7.4: Earned Value Management (EVM)

A project manager must regularly compare the amount of money spent with the budgeted amount and report this information to key stakeholders. In addition, project managers must also compare the progress of the actual work completed with the estimated durations in the project schedule. One of the quantitative monitoring techniques project managers utilize is Earned Value Management (EVM) which combines scope, schedule and cost baselines to determine the project's well-being and to decide whether an action is required in case of problems. EVM is essential to project success. It is used extensively in many business fields and organizations such as the Department of Defense (DOD) and construction industries while the IT industry has not due to the reasons such as practicing agile (adaptive) project management and hence lack of a fixed baseline[1].

EVM is a quantitative monitoring technique that uses metrics and indexes to assess project performance. Earned value analysis compares the performance measurement baseline to the actual schedule and cost performance. EVM integrates the scope baseline with the cost baseline and schedule baseline to form the performance measurement baseline [2][ii]. The application of earned value in the early initiation and planning phases of a project increases the validity and usefulness of the cost and schedule baseline and is an excellent verification of the project scope assumptions and the scope baseline. Once established, these baselines become the best source for understanding project performance during execution. A comparison of actual performance (both cost and schedule) against this baseline provides feedback on project status and data, not only for projecting probable outcomes but also for management to make timely and useful decisions using objective data[3]. EVM, known as "management with the lights on", is based on the principle that past patterns and trends can indicate future conditions. EVM helps us clearly and objectively see where our project is headed compared to where it's supposed to be[4].

EVM can help answer the questions below[5]:

- Are we delivering more or less work than planned?
- When is the project likely to be completed?
- Are we currently over or under budget?
- What is the remaining work likely to cost?
- What is the entire project likely to cost?
- How much will we be over or under budget at the end of the project?
- What is driving the significant cost and/or schedule variances?

In EVM, there is an important point that must be clarified. We will always see monetary amounts even though we are measuring the scope or schedule performance. The denominator for all of them is the currency we are using for our project. If we are using the US dollar, the denominator would be the US dollar. The analogy for EVM would be doing shopping in a market. We buy different items such as olive oil, cookies, milk, eggs, and laundry detergent. All these items are converted to a monetary value, and it allows us to compare the prices between different brands. In the end, we know the total amount in dollars. This is exactly what is happening for EVM. Therefore, when we see a result showing dollars, it doesn't necessarily mean that it is related to the cost. It can indicate a problem in scope (e.g., not all planned activities have been completed) or schedule (e.g., the project is behind schedule).

Earned value analysis (EVA) is a monitoring and controlling process that compares project progress to the project baseline (original plan). EVA measures the performance of a project in terms of cost and schedule. It can tell the project team if a project is:

- Behind Schedule
- Ahead of Schedule
- Under Budget
- Over Budget

EVA provides hard numbers for making these judgements and can be used to forecast where a project will end up in terms of time and cost. As a result, EVA helps the project manager clearly communicate project progress to all stakeholders and can focus the attention of the project team on any changes needed for the project to be completed on time and on budget. Most project management information systems (PMIS), can calculate earned value metrics if a baseline is properly set and the earned value inputs are provided. Project managers who do not conduct an earned value analysis run the risk of misinterpreting or miscommunicating the meaning of the project information that is collected during the execution phase.

EVA Example

For example, assume that the direct costs of a project are budgeted at $100,000, and the project is scheduled to take 12 months. If it is three months into the project and $25,000 has been spent, a naive project manager might assume that the project is 25% done and is on track to finish within the project timeline and budget.

In this example, the project is certainly 25% done as far as the time allowed for the project, and 25% done with the budget, but what is not known is which activities have been worked on and if those activities are complete or still in progress. If only 10% of the scheduled work has actually been completed, then the project may be in trouble. Alternatively, if 50% of the scheduled work has been completed, then the project may end up being done much earlier and with much less expense than planned. Either situation requires action:

- If a project is going to be over budget and/or take more time, the project manager needs to figure out if what can be done to correct the situation. Should they try to get more resources and time, or should they re-evaluate the project entirely?
- If a project is going to be done in significantly less time and/ or with significantly less cost, then the project manager should see if some of the resources allocated for the project can be released to other projects and priorities in the organization, and the impact of an earlier completion date should be evaluated.

Before attempting the calculations involved in an earned value analysis of a project, it is important to understand the three basic inputs for EVA calculations. The three basic inputs are Planned Value (PV), Actual Costs (AC), and Earned Value (EV).

Planned Value (PV)

Planned Value—Refers to the expected cost that will be spent on the project over its lifetime. For each activity, there is a total Planned Value (cost). More importantly, the amount that was going to be spent on each activity over time is also known.

Consider the information presented on Project Breakdown in Table 7.1. The amount that the project team thinks an activity will cost is called the planned value for that activity.

Table 7.1: Project Breakdown

Sequence Order	Activity	Planned Value (PV)	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
1	Design celebratory cake	$50	$50					
2	Order ingredients and equipment	$225	$150	$75				
3	Mix cake ingredients	$50		$50				
4	Bake cake	$120		$120				
5	Cool cake	$0						
6	Mix frosting	$20			$20			
7	Apply frosting	$80			$50	$20	$10	
8	Cool frosting							

9	Apply decorations	$25					$25	
10	Pack and ship cake	$100					$100	
11	Confirmation of receipt							
12	Bill customer	$10						$10
	Total	$680	$200	$245	$70	$20	$135	$10

Actual Costs (AC)

The **Actual Costs**—this refers to the completed work—is the easiest of the inputs to understand. AC refers to any given activity cost at specific time. Actual costs don't reflect what was planned to be spent, but rather what was spent. This information is obtained from the accounting department and the data is based on invoices, paychecks and receipts related to the activity. While the project manager may have been planning to spend $78 on Activity 1 by the end of period one, the accounting department may inform him or her that the actual cost (AC) at the end of period one for Activity 1 is $50!!

However, the project manager still doesn't know if spending $50 on Activity 1 by the end of period one is good or bad, since he or she doesn't yet know how much work has been performed on Activity 1. The next basic input, earned value, will tell the project manager what percentage of the activity is completed and they will then know how well the project is progressing.

Earned Value (EV)

Earned Value—refers to the cost of work completed on an activity which can be found by multiplying the percentage of completed work for a given activity by the planned value for the same activity.

> **EV = PV for the Activity × Percentage Complete**

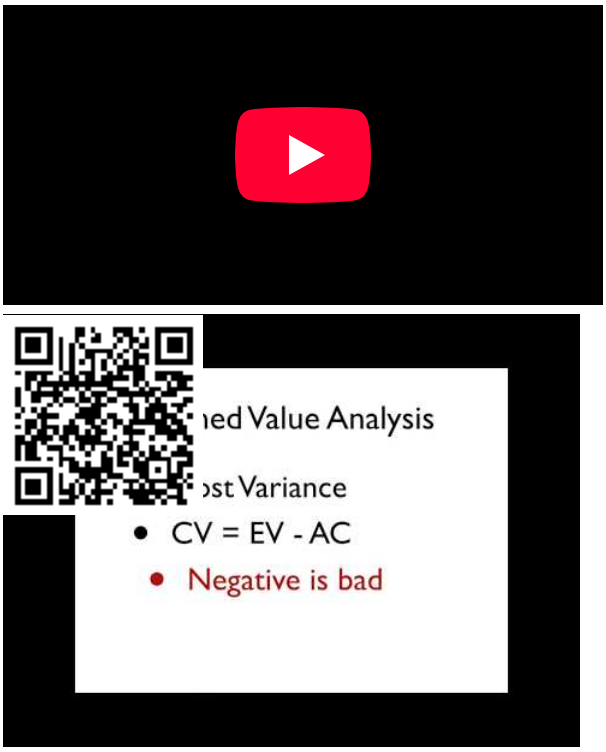
One thing to watch out for is that the calculation of EV is not time-dependent; it uses the total PV for an activity, not the value for PV at a certain point in time as found on a time-phased budget. For example, if Activity 1 is 100% complete at the end of period one, then EV = $50 × 100%, or EV = $50 On the other hand, if no progress has been made on this activity (0% complete), then $50 × 0%, or EV = $0.00

Cost Variance (CV)

CV is the first of two basic variances that can be calculated once EV, PV and AC have been determined for an activity or project. CV is simply the Earned Value minus the Actual Costs.

> **CV = EV − AC**

If CV is negative, that means that the project work is costing more than planned. If CV is positive, then the project work is costing less than planned. CV can be calculated for each activity, for segments of a project (for example a deliverable or sub-deliverable) or for the entire project. Watch the video: Calculating and Understanding Cost Variance for an explanation of how to calculate and interpret CV.



Video: Calculating and Understanding Cost Variance by Prof C [3:32] Transcript available.

Schedule Variance (SV)

SV is the second of two basic variances that can be calculated once EV, PV, and AC have been determined for an activity or project. SV is simply the Earned Value minus the Planned Value.

> **SV = EV − PV**

If SV is negative, that means that less work has been performed than what was planned. If SV is positive, then more work has been done than planned.

Like CV, SV can be calculated for each activity, for segments of a project (for example a deliverable or sub-deliverable) or for the entire project. Watch the video: Calculating and Understanding Schedule Variance for an explanation of how to calculate and interpret SV.

Video: Calculating and Understanding Schedule Variance by Prof C [4:14] Transcript available.

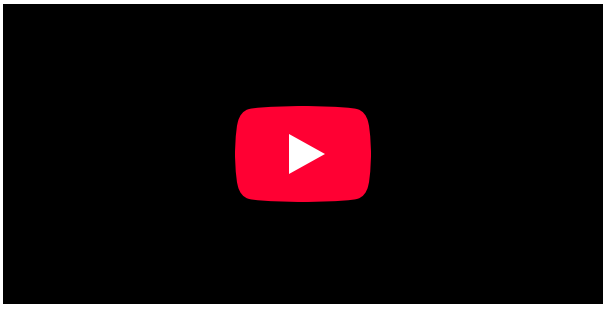
Cost Performance Index (CPI)

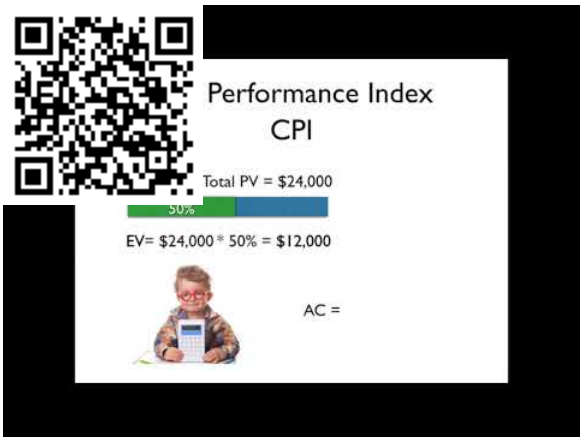
While CV provides a dollar amount that reflects how much over or under the project is at a particular point in time, The **Cost Performance Index (CPI)** provides an indicator of the overall cost performance to date and a good idea of how the project work is trending with regard to cost performance. CPI is calculated as follows:

> **CPI = EV ÷ AC**

- A CPI that is < 1 means that the cost of completing the work is higher than planned.
- A CPI that is = 1 means that the cost of completing the work is right on plan.
- A CPI that is > 1 means that the cost of completing the work is less than planned.

Watch the video: Cost Performance Index (CPI) for a basic walk-through of CPI calculations and the interpretation of the results.





Video: Cost Performance Index (CPI) by Prof C [3:47] Transcript available.

Schedule Performance Index (SPI)

While SV provided a dollar amount that reflected well the project is doing at turning dollars into completed activities on schedule, **Schedule Performance Index (SPI)** provides an indicator of the overall schedule performance to date. Remember that there are some limitations on using money to measure time. Those limitations apply to SPI as well. To know whether a project is really behind or ahead of schedule, a project manager will also look at the planned start and finish dates, milestones, etc.

SPI is calculated as follows:

> **SPI = EV ÷ PV**

- An SPI that is < 1 means that the project is behind schedule.
- An SPI that is = 1 means that the project is on schedule.
- An SPI that is > 1 means that the project is ahead of schedule.

Watch the video: Schedule Performance Index (SPI) for a basic introduction to SPI calculations and the interpretation of the results.

Video: Schedule Performance Index (SPI) by Prof C [7:09] Transcript available.