

## Earned Value analysis

### Definition:

Earned value analysis is a method of performance measurement. Earned value integrates cost, schedule and scope and can be used to forecast future performance and project completion dates. It allows projects to be managed better – on time, on budget.

**Three quantities** form the basis for cost performance measurement using Earned Value Management. They are

1. Budgeted Cost of Work Scheduled (BCWS) or Planned Value (PV)
2. Budgeted Cost of Work Performed (BCWP) or Earned Value (EV) and
3. Actual Cost of Work Performed (ACWP) or Actual Cost (AC).

The above quantities are defined below.

- **Budgeted Cost of Work Scheduled (BCWS) or Planned Value (PV)** – The sum of budgets for all work packages scheduled to be accomplished within a given time period.
- **Budgeted Cost of Work Performed (BCWP) or Earned Value (EV)** – The sum of budgets for completed work packages and completed portions of open work packages.
- **Actual Cost of Work Performed (ACWP) or Actual Cost (AC)** – The actual cost incurred in accomplishing the work performed within a given time period. For equitable comparison, ACWP is only recorded for the work performed to date against tasks for which a BCWP is also reported.

From these three quantities we can determine our total program budget as well as make a determination of schedule and cost performance and provide an estimated cost of the project at its completion.

### Baseline budget:

- Aggregating the estimated costs of the individual scheduled activities to establish a total COST BASELINE for measuring and budgeting the project
- Inputs: WBS, Activity Cost Estimate, Project Schedule, Resource Calendar, Contracts, Cost Management Plan
- Tools & Techniques: Cost Aggregation, Reserve Analysis, Parametric Estimating (adjustment to the aggregate cost), Funding Limit Reconciliation (can impact the schedule and overall cost)
- Output: Cost Baseline, Expected Cash Flow, Funding Requirements (including Management Reserve), Requested Changes, Updated Cost Management Plan

Additional terms are defined to record cost and schedule performance and program budget:

- **Schedule Variance (SV)** – The difference between the work actually performed (BCWP) and the

work scheduled (BCWS). The schedule variance is calculated in terms of the difference in dollar value between the amount of work that should have been completed in a given time period and the work actually completed.

- **Cost Variance (CV)** – The difference between the planned cost of work performed (BCWP) and actual cost incurred for the work (ACWP). This is the actual dollar value by which a project is either overrunning or under running its estimated cost.

**Two Performance Ratios:**

- **Cost Performance Index (CPI)** – The ratio of cost of work performed (BCWP) to actual cost (ACWP). CPI of 1.0 implies that the actual cost matches to the estimated cost. CPI greater than 1.0 indicates work is accomplished for less cost than what was planned or budgeted. CPI less than 1.0 indicates the project is facing cost overrun.
- **Schedule Performance Index (SPI)** – The ratio of work accomplished (BCWP) versus work planned (BCWS), for a specific time period. SPI indicates the rate at which the project is progressing.
- **Estimate At Completion (EAC)** – It is a forecast of most likely total project costs based on project performance and risk quantification. At the start of the project BAC and EAC will be equal. EAC will vary from BAC only when actual costs (ACWP) vary from the planned costs (BCWP).

**Earned Value Management Formula:**

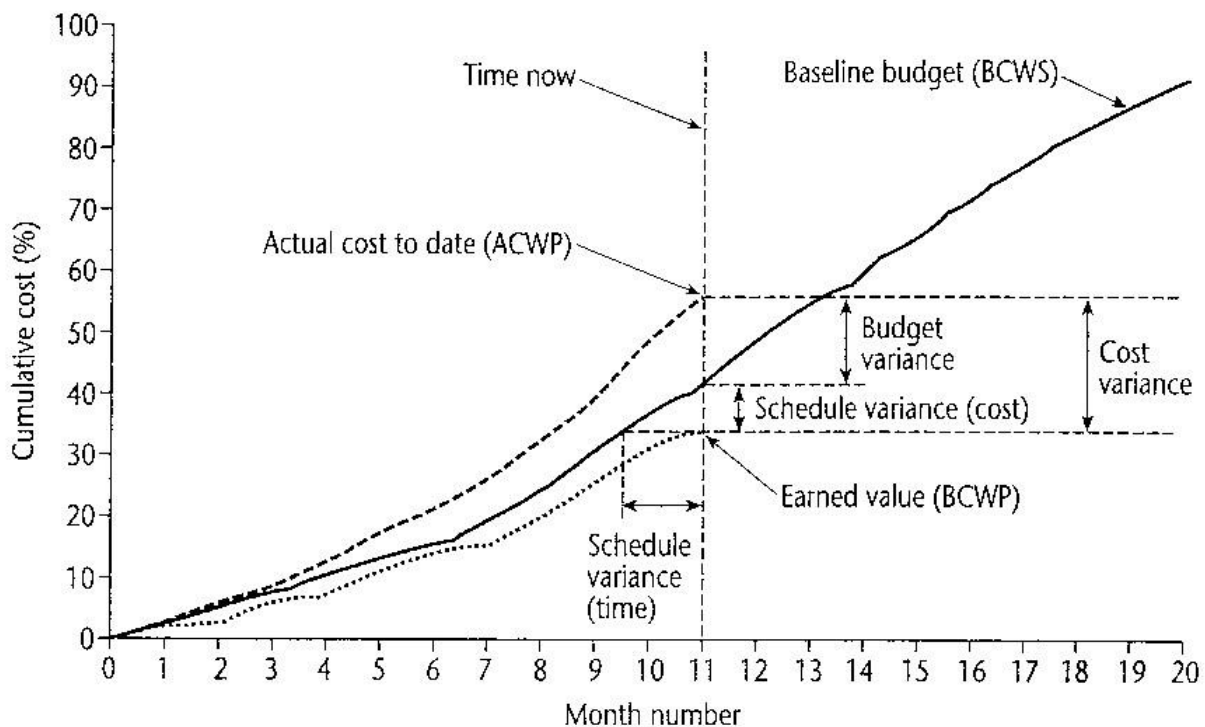
Name	Formula
Cost Variance (CV)	$EV - AC$
Schedule Variance (SV)	$EV - PV$
Time Variance (TV)	Difference between the time when the achievement of the current earned value was planned to occur and the time now
Cost Performance Index (CPI)	$EV / AC$
Schedule Performance Index (SPI)	$EV / PV$

**Earned value – an example**

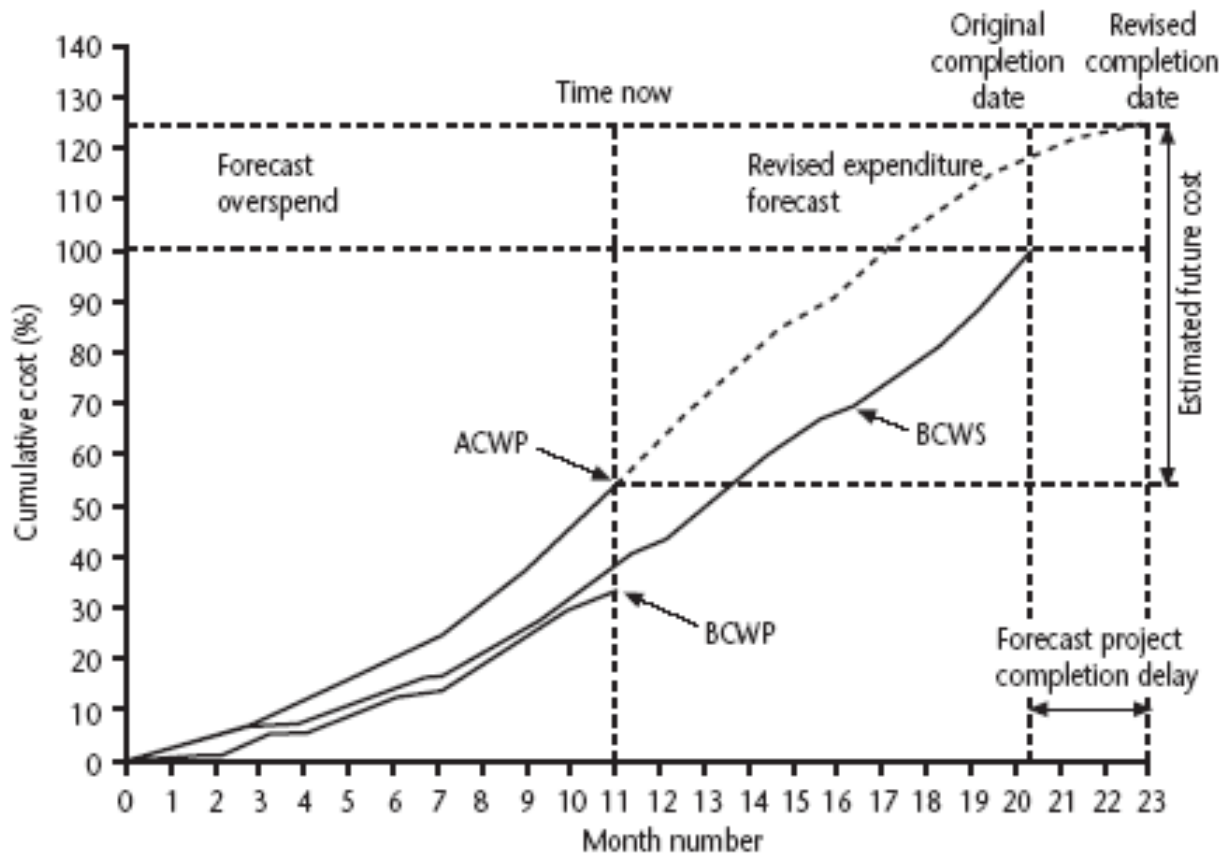
- Tasks
  - Specify module      5 days
  - Code module          8 days
  - Test module            6 days
- At the beginning of day 20, PV = 19 days

- If everything but testing completed, EV = 13 days
- Schedule variance = EV-PV i.e. 13-19 = -6
- Schedule performance indicator (SPI) = EV/PV  
i.e.  $13/19 = 0.68$
- A negative schedule variance (SV) means that the project is behind schedule as does a SPI that is less than 1.0.
- Actual cost (AC) is also known as Actual cost of work performed (ACWP)
- In previous example, if
- ‘Specify module’ actually took 3 days (planned 5 days)
- ‘Code module’ actually took 4 days (planned 8 days)
- Actual cost = 7 days
- Cost variance (CV) = EV-AC  
i.e.  $13-7 = 6$  days
- Cost performance indicator (CPI) = EV/AC  
i.e.  $13/7 = 1.86$
- Positive CV or CPI > 1.00 means project under budget or the work is completed better than planned

**An Earned value tracking chart**



Earned value chart with revised forecasts



- This shows how the planned value (PV), earned value (EV) and actual cost (AC) can be tracked over the lifetime of a project.
- It also shows how the graph can be used to show adjustments to the final estimated cost and duration. A revised assessment of the budget at completion (EAC estimate at completion) can be produced by dividing the original estimated budget at completion (BAC) by the current CPI.
- Similarly a forecast of the actual duration of the project can be derived by dividing the original estimated duration by the SPI.