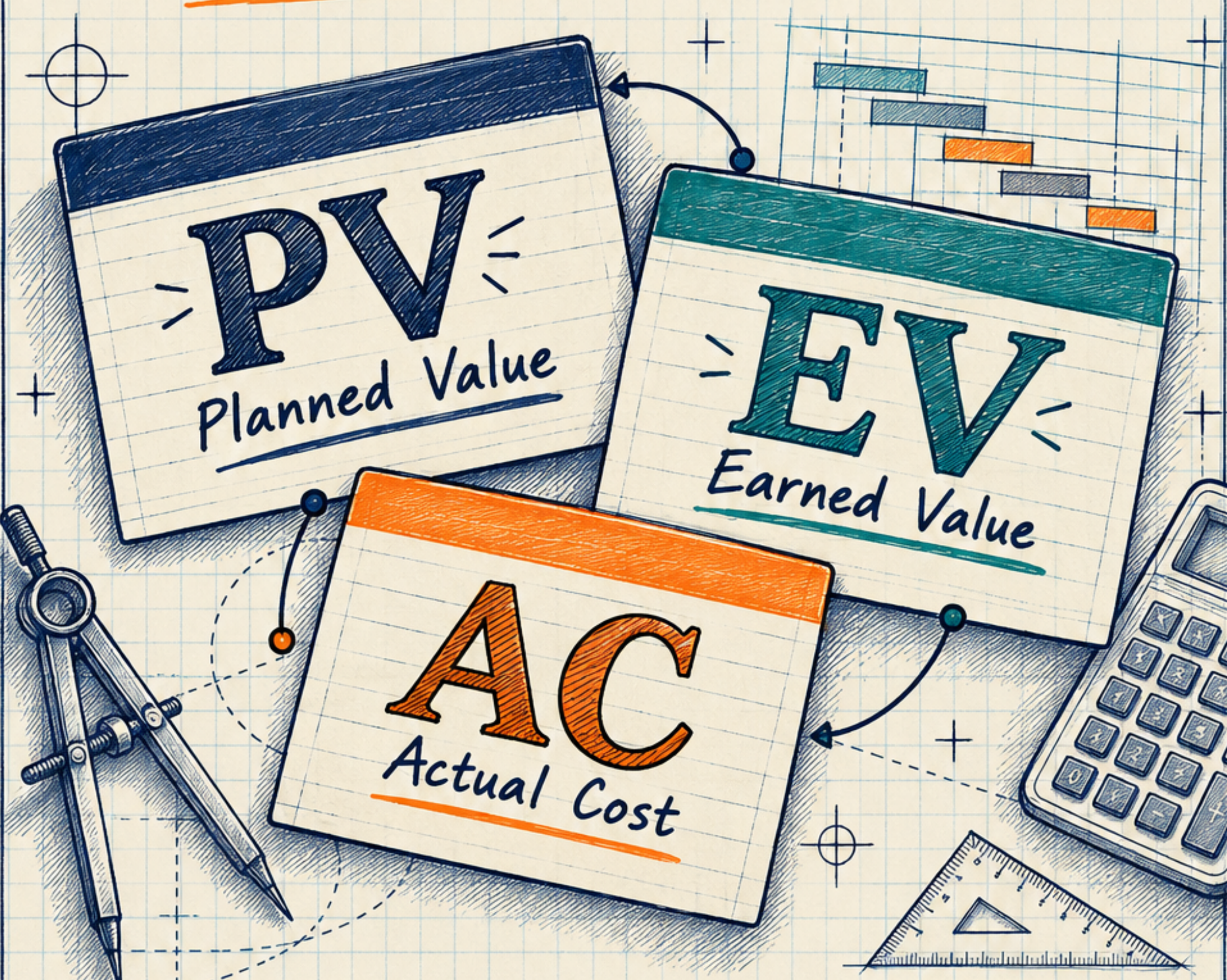
WIKIFREE HANDBOOKS | BOOK 02

EARNED VALUE MANAGEMENT

The Essential Formula Handbook



Variances • Performance indices
Forecasting • Worked examples

wikifree.com

PV, EV & AC

Start with the three inputs every EVM calculation needs.

PV | PLANNED VALUE

Budgeted cost of work scheduled by the status date.

What should we have completed?

EV | EARNED VALUE

Budgeted value of work actually completed by that date.

What have we achieved, valued at the baseline budget?

AC | ACTUAL COST

Cost incurred for the work performed by that date.

What costs have we incurred for work performed?

ONE PROJECT. ONE STATUS DATE.

10 equal-budget work packages × $1,000 each.

BAC (Budget at Completion) = $10,000.

By today: 6 planned complete · 4 actually complete.

Recorded cost incurred: $5,000.

PV	EV	AC
$6,000	$4,000	$5,000
6 × $1,000	4 × $1,000	From cost records

Assumption: A package earns its full budget only when complete (0/100).

READ THE RESULT

EV < PV: Less work completed than planned.

EV < AC: Completed work cost more than its budget.

CHECK BEFORE CALCULATING

Use the same scope, status date and reporting basis.

EV is budgeted value — not revenue or cash received.

COST VARIANCE (CV)

Are we over or under budget for the work performed?

THE FORMULA

$$CV = EV - AC$$

EV = budgeted value of work performed.
AC = actual cost incurred for the same work.

Express CV in currency, using the same scope, date and reporting basis.

WHAT THE SIGN MEANS

CV > 0
UNDER BUDGET
Actual cost is lower than earned value.

CV = 0
ON BUDGET
Actual cost matches earned value.

CV < 0
OVER BUDGET
Actual cost exceeds earned value.

WORKED EXAMPLE

Using the same project and status date as page 01:

EV = $4,000

AC = $5,000

$$CV = \$4{,}000 - \$5{,}000 = -\$1{,}000$$

RESULT: $1,000 OVER BUDGET
The work performed cost $1,000 more than its budgeted value.

WHAT TO CHECK NEXT

Review labor rates, material costs, rework and cost-record accuracy.

Identify the cause before choosing corrective action.

DO NOT CONFUSE CV WITH MONEY LEFT

BAC − AC is budget remaining; CV compares EV with AC.
CV describes performance so far, not the final project cost.

SCHEDULE VARIANCE (SV)

Have we earned more or less value than scheduled?

THE FORMULA

$$SV = EV - PV$$

EV = budgeted value of work performed.
PV = budgeted value of work scheduled by the same date.

SV is measured in currency. It is not a number of days.

WHAT THE RESULT MEANS

SV > 0
AHEAD OF PLAN
More budgeted work earned than planned.

SV = 0
MATCHING PLAN
Earned value equals planned value.

SV < 0
BEHIND PLAN
Less budgeted work earned than planned.

WORKED EXAMPLE

Using the same project and status date as page 01:

EV = $4,000

PV = $6,000

$$SV = \$4{,}000 - \$6{,}000 = -\$2{,}000$$

RESULT: $2,000 LESS WORK VALUE EARNED
Progress is below plan in budget terms, not $2,000 of extra cost.

HOW TO USE IT

Locate unfinished planned work and inspect dependencies.

Use the project schedule to assess milestone and finish-date effects.

A LIMIT OF TRADITIONAL SV

SV does not measure delay in days or identify the critical path.
Once EV and PV both reach BAC, SV = 0, even after a late finish.

COST PERFORMANCE INDEX

How much budgeted work value do we earn per dollar spent?

THE FORMULA

$$CPI = EV / AC$$

CPI compares earned value with actual cost.
An index of 1.00 means cost performance matches the budget.

CPI is a ratio, not a currency amount. AC must be greater than zero.

WHAT THE RESULT MEANS

CPI > 1
FAVORABLE
More than $1 of value per $1 of cost.

CPI = 1
ON BUDGET
$1 of earned value per $1 of cost.

CPI < 1
UNFAVORABLE
Less than $1 of value per $1 of cost.

WORKED EXAMPLE

Using the same project and status date as page 01:

EV = $4,000

AC = $5,000

$$CPI = \$4{,}000 / \$5{,}000 = 0.80$$

RESULT: $0.80 OF VALUE PER $1 SPENT

The work is costing more than its budgeted value.

HOW TO USE IT

Compare the index across reporting dates, then investigate causes.

Use cumulative EV and AC when making a cumulative-CPI forecast.

DO NOT MISREAD THE PERCENTAGE

CPI = 0.80 does not mean cost is only 20% above earned value.
AC / EV = 1 / CPI = 1.25: actual cost is 25% above that value.

SCHEDULE PERFORMANCE INDEX

How much planned work value has actually been earned?

THE FORMULA

$$SPI = EV / PV$$

SPI compares earned value with planned value.
An index of 1.00 means earned value matches the plan.

SPI is a ratio, not elapsed time. PV must be greater than zero.

WHAT THE RESULT MEANS

SPI > 1
AHEAD IN VALUE
More earned value than scheduled.

SPI = 1
MATCHING PLAN
Earned value matches scheduled value.

SPI < 1
BEHIND IN VALUE
Less earned value than scheduled.

WORKED EXAMPLE

Using the same project and status date as page 01:

EV = $4,000

PV = $6,000

$$SPI = \$4,000 / \$6,000 \approx 0.667$$

RESULT: ABOUT 66.7% OF PLANNED VALUE
This does not mean the project is 66.7% physically complete.

HOW TO USE IT

Inspect the critical path and near-critical activities as well.

Keep full precision in calculations; round only the displayed result.

SPI IS NOT A FINISH-DATE FORECAST

Do not assume duration = planned duration / SPI.
Traditional SPI reaches 1 when EV = PV = BAC, even if late.

U.S. DOE / see p.15

The All-in-One PM Templates Bundle

940+ Premium Templates • One Payment • Lifetime Access

$49

SAVE 94%

Worth $3,300+

EXCEL & GOOGLE SHEETS | PROFESSIONAL & RELIABLE | AUTOMATED DASHBOARDS | SAVE TIME & STAY ON TRACK | INSTANT ACCESS DOWNLOAD

GET LIFETIME ACCESS

BUDGET & PROGRESS

Separate earned progress, budget used and remaining work.

THE BASELINE

BAC = baseline scope budget

Budget at Completion is the budget assigned to the baseline work.
Management reserve is outside the performance measurement baseline.

THREE DIFFERENT PERCENTAGES

Earned progress
EV / BAC × 100
40%

Planned progress
PV / BAC × 100
60%

Budget used
AC / BAC × 100
50%

Example: BAC = $10,000; PV = $6,000; EV = $4,000; AC = $5,000.

WORK REMAINING IS NOT MONEY REMAINING

Budgeted value of unfinished work
BAC - EV = $10,000 - $4,000 = $6,000

Budget left before reaching BAC
BAC - AC = $10,000 - $5,000 = $5,000

MEASURE PROGRESS OBJECTIVELY

Assign budget weights and earning rules before work starts.

Earn value from verified achievement, not simply from spending.

CHECK THE BASIS

EV / BAC is budget-weighted completion, not elapsed time.
Use a consistent approved baseline and BAC > 0.

EAC: FUTURE WORK AT BUDGET

Forecast total cost when remaining work can meet its budget.

THE FORMULA

$$EAC = AC + (BAC - EV)$$

EAC = Estimate at Completion: expected total project cost.
AC is already incurred; BAC - EV is remaining work at budget.

WHEN THIS METHOD FITS

Use when past cost variance is not expected to continue.
The remaining work is expected to be done at budgeted rates.
This is an assumption to justify, not an automatic recovery.

WORKED EXAMPLE

BAC = $10,000 / EV = $4,000 / AC = $5,000

Remaining work at budget = $10,000 - $4,000 = $6,000

$$EAC = \$5,000 + \$6,000 = \$11,000$$

RESULT: FORECAST FINAL COST OF $11,000

The $1,000 overrun already incurred remains in the forecast.

A USEFUL CROSS-CHECK

$$EAC = BAC - CV$$

CV = -$1,000, so $10,000 - (-$1,000) = $11,000.
The extra $1,000 is not erased by better future performance.

DOCUMENT THE ASSUMPTION

Explain why the remaining work can return to budgeted cost.
If current inefficiency will continue, use a different forecast.

EAC: CURRENT CPI CONTINUES

Forecast total cost if the current cost efficiency persists.

THE FORMULA

$$EAC = BAC / CPI$$

Use cumulative CPI = cumulative EV / cumulative AC.
Assumption: the remaining work follows the same cost efficiency.

AN EQUIVALENT FORM

$$EAC = AC + (BAC - EV) / CPI$$

With the same cumulative data, both forms give the same answer.
The second form separates incurred cost from future cost.

WORKED EXAMPLE

BAC = $10,000; EV = $4,000; AC = $5,000.
CPI = $4,000 / $5,000 = 0.80

$$EAC = \$10,000 / 0.80 = \$12,500$$

RESULT: FORECAST FINAL COST OF $12,500

Expected remaining cost = $12,500 - $5,000 = $7,500.

CHECK THAT THE TREND IS RELEVANT

Ask whether upcoming work has similar resources, rates and risks.
A different work mix or a one-off past event can weaken this model.
CPI must be positive; a zero denominator cannot produce a forecast.

A FORECAST IS NOT A COMMITMENT

Keep full precision and refresh the forecast as evidence changes.
EAC = $12,500 does not change the $10,000 baseline BAC.

EAC: COST + SCHEDULE

Use a combined factor only when schedule effects drive future cost.

THE FORMULA

$$EAC = AC + (BAC - EV) / (CPI \times SPI)$$

CPI × SPI is the assumed efficiency factor for the remaining work.
This method needs a credible cost impact from schedule performance.

WHEN TO CONSIDER IT

For example, delay may extend site overhead or require overtime.
Being behind schedule alone does not prove this model is suitable.
Use it as a reasoned scenario, alongside a detailed remaining estimate.

WORKED EXAMPLE

BAC = $10,000; EV = $4,000; AC = $5,000; PV = $6,000.
CPI = 0.80; SPI = 4,000 / 6,000 = 0.666...
Remaining budgeted work = $10,000 - $4,000 = $6,000.

$$EAC = \$5,000 + \$6,000 / (0.80 \times 2/3)$$

$$EAC = \$5,000 + \$11,250 = \$16,250$$

RESULT: A HIGHER COST-AND-SCHEDULE SCENARIO

The forecast differs because the future-performance assumption differs.

Use full precision: rounding SPI to 0.67 changes the calculation.
CPI and SPI must both be positive.

DO NOT APPLY THIS FORMULA AUTOMATICALLY

CPI and SPI are not independent causes of cost in every project.
Explain the mechanism and compare against a bottom-up estimate.

EAC: BUILD IT FROM THE WORK

Estimate the unfinished work directly when past trends are a poor guide.

THE FORMULA

$$EAC = AC + \text{bottom-up ETC}$$

ETC = Estimate to Complete: expected cost of the remaining work.
Re-estimate remaining tasks, quantities, resources, rates and risks.

WORKED EXAMPLE: NEW ESTIMATES

At the same status date, AC = $5,000. The team estimates:

Remaining labor	$3,600
Remaining materials	$2,400
Testing and closeout	$1,200

Bottom-up ETC = $3,600 + $2,400 + $1,200

$$ETC = \$7,200$$

$$EAC = \$5,000 + \$7,200 = \$12,200$$

RESULT: FORECAST FINAL COST OF $12,200

This scenario is based on refreshed estimates, not a fixed CPI.

MAKE THE ESTIMATE TRACEABLE

Record owners, quantities, rates, assumptions and included risks.
Exclude work already costed in AC so the forecast does not double-count.

KEEP THE BASELINE AND FORECAST DISTINCT

An updated EAC does not automatically authorize a new BAC.
Review approved changes through the project change process.

REMAINING COST & FINAL VARIANCE

Separate the cost still expected from the overrun expected at completion.

ESTIMATE TO COMPLETE

$$ETC = EAC - AC$$

The additional cost expected to finish the remaining work.

VARIANCE AT COMPLETION

$$VAC = BAC - EAC$$

Positive: forecast underrun. Zero: on budget. Negative: overrun.

WORKED EXAMPLE

Use the CPI forecast: EAC = $12,500; AC = $5,000; BAC = $10,000.

$$ETC = \$12,500 - \$5,000 = \$7,500$$

$$VAC = \$10,000 - \$12,500 = -\$2,500$$

RESULT: $7,500 TO FINISH; $2,500 FORECAST OVERRUN

Both results depend on the selected $12,500 EAC being credible.

DO NOT MIX UP CV AND VAC

CV = EV - AC: cost variance on work performed so far.

VAC = BAC - EAC: forecast variance for the finished project.

Here, CV = -$1,000 while VAC = -$2,500.

A SIMPLE CONSISTENCY CHECK

AC + ETC must equal EAC for the same scope and status date.

ETC is a forecast; BAC - AC is only the unspent baseline budget.

TCPI: MEET THE BAC

How efficient must the remaining work be to meet the chosen cost target?

THE FORMULA

$$TCPI(BAC) = (BAC - EV) / (BAC - AC)$$

Numerator: budgeted value of the work still to be earned.
Denominator: cost allowance left before reaching the target.

HOW TO READ THE REQUIREMENT

TCPI > 1: earn more than $1 of budgeted work per $1 of future cost.
TCPI = 1: remaining work must perform at budgeted cost.
TCPI < 1: the target allows less than $1 of value per $1 of cost.

WORKED EXAMPLE

BAC = $10,000; EV = $4,000; AC = $5,000; BAC target = $10,000.
Remaining work value = $10,000 - $4,000 = $6,000.
Cost allowance left = $10,000 - $5,000 = $5,000.

$$TCPI(BAC) = \$6,000 / \$5,000 = 1.20$$

REQUIRED FUTURE COST EFFICIENCY

The remaining work must earn $1.20 of value per $1 of cost.

COMPARE WITH PERFORMANCE TO DATE

Current CPI = 0.80; required future efficiency = 1.20.
Closing that gap requires a credible recovery plan, not just a target.

CHECK THAT THERE IS AN ALLOWANCE LEFT

If BAC = AC, the ratio is undefined; if BAC < AC, it is not useful.
With unfinished work, no allowance remains for positive-cost work.

TCPI: MEET THE EAC

How efficient must the remaining work be to meet the chosen cost target?

THE FORMULA

$$TCPI(EAC) = (BAC - EV) / (EAC - AC)$$

Numerator: budgeted value of the work still to be earned.
Denominator: cost allowance left before reaching the target.

HOW TO READ THE REQUIREMENT

TCPI > 1: earn more than $1 of budgeted work per $1 of future cost.
TCPI = 1: remaining work must perform at budgeted cost.
TCPI < 1: the target allows less than $1 of value per $1 of cost.

WORKED EXAMPLE

BAC = $10,000; EV = $4,000; AC = $5,000; EAC target = $12,200.
Remaining work value = $10,000 - $4,000 = $6,000.
Cost allowance left = $12,200 - $5,000 = $7,200.

$$TCPI(EAC) = \$6,000 / \$7,200 \approx 0.833$$

REQUIRED FUTURE COST EFFICIENCY

This $12,200 target needs about $0.833 of value per $1 of future cost.

COMPARE WITH PERFORMANCE TO DATE

Current CPI = 0.80, so this target still needs a modest improvement.
Use the selected forecast as the target; do not replace BAC in the numerator.

A FORECAST CROSS-CHECK, NOT PROOF

When EAC = BAC / CPI, TCPI(EAC) equals that same CPI by algebra.
A meaningful ratio needs remaining work and EAC > AC.

ONE COMPLETE EVM REVIEW

Bring measurement, forecasting and recovery into one decision.

NEW EXAMPLE: ONE COMMON STATUS DATE

BAC = $80,000 PV = $40,000

EV = $32,000 AC = $40,000

1. MEASURE CURRENT PERFORMANCE

CV = $32,000 - $40,000 = -$8,000

Over budget for work performed.

SV = $32,000 - $40,000 = -$8,000

Behind plan in budgeted work value.

CPI = 0.80 SPI = 0.80

Both indices are unfavorable.

2. FORECAST: ASSUME CURRENT CPI CONTINUES

EAC = $80,000 / 0.80 = $100,000

ETC = $100,000 - $40,000 = $60,000

VAC = $80,000 - $100,000 = -$20,000

3. TEST THE ORIGINAL TARGET

TCPI(BAC) = ($80,000 - $32,000) / ($80,000 - $40,000)

TCPI(BAC) = $48,000 / $40,000 = 1.20

DECISION: INVESTIGATE, FORECAST, THEN ACT

At CPI 0.80, the forecast is $20,000 above BAC.

Meeting BAC needs future efficiency 1.20; assess a credible recovery plan.

THE ASSUMPTION CHANGES THE ANSWER

Future work at budget: EAC = $88,000. CPI-only: $100,000.

CPI × SPI scenario: EAC = $115,000. Compare the evidence.

Original worked example / see p.15

YOUR FORMULA QUICK REFERENCE

Choose the formula by the question and the forecast assumption.

COST VARIANCE
$$CV = EV - AC$$
Positive favorable; negative unfavorable.

SCHEDULE VARIANCE
$$SV = EV - PV$$
Currency variance, not delay in days.

COST INDEX
$$CPI = EV / AC$$
Above 1 favorable; AC must be > 0.

SCHEDULE INDEX
$$SPI = EV / PV$$
Above 1 ahead in value; PV must be > 0.

FORECASTS: PICK THE ASSUMPTION

Future work at budget
$$EAC = AC + (BAC - EV)$$

Current cost efficiency continues
$$EAC = BAC / CPI$$

Cost and schedule factor applies
$$EAC = AC + (BAC - EV) / (CPI \times SPI)$$

Fresh estimate of remaining work
$$EAC = AC + \text{bottom-up ETC}$$

REMAINING COST
$$ETC = EAC - AC$$
Expected additional cost to finish.

FINAL VARIANCE
$$VAC = BAC - EAC$$
Negative means forecast overrun.

$$TCPI(BAC) = (BAC - EV) / (BAC - AC)$$
$$TCPI(EAC) = (BAC - EV) / (EAC - AC)$$

Use remaining work and a positive remaining cost allowance.

Earned progress = EV / BAC × 100. Keep scope, date and basis consistent.

REFERENCES / TAP TO OPEN IN THE PDF

U.S. DOE - EVM Tutorial, Module 6
U.S. DoD - IPM Definitions
SAS - Earned Value Cost Estimates
Oracle - Earned Value Formulas

Learn from 350+ top universities and companies

ILLINOIS

Duke UNIVERSITY

Google

UNIVERSITY OF MICHIGAN

IBM

VANDERBILT UNIVERSITY

JOHNS HOPKINS UNIVERSITY

Invest in your career

Explore new skills

Access 10,000+ courses in AI, business, technology, and more.