion of a work project or during ongoing

project. It is more effective while the project is still running or halfway done so that by using EVA method project manager can find out the odds in Cost structure. If the odds are major in nature, he or she can apply remedies and avoid them in the future. EVA with software saves time, describes the relationship of cost structure, WBS, elements of cost structure, and elements affecting cost structure in diagrammatic format, and gives results as soon as possible.

From Carr’s paper it’s clear that the cost of the project depends upon many elements, if any of that elements get affected due to unfavorable conditions cost structure shows deflection. By elaborating on the deviations (in the form of calculations) and finding out the reasons behind the deviation in elements during the project will help in concentrating on particular elements with problems and correcting the problems at that point so the same problem can be avoided in the future. EVA method explains everything in a calculative format which gives data to support the theory of earned value and components of cost variances.

At the end to conclude EVA is an effective monitoring method that can be used to extract numerical data required for calculating components of cost variances. This can be used for short-term projects as weekly deflection can also be derived using the above formulas. So that precautions can be taken to avoid any kind of obstruction during a live project. This will help in minimizing delays and ultimately smooth the completion of the project.

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