

Time and Cost Control using Earned Value Management

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Abstract: Time and cost are the most important things to remember when designing a building project. Project management is used to maximize human capital and material performance. Earned Value Management (EVM) is a project management tool that uses information based on cost, schedule and work performance to define the current status of the project. The methodology aids in the comparison between budgeted and actual costs. EVM helps the manager to extrapolate current trends to predict their likely final effect. This method is proved effective in cost control. The Primavera is project management software which enables users to track and analyze performance of project. The current study looks at the preparation and project control methods, as well as the key criteria that go into measuring EVM in construction project management. For this measurements, Primavera P6 program is used. The use of Primavera P6 program for project received benefit measurement estimation is concluded.

Keywords: Project management, Primavera, Earned value management

1. Introduction

Project management is a body of expertise, a set of principles, or a series of strategies that deals with project planning and supervision [1]. In architecture, project management consists of a collection of priorities that can be achieved by carrying out a sequence of operations that are constrained by resources. In terms of reach, expense, time, content, human, material, and financial capital, there are often possible contradictions between specified goals [2]. These disputes should be overcome as quickly as possible by making the required trade-offs (change) or by developing alternative options.

Traditionally, the budgeted expense has been calculated by estimating the discrepancy between the project's expected and real costs [3]. The emphasis was on both planned and real costs. Earned Value explores actual success as well as potential prospects. Earned Value Analysis (EVA) provides project managers with enough assistance to maintain a strong intuitive knowledge of future danger areas [4]. Managers may create risk reduction plans based on the current expense, timetable, and technological success of the job with the aid of a better understanding of the project's cost efficiency. It acts as a warning to administrators to recognise and monitor challenges by taking prompt corrective steps before they become too big to handle. EVM makes for a clearer view of the project's timetable and budget. The EVA System is a series of instructions that ensures a successful project completion. It has been observed that in order to offset cost overruns, the project management reduces costs by either reducing the scale and efficiency of the project or by supplying extra funding [5]. In the event of a time overrun, they prepare for operations to be halted or swift tract programs to be implemented. As a result of the use of the EVA system, project goals are accomplished more effectively.

The Primavera enables users to track and analyze performance. It's a multiuser, multi-project system with scheduling and resource management features that enable multi-tiered project hierarchies, resource scheduling with an emphasis on

responsibilities and abilities, real data logging, customizable views, and user-defined data [6]. It can manage an infinite range of tasks, events, baselines, and services, as well as task breakdown structures (WBS), organizational breakdown structures (OBS), user-defined codes, and critical path system (CPM) scheduling and resource scaling.

2. Objectives

The salient objectives of the present study have been identified as follows:

- To suggest the importance and purpose of monitoring the construction work.
- Surveying the techniques or tools, for the evaluation of the management of construction projects
- To suggest guidelines to contractors for updating the project.
- To determine the activities which are critical and causes major delays in the project, initially from the point of view of the client and also generally from a broader perspective.
- To make a watch on the existing planning, techniques and tools in achieving goals to complete a project on time and within budgeted value.
- To determine the level of effectiveness or otherwise of existing cost monitoring and control methods employed by contractors.
- Assessing the suitability of contractor's approaches to project organization for cost monitoring and control.
- To propose a specification, a structure and suitable components for a general construction management evaluation system.

3. Methodology

3.1. Earned Value Management

It is the method by which a project manager evaluates the success of a project by calculating the cost of work completed up to the project status date. By example, when calculating a project's received worth, it applies the initial expense projections to the real work completed to decide if your project is on schedule or not. When comparing the cost of work done to the baseline cost for the job, resource, or assignment, earn value is a calculation that shows how much of the budget should have been spent. The Earned Value system was created as a way to help project managers keep track of their success [7].

3.2. Concept of EVM [6]

BCWS - Budgeted Cost of Works Scheduled - the reference point of the analysis, a sum of expected costs based on the date of their occurrence

BCWP - Budgeted Cost of Work Performed - It is also known as Earned Value, and it is a metric of physical success of works represented by the amount of expected costs of works currently completed in relation to time.

ACWP - Actual Cost of Work Performed - a total sum due for work completed over a period of time

BAC - Budget at Completion - BCWS at the projected finish is the estimated planned cost of the whole plant.

T – Planned duration of Project

Figure 1 show the Earned value curve, this project is currently behind the schedule and over budget.

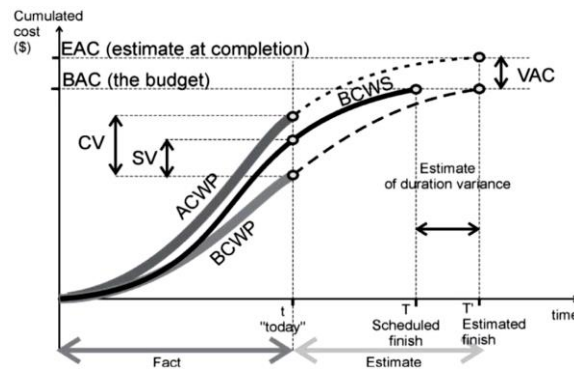


Figure 1 Earned value curve

3.3. Project status indicators

PC - Percentage Complete:

$$PC = \frac{BCWP}{BAC}$$

CV - Cost Variance a statistic for the difference between the expected and actual cost of work performed up to the date of documenting change in money units. If the value is negative, the proposal is over budget:

$$PC = \frac{ACWP}{BCWP}$$

Fraction of the budgeted cost of works performed

$$CV\% = \frac{CV}{BCWP} \times 100$$

SV - Schedule Variance - a calculation of the difference between real and expected progress. It is expressed in money units, considering the fact that it is perceived as time variance. In other words, it is the difference between the planned cost of works finished and the planned cost of works completed by the reporting date. If that's negative, it means there's a lag:

$$SV = BCWP - BCWS$$

$$SV\% = \frac{BCWP}{BCWS} \times 100$$

CPI - Cost Performance Index - compares the expected and real value of completed work; if less than 1, the project has expended more resources than anticipated; if greater than 1, the project has saved money.

$$CPI = \frac{BCWP}{ACWP}$$

SPI - Schedule Performance Index - compares the expected cost of completed work to the planned cost of planned work; If the number is less than one, there is a delay:

$$SPI = \frac{BCWP}{BCWS}$$

3.4. Monitoring with Primavera

This study involves monitoring and controlling the project using Primavera P6. The progress at site must be incorporated in the Primavera schedule and updated. These updates need to be thoroughly monitored using Primavera. Tools and techniques involved in this process are:

- Earned value management (EVM)
- Cost performance baseline
- Work performance measurements

4. Results and Discussion

The Report Wizard creates customized reports that extract specific data from its database. The following are the various steps of Primavera for Earn Value

Step-1: Additions of Activities, Tie Logic, Set % Complete to Physical

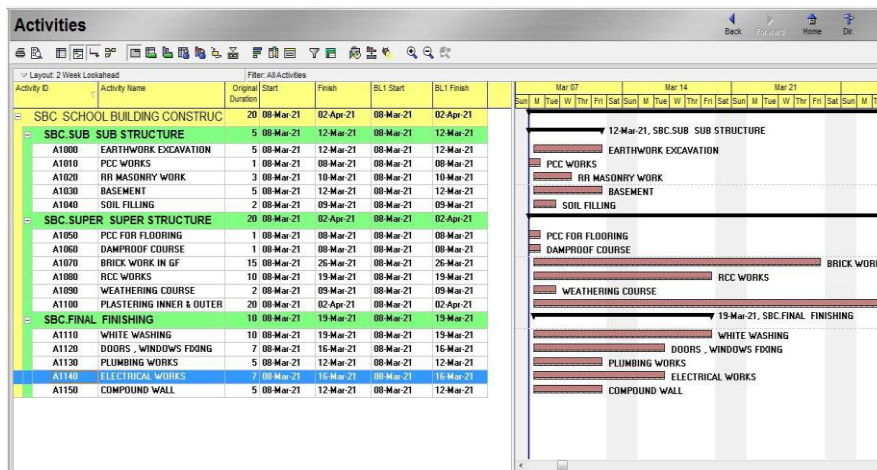


Figure 2 Add Activities Tie Logic set and percentage Complete

Step-2: Calendar assignments

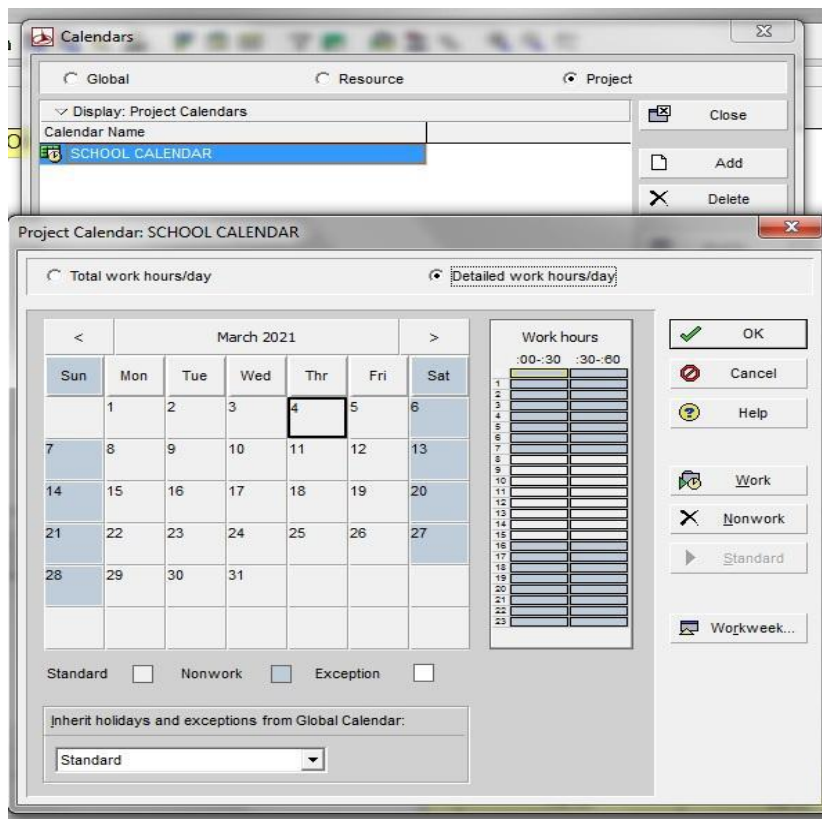


Figure 3 Calendar assignment

Step-3: Relationships

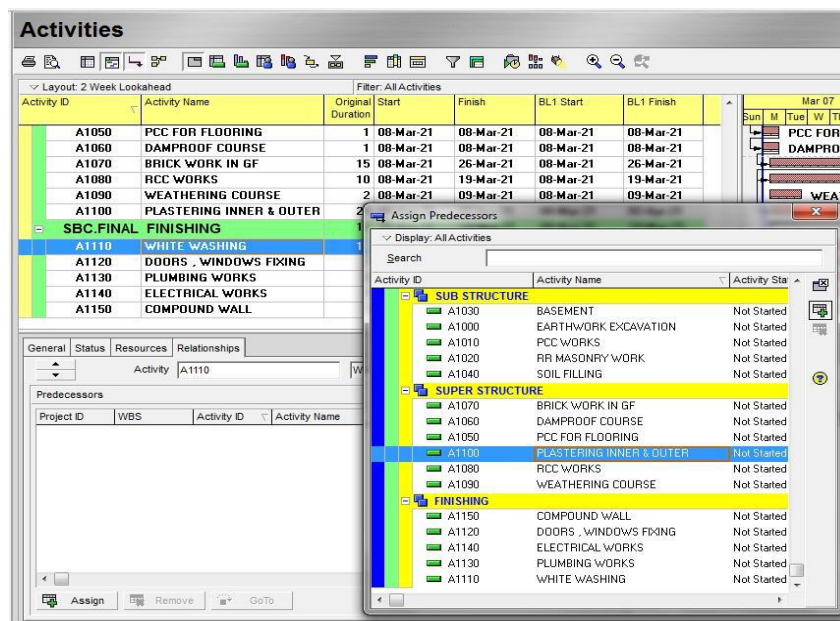
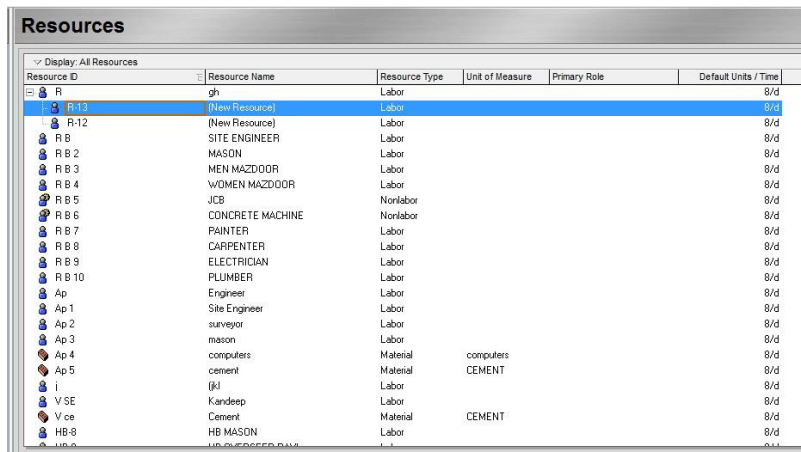


Figure 4 Relationship chart

Step 4: Resource assignments



Resource ID	Resource Name	Resource Type	Unit of Measure	Primary Role	Default Units / Time
R-13	(New Resource)	Labor			8/d
R-12	(New Resource)	Labor			8/d
R-8	SITE ENGINEER	Labor			8/d
R-8.2	MASON	Labor			8/d
R-8.3	MEN MAZDOOR	Labor			8/d
R-8.4	WOMEN MAZDOOR	Labor			8/d
R-8.5	JCB	Nonlabor			8/d
R-8.6	CONCRETE MACHINE	Nonlabor			8/d
R-8.7	PAINTER	Labor			8/d
R-8.8	CARPENTER	Labor			8/d
R-8.9	ELECTRICIAN	Labor			8/d
R-8.10	PLUMBER	Labor			8/d
Ap	Engineer	Labor			8/d
Ap.1	Site Engineer	Labor			8/d
Ap.2	surveyor	Labor			8/d
Ap.3	mason	Labor			8/d
Ap.4	computers	Material	computers		8/d
Ap.5	cement	Material	CEMENT		8/d
i	(kl)	Labor			8/d
V.5E	Kandep	Labor			8/d
V.5e	Cement	Material	CEMENT		8/d
HB-8	HB MASON	Labor			8/d

Figure 5 Resource management

Step-5: Maintain baseline and assign to project

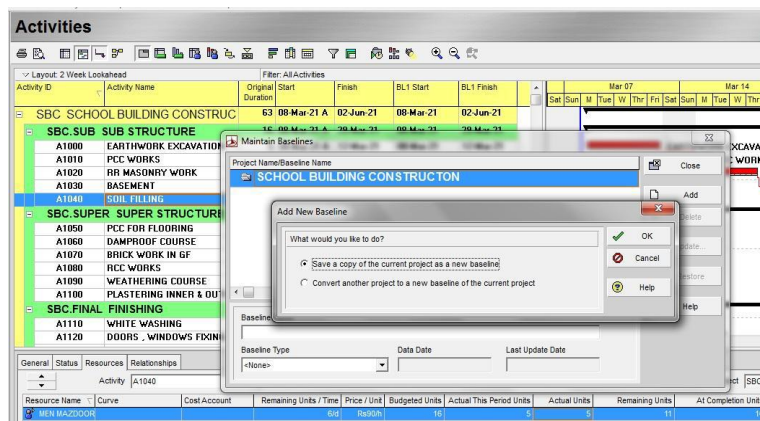


Figure 6 Baseline maintenance

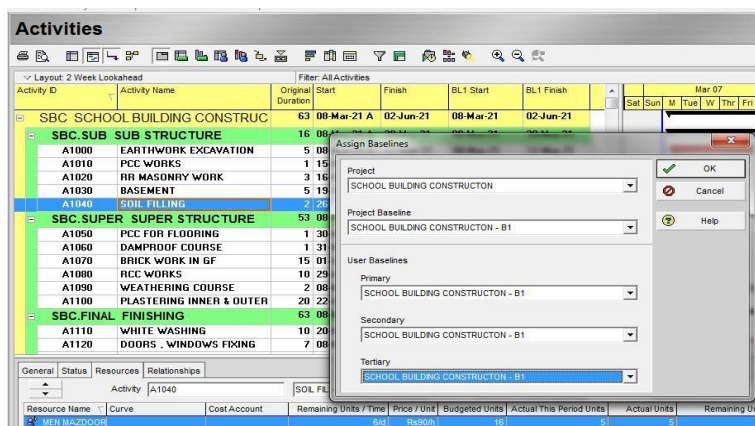


Figure 7 Project assignment

Step-6: Schedule project, advance data activity

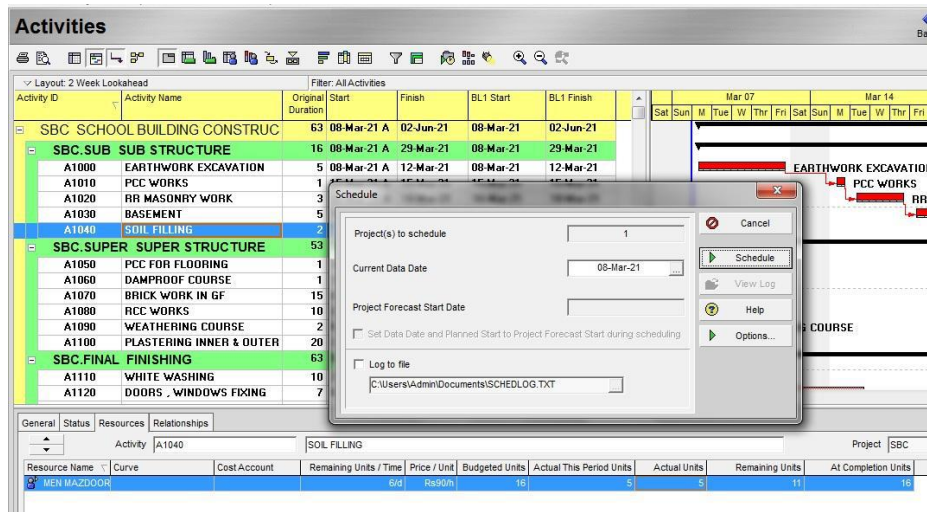


Figure 8 Data activity

Step- 7: Activity earned value

SCHOOL BUILDING CONSTRUCTION
Report Date 04-Mar-21 21:02

Project Start 08-Mar-21
Project Finish 14-May-21
Data Date 08-Mar-21

AC-01 Activity Eamed Value

WBS	Activity ID	Activity Name	Activity Status	Planned Value Cost	Earned Value Cost	Actual Cost
SP		SCHOOL PRINCIPAL				
	SBC	SCHOOL BUILDING CONSTRUCTION				
	SBC.SUB	SUB STRUCTURE				
	A1000	EARTHWORK EXCAVATION	In Progress	Rs0	Rs41,578	Rs43,732
	A1010	PCC WORKS	In Progress	Rs0	Rs0	Rs4,387
	A1020	RR MASONRY WORK	In Progress	Rs0	Rs0,000	Rs0,000
	A1030	BASEMENT	In Progress	Rs0	Rs14,800	Rs14,800
	A1040	SOIL FILLING	In Progress	Rs0	Rs720	Rs720
	Subtotal			Rs0	Rs63,756	Rs70,899
	SBC.SUPER	SUPER STRUCTURE				
	A1050	PCC FOR FLOORING	Completed	Rs0	Rs0	Rs0
	A1060	DAMPROOF COURSE	Completed	Rs0	Rs0	Rs0
	A1070	BRICK WORK IN GF	Not Started	Rs0	Rs0	Rs0
	A1080	RCC WORKS	Not Started	Rs0	Rs0	Rs0
	A1090	WEATHERING COURSE	Not Started	Rs0	Rs0	Rs0
	A1100	PLASTERING INNER & OUTER	Not Started	Rs0	Rs0	Rs0
	Subtotal			Rs0	Rs0	Rs0
	SBC.FINAL	FINISHING				
	A1110	WHITE WASHING	Not Started	Rs0	Rs0	Rs0
	A1120	DOORS , WINDOWS FIXING	Not Started	Rs0	Rs0	Rs0

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Table 1 Activity earned value

Step-8: Earned value analysis

SCHOOL BUILDING CONSTRUCTION
Data Date: 08-Mar-21

Report Date: 04-Mar-21 21:01
Primary Baseline: SBC - B

RE-01 Earned Value for WBS and Activities

Activity ID	Activity Name	Planned (BQWP)	Actual (AQWP)	Earned (BQWS)	Variance At Completion	Activity Status
SP						
EV Type: Activity % Complete						
SBC						
EV Type: Activity % Complete						
SBC.SUB						
EV Type: Activity % Complete						
A1000	EARTHWORK EXCAVATION	0	89	85	-12	In Progress
A1010	PCC WORKS	0	11	0	-4	In Progress
A1020	RR MASONRY WORK	0	72	72	-7	In Progress
A1030	BASEMENT	0	160	160	15	In Progress
A1040	SOIL FILLING	0	8	8	-4	In Progress
Subtotal		0	340	325	-12	
SBC.SUPER						
EV Type: Activity % Complete						
A1050	PCC FOR FLOORING	0	0	0	0	Completed
A1060	DAMP ROOF COURSE	0	0	0	0	Completed
A1070	BRICK WORK IN GF	0	0	0	0	Not Started
A1080	RCC WORKS	0	0	0	0	Not Started
A1090	WEATHERING COURSE	0	0	0	0	Not Started
A1100	PLASTERING INNER & OUTER	0	0	0	0	Not Started
Subtotal		0	0	0	0	
SBC.FINAL						
EV Type: Activity % Complete						
A1110	WHITE WASHING	0	0	0	0	Not Started
A1120	DOORS , WINDOWS FIXING	0	0	0	0	Not Started
A1130	PLUMBING WORKS	0	0	0	0	Not Started
A1140	ELECTRICAL WORKS	0	0	0	0	Not Started

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Table 2 Earned value analysis

Step-9: WBS Earned value

PW-01 WBS Earned Value

WBS Code	WBS Name	Planned Value Cost	Earned Value Cost	Actual Cost	Budget At Completion	Estimate To Complete
SBC	SCHOOL BUILDING CONSTRUCTION	Rs0	Rs63,756	Rs70,899	Rs98,880	Rs40,861
SBC.SUB	SUB STRUCTURE	Rs0	Rs63,756	Rs70,899	Rs98,880	Rs40,861
SBC.SUPER	SUPER STRUCTURE	Rs0	Rs0	Rs0	Rs0	Rs0
SBC.FINAL	FINISHING	Rs0	Rs0	Rs0	Rs0	Rs0
Total		Rs0	Rs63,756	Rs70,899	Rs98,880	Rs40,861

Table 3 WBS Earned value

5. Conclusion

Earned value performance reporting is designed to alert managers to future expense and scheduling issues so that corrective steps can be taken before the situation becomes urgent. Staff would have more time to formulate alternative plans if the project status review is completed quickly. When the earned benefit methodology is used for project management, it makes for a more precise measurement of operation time and expenditure criteria. Management would provide a greater understanding of how to distribute workloads. Improved efficiency can be accomplished by giving continuous input to management on cost and schedule results, enabling them to focus on problem areas. Won value, on its own, is inadequate for successful project management. It is a standardized output assessment technique that can only be useful if it is backed up by good cost and schedule management systems. Although handling such a huge volume of data

can seem overwhelming, the use of available programming software built for the task renders the execution a reasonably straightforward book procedure.

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