Earned Value

Introduction to Earned Value

Approximate Length: 1 hour

Welcome to the Earned Value Module. Earned value management principles provide an important set of tools used to measure contractor performance. This module will introduce you to earned value and its use in estimating the budget requirements for a contract.

Located throughout and at the end of this module are Knowledge Reviews, which are not graded but enable you to measure your comprehension of the lesson material.

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Learning Objectives

By completing this module, you should be able to:

- Identify the purpose of Earned Value Management (EVM) and its application to various types of contracts.
- Describe how Earned Value data can be used to estimate the budget requirements for a contract.

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Earned Value Management Description

DoD uses Earned Value Management principles to measure contractor performance on selected contracts. Earned Value Management (EVM):

- Relates the scope of the work to its associated budgets and schedule.
- Measures the work progress in objective terms.
- States the value of the work completed in dollars, or other measurable units.

EVM is a management tool that allows the Program Manager (PM) to manage risk by providing information that allows early identification of contract performance issues.

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Obtaining EV Information

PMs obtain Earned Value (EV) information from contractors and other performing agencies by requiring it as a deliverable under the contract/agreement in the form of the Contract Performance Report (CPR) (DI-MGMT-81466A) and the Integrated Master Schedule (IMS) (DI-MGMT-81650). Contractors must also meet EV management and reporting requirements described in DFAR contract clauses 252.234-7001 and 252.234-7002.

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Contract Performance Report (CPR)

The CPR allows the PM to select from a wide array of data elements presented on as many as five report formats. CPR reporting is usually reserved for work efforts considered to be relatively high-risk. CPR and IMS reporting is required for cost or incentive contracts (i.e., non-Firm-Fixed Price), subcontracts, intra-government work agreements, and other agreements valued at or greater than $20 million in then-year dollars.

| **Long description** |
| --- |
| Program Manager with table listing: CPR required for contracts, subcontracts, intra-government agreements, and other agreements valued at $20M or greater (then-year $). |

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Earned Value Data

A management system consistent with Earned Value Management principles provides three data elements useful in assessing project status:

- The budgeted value of the work planned is the cumulative amount budgeted for the work scheduled by a given date. It is also known as the Budgeted Cost of Work Scheduled (BCWS).
- The budgeted value of the work accomplished is Earned Value. The Earned Value is the sum of the amount budgeted for the tasks accomplished so far, or the Budgeted Cost of Work Performed (BCWP).
- The actual costs incurred in accomplishing the tasks so far is known as the Actual Cost of Work Performed (ACWP).

The total budgeted value of the work planned through the end of the project or contract is known as the **Budget at Completion (BAC)**.

Earned Value Data Example (1 of 2)
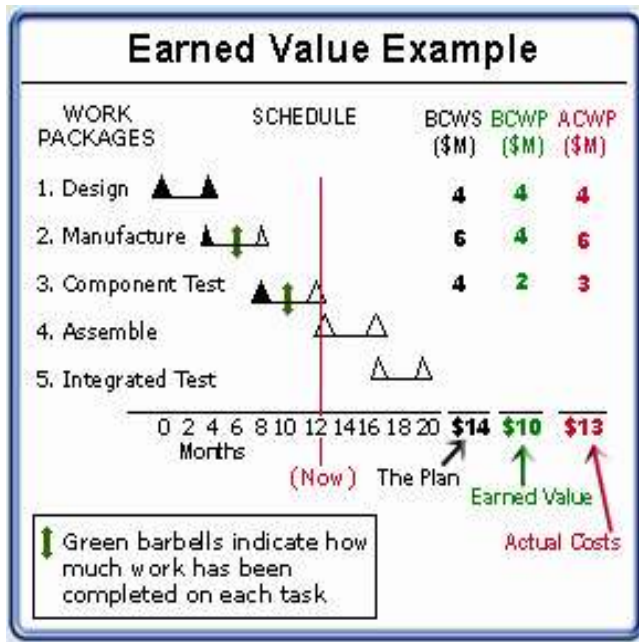
The chart illustrates data for a hypothetical project. It shows the raw data for a 20-month contract consisting of 5 work packages. The total budgeted value of the project at completion (BAC) is $20M.

Time now is 12 months into the contract performance. $14M of work was planned to be completed (BCWS) by this time. However, the work accomplished (BCWP) or Earned Value to date was only $10M. The actual cost to accomplish the work to date is $13M (ACWP). In summary, $14M was planned, we accomplished $10M, and it cost us $13M to accomplish the $10M of work.

Although the Design task was completed on cost and on schedule, the Manufacture task is only 2/3 complete, but has incurred actual costs of $6M (the total amount planned for that task). The Component Test task is also incurring cost faster than anticipated.


Long Description

Illustration of Earned Value Example. 20-month contract is divided into five work packages: Design, Manufacture, Component Test, Assemble, and Integrated Test. Chart shows cost and schedule status of each work package 12 months into contract performance. The Design work package was scheduled to run from the start of contract to month 4. This package was completed in month 4 with BCWS = $4 million, BCWP = $4 million and ACWP = $4 million. The Manufacture work package was scheduled to start in month 4 and end in month 8. However, this work package is only about two-thirds complete with BCWS = $6 million, BCWP = $4 million and ACWP = $6 million. The Component Test work package was scheduled to start in month 8 and end in month 12, however, this work package is only about one-half complete with BCWS = $4 million, BCWP = $2 million and ACWP = $3 million. The Assemble work package is scheduled to start in month 12 and end in month 16. Work on this package has not yet started, and no earned value information is shown. The

Integrated Test work package is scheduled to start in month 16 and end in month 20. Work on this package has not yet started, and no earned value information is shown.

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Earned Value Data Example (2 of 2)
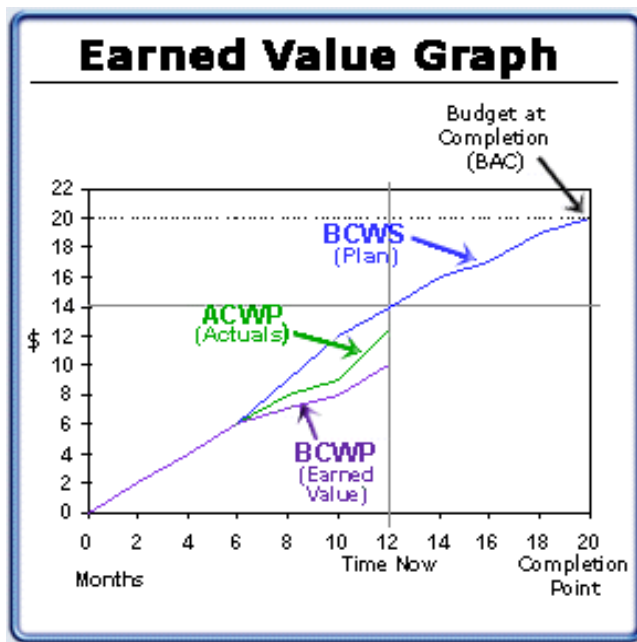
Note a graphical representation of the same data. The graph shows the BAC of $20M at the end of 20 months. As we saw on the previous screen, at the 12 month point, the plan (BCWS) indicates that $14M of work was planned to be completed. However, the actual cost of the work performed (ACWP) to date is $13M and the Earned Value (BCWP) is only $10M.

Long Description

Graphical representation of the data in the example on this page and the previous page. Vertical axis is labeled "$M" and runs from 0 to 22. Horizontal axis is labeled "Months" and runs from 0 to 20 (the Completion Point). BCWS (Plan) is plotted at the current time of 12 months and $14M. Budget at Completion (BAC) is plotted at the end of the BCWS line at 20 months and $20M. The ACWP (Actuals) line plots below the BCWS line from about the 6 month mark, and at the current point in time plots at 12 months, $13M. The BCWP (Earned Value) line plots below both the BCWS and ACWP lines from about the 6 month mark, and at the current point in time plots at 12 months, $10M.

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Knowledge Review

The following Knowledge Review is a matching question. Select a letter associated with the answers below and type that letter in the space next to the best corresponding phrase or statement. Then, select the Submit button and feedback will appear.

Match the appropriate Earned Value Management data elements with their descriptions.

1. The costs incurred in accomplishing the work accomplished so far.

2. The total budgeted value of the work planned through the end of the project.

3. The cumulative amount budgeted for the work planned to be accomplished by a given date.

4. The cumulative amount budgeted for the work accomplished so far.

a. Budgeted Cost of Work Scheduled (BCWS)

b. Budgeted Cost of Work Performed (BCWP)

c. Actual Cost of Work Performed (ACWP)

d. Budget at Completion (BAC)

Correct! The cumulative amount budgeted for the work by a given date is also known as the Budgeted Cost of Work Scheduled (BCWS). The sum of the amount budgeted for the tasks completed so far is the Budgeted Cost of Work Performed (BCWP). The actual costs incurred in accomplishing the tasks completed so far is also known as the Actual Cost of Work Performed (ACWP). Finally, the total budgeted value of the work planned through the end of the project is known as the Budget at Completion (BAC).

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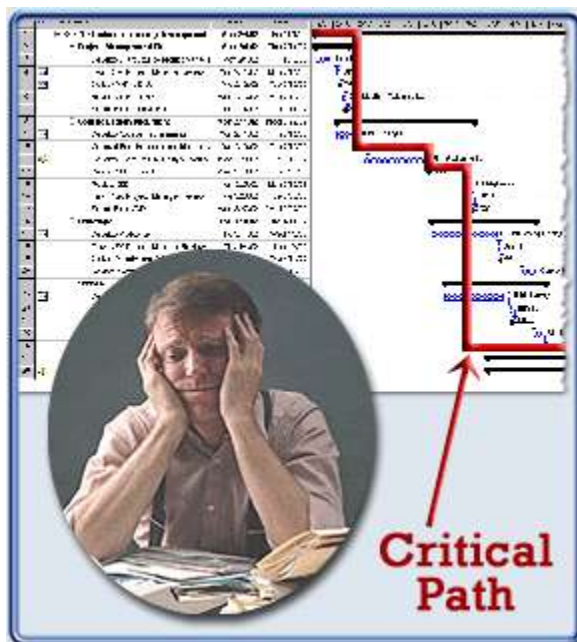## Schedule Variance (SV)

$$BCWP - BCWS = SV$$
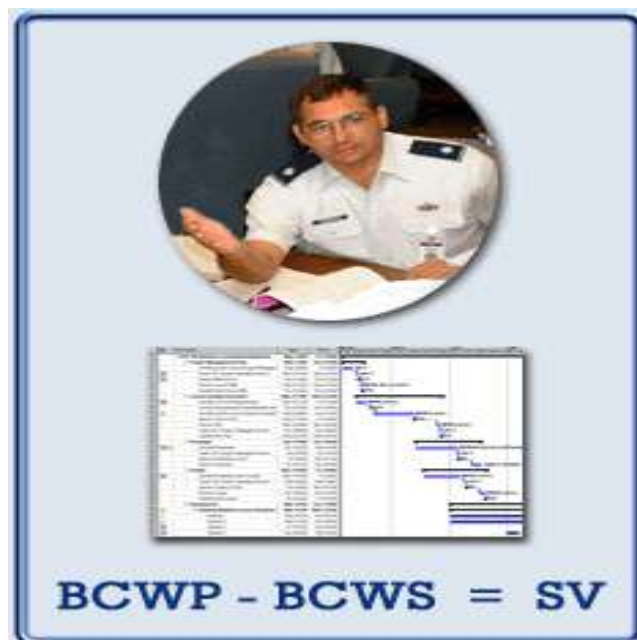
The Program Manager (PM) can use EV information to estimate contract schedule performance by examining the difference between the earned value of the work performed to date (BCWP) and the planned value of work that should have been completed by now (BCWS). This difference is known as the **Schedule Variance (SV)** (BCWP - BCWS). The SV value falls into one of three categories:

- **SV equals 0.** This MAY mean that the project is on schedule.
- **SV greater than 0 (+SV).** This means that more value has been earned than originally planned, so the project MAY be ahead of schedule = Favorable.
- **SV less than 0 (-SV).** This means that less value has been earned than originally planned, so the project MAY be behind schedule = Unfavorable.

The PM must look at the related "Critical Path" Schedule to determine how the project is progressing. SV is an indicator only.

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Negative Schedule Variance

A negative schedule variance should be cause for concern but does not necessarily mean that the project's scheduled completion date is likely to slip. A lagging work package that is not on the project's critical path may not affect the overall project completion date if it can be completed in parallel with other work packages before the scheduled completion date.

Select the following hyperlink to access a negative schedule variance example.

Negative Schedule Variance Example

In the example discussed earlier,

SV = BCWP ($10M) minus BCWS ($14M) = minus $4M, so the PM should be concerned about potential schedule slip.
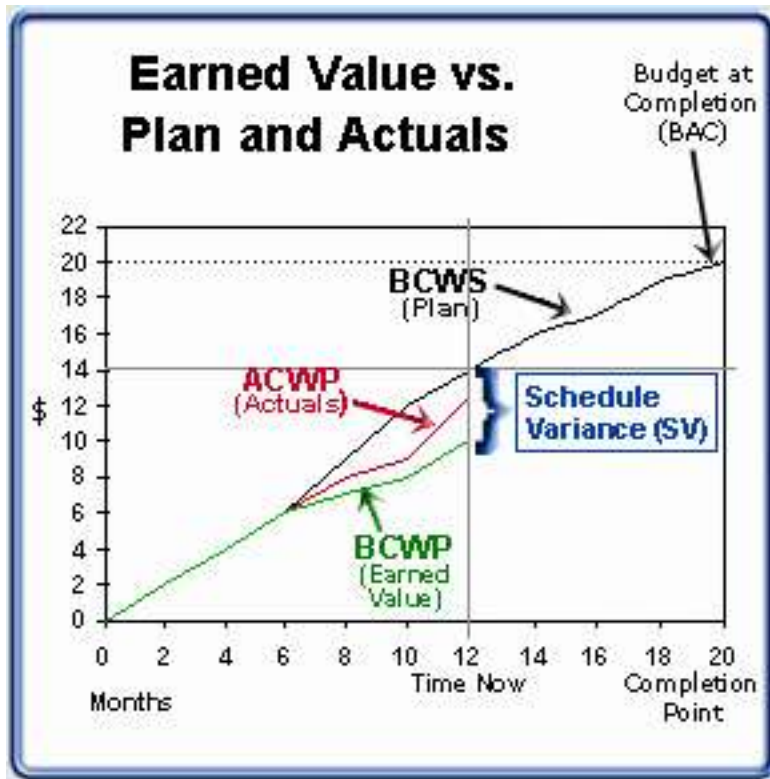

Long Description

Representation of the data in the example on this page and the previous page. Vertical axis is labeled "$M" and runs from 0 to 22. Horizontal axis is labeled "Months" and runs from 0 to 20 (the Completion Point). BCWS (Plan) is plotted at the current time of 12 months and $14M. Budget and Completion (BAC) is plotted at the end of the BCWS line at 20 months and $20M. The ACWP (Actuals) line plots below the BCWS line from about the 6 month mark, and at the current point in time plots at 12 months, $13M. The BCWP (Earned Value) line plots below both the BCWS and ACWP lines from about the 6 month mark, and at the current point in time plots at 12 months, $10M. Schedule Variance is marked as the difference between BCWS and BCWP currently, and is minus $4M.

Cost Variance (CV)
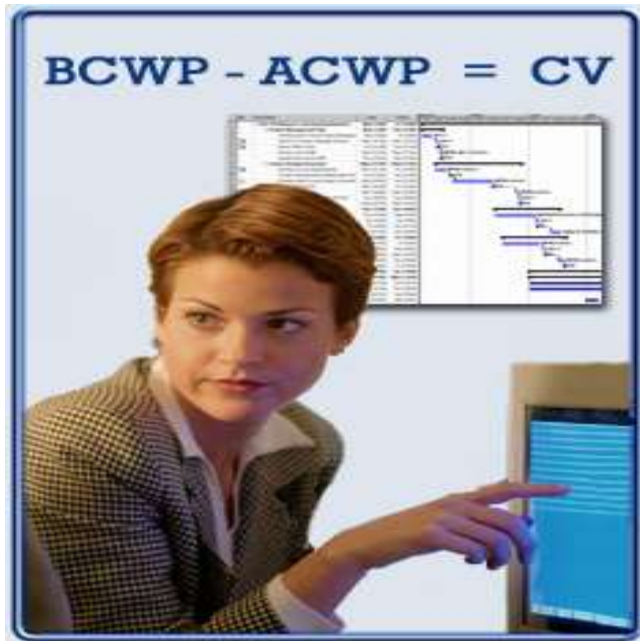
The Program Manager (PM) can use EV information to evaluate contract cost performance by examining the difference between the earned value of the work performed (BCWP) to date and the actual cost of the work performed (ACWP) to date. This difference is known as the **Cost Variance (CV)** (BCWP - ACWP). The CV value falls into one of three categories:

- **CV equals 0.** This usually means that the project is on budget.
- **CV greater than 0 (+CV).** This means that the cost of the work performed was less than originally estimated, so the project is under budget.
- **CV less than 0 (-CV).** This means that the cost of the work performed was more than originally estimated, so the project is over budget.
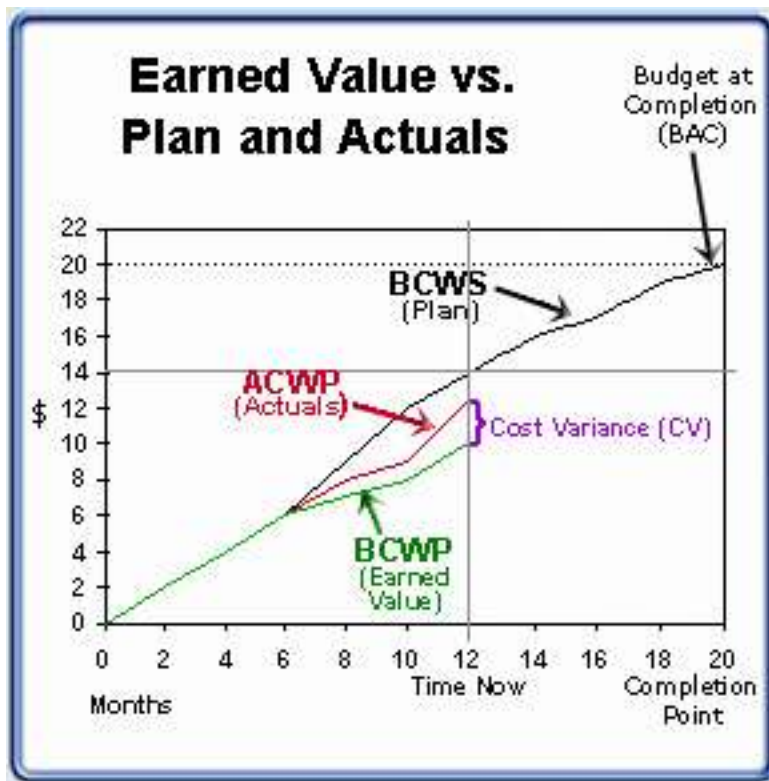
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Negative Cost Variance

Obviously, a negative cost variance should be of concern to the PM, as it may lead to contract cost overruns and the need for additional funds to finish the entire scope of work. A positive cost variance, on the other hand, can present an opportunity to free up funds currently obligated on the contract to meet other program needs.

Select the following hyperlink to access an example of negative cost variance.

Negative Cost Variance Example

In the example discussed earlier,

CV = BCWP ($10M) minus ACWP ($13M) = minus $3M, so the PM should be concerned about being over budget.

Long Description

Representation of the data in the example on this page and the previous page. Vertical axis is labeled "$M" and runs from 0 to 22. Horizontal axis is labeled "Months" and runs from 0 to 20 (the Completion Point). BCWS (Plan) is plotted at the current time of 12 months and $14M. Budget and Completion (BAC) is plotted at the end of the BCWS line at 20 months and $20M. The ACWP (Actuals) line plots below the BCWS line from about the 6 month mark, and at the current point in time plots at 12 months, $13M. The BCWP (Earned Value) line plots below both the BCWS and

ACWP lines from about the 6 month mark, and at the current point in time plots at 12 months, $10M. Cost Variance is marked as the difference between ACWP and BCWP currently, and is minus $3M.

Schedule Performance Index (SPI)

SPI = BCWP / BCWS

The Schedule Performance Index (SPI) is a measure of the contractor's schedule efficiency to date, and can be used to project future performance. SPI is calculated as the ratio of earned value (BCWP) to the plan (BCWS), or:

SPI = BCWP/BCWS.

The SPI value falls into one of these ranges:

- **SPI equals 1.** This means that the contractor is working at the originally planned efficiency (BCWP = BCWS).
- **SPI greater than 1.** This means that the contractor has been more efficient than originally planned (BCWP > BCWS). If performance continues at this SPI, the project may finish ahead of schedule, depending on the critical path.
- **SPI less than 1.** This means that the contractor has been less efficient than originally planned (BCWP < BCWS). If performance continues at this SPI, the project may finish behind schedule, depending on the critical path.

Select the following hyperlink to access an example of SPI.

SPI Example

For the example presented earlier in the lesson, the cumulative BCWP is 10 and the cumulative BCWS is 14. The cumulative SPI equals the cumulative BCWP divided by cumulative BCWS, or 10

divided by 14, which is 0.71. Since this is less than 1, the PM should be concerned about the contractor's apparent inefficiency with regard to schedule performance.

Cost Performance Index (CPI)

The Cost Performance Index (CPI) is a measure of the contractor's cost efficiency, and can be used to project future performance. CPI is calculated as the ratio of earned value (BCWP) to actual costs (ACWP), or:

CPI = BCWP divided by ACWP.

The CPI value falls into one of these ranges:

- **CPI equals 1**. This usually means that the contractor is working at the originally planned efficiency (BCWP = ACWP).
- **CPI greater than 1**. This means that the contractor has been more efficient than originally planned (BCWP > ACWP). If performance continues at this CPI, the project will finish under budget.
- **CPI less than 1**. This means that the contractor has been less efficient than originally planned (BCWP < ACWP). If performance continues at this CPI, the project will finish over budget.

Select the following hyperlink to access an example of CPI.

CPI Example

For the example presented earlier in the lesson, the cumulative BCWP is 10 and the cumulative ACWP is 13. The cumulative CPI equals the cumulative BCWP divided by cumulative ACWP, or 10 divided by 13, which is 0.77. This means that the contractor is accomplishing 77 cents worth of work for every dollar spent, the PM should be concerned about the contractor's apparent inefficiency with regard to cost performance.

Knowledge Review

The following Knowledge Review is a matching question. Select a letter associated with the answers below and type that letter in the space next to the best corresponding phrase or statement. Then, select the Submit button and feedback will appear.

Match the terms below with the appropriate concepts and formulas:

a. Schedule Variance (SV)   b. Cost Variance (CV)   c. Schedule Performance Index (SPI)   d. Cost Performance Index (CPI)

1. **Measure of contractor's cost efficiency that can be used to project future performance. Calculated as the ratio of earned value to actual costs, or *BCWP ÷ BCWS***
2. **Measure of contractor's cost efficiency that can be used to project future performance. Calculated as the ratio of earned value to actual costs, or *BCWP ÷ ACWP*.**
3. **Measure of contractor's schedule performance that is the difference between the earned value and the plan. Calculated as *BCWP − BCWS*.**
4. **Measure of contractor's cost performance that is the difference between the earned value and the actual cost. Calculated as *BCWP − ACWP*.**

Correct! Schedule Variance (SV)is a measure of contractor's schedule performance that is the difference between the earned value and the plan. SV is calculated as BCWP minus BCWS. Cost Variance (CV) is a measure of contractor's cost performance that is the difference between the earned value and the actual cost. CV is calculated as BCWP minus ACWP. Schedule Performance Index (SPI) is a measure of contractor's schedule efficiency that can be used to project future performance. SPI is calculated as a ratio of earned value to the plan, or BCWP divided by BCWS. Finally, Cost Performance Index (CPI) is a measure of contractor's cost efficiency that can be used to project future performance. CPI is calculated as a ratio of earned value to actual costs, or BCWP divided by ACWP.

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Estimate at Completion (EAC)
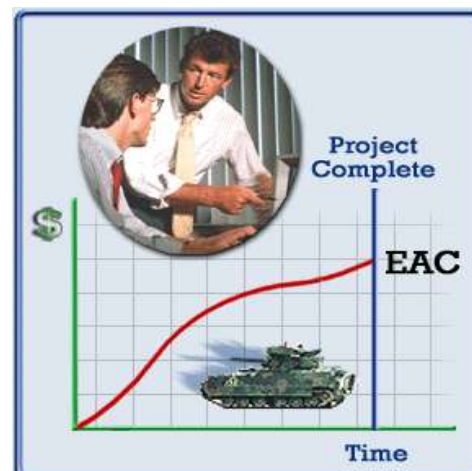
To determine whether a contract has sufficient funding to complete its desired scope, the PM must estimate what the total cost of the contract will be upon completion of all work. This is known as an **Estimate at Completion (EAC)**. The EAC is a key piece of required information in program reports such as the Defense Acquisition Executive Summary and Selected Acquisition Report, as well as in budget justification documents such as the R-3 Budget Exhibit (RDT&E Program Element / Project Breakdown). In program reports, PMs must usually report a "best case" (optimistic), "worst case" (pessimistic), and "most likely" EAC. The "most likely" EAC should fall between "best case" and "worst case" EACs.

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Estimate at Completion (EAC) Formulas

A common way of developing EACs is to use a formula that calculates the EAC based on the contractor's performance efficiency to date as measured by the Cost Performance Index (CPI) and Schedule Performance Index (SPI). "Best case" and "worst case" EACs are often developed using formulas such as those on the following pages. Keep in mind, in addition to your calculated EAC, the PM must consider the Risk associated with the remaining work and the schedule to accomplish the work.

CPI$_{cum}$Formula

$$EAC = \text{Actual Cost of work to date} + \frac{\text{remaining work}}{\text{Cost efficiency}}$$

$$EAC = ACWP_{cum} + \frac{(BAC - BCWP_{cum})}{CPI_{cum}}$$

$ACWP_{cum}$ = Cumulative Actual Cost of Work Performed

BAC = Budget at Completion (total Budget Cost of Work Scheduled at completion of work)

$BCWP_{cum}$ = Cumulative Budgeted Cost of Work Performed

CPI_{cum} = Cumulative Cost Performance Index

The CPI$_{cum}$ Formula shown in the figure above uses only the cumulative CPI as a factor in computing the EAC. This formula is often used to calculate the "best case" or "**floor**" EAC because analysis of numerous historical contracts shows that contracts almost never achieve a lower final cost if the computation is done after the contract is more than 20% complete.

Select the following hyperlink to access an example using the CPI$_{cum}$ formula.

Long Description

The CPIcum*SPIcum Formula is: EAC equals Actual Cost of work to date (ACWPcum) plus remaining work (BAC minus BCWPcum) divided by Cost efficiency times Schedule efficiency (CPIcum x SPIcum). In this formula, ACWPcum is the Cumulative Actual Cost of Work Performed. BAC is Budget at Completion, or the total Budgeted Cost of Work Scheduled at completion of contract. BCWPcum is the Cumulative Budgeted Cost of Work Performed. CPIcum is the Cumulative Cost Performance Index. Finally, SPIcum is the Cumulative Schedule Performance Index.

CPIcum Formula Example

In our example, where ACWPcum = $13M, BAC = Budget at Completion = $20M, BCWPcum = $10M, and CPIcum = 0.77, the EAC using the CPIcum formula would be $26M. The computation of this EAC is shown in the graphic below:

$$\text{"Best Case" EAC} = 13 + \frac{(20 - 10)}{0.77}$$
$$= 13 + \frac{10}{0.77}$$
$$= 13 + 13$$
$$= \$26M$$

CPI$_{cum}$ × SPI$_{cum}$ Formula

$$EAC = \text{Actual Cost of work to date} + \frac{\text{remaining work}}{\text{Cost efficiency}}$$

$$EAC = ACWP_{cum} + \frac{(BAC - BCWP_{cum})}{CPI_{cum} \times SPI_{cum}}$$

$ACWP_{cum}$ = Cumulative Actual Cost of Work Performed

BAC = Budget at Completion (total Budget Cost of Work Scheduled at completion of work)

$BCWP_{cum}$ = Cumulative Budgeted Cost of Work Performed

CPI_{cum} = Cumulative Cost Performance Index

SPI_{cum} = Cumulative Schedule Performance Index

The CPI$_{cum}$ × SPI$_{cum}$ Formula shown above uses both the cumulative CPI and the cumulative SPI to compute the EAC. This formula is used when there is reason to believe that schedule performance will also impact cost performance. It is also often used to calculate the "worst case" EAC because when both performance indices are less than one, multiplying them together results in an even smaller divisor, and therefore a higher estimate of the cost of remaining work.

Select the following hyperlink to access an example using the CPI$_{cum}$ × SPI$_{cum}$ formula.

CPIcum*SPIcum Formula Example

For the example presented previously, where ACWPcum = $13M, BAC = Budget at Completion = $20M, BCWPcum = $10M, CPIcum = 0.77, and SPIcum = 0.71, the EAC using the CPIcum*SPIcum formula would be $31.3M. The computation is shown in the graphic below:

"Worst Case" EAC $= 13 + \dfrac{(20 - 10)}{0.77 \times 0.71}$

$= 13 + \dfrac{10}{0.547}$

$= 13 + 18.3$

$= \$31.3M$

Long Description

"Worst case" EAC equals 13 plus, 20 minus 10 divided by 0.77 times 0.71. Continuing the calculation, this equals 13, plus 10 divided by 0.547, or 13 plus 18.3, or $31.3M.

'Most Likely' EAC (1 of 3)
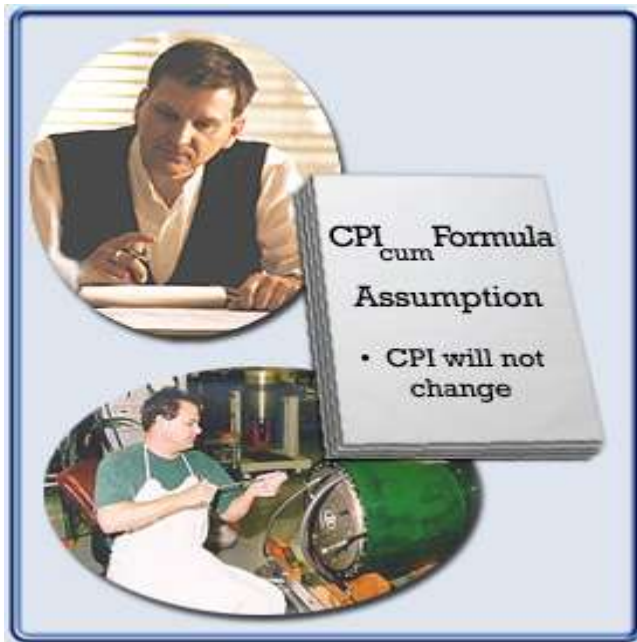
PMs should develop an EAC that is based on the conditions most likely to prevail during contract performance. While a formula can be used as the basis for developing a "most likely" EAC, PMs should be careful to consider the formula's underlying assumptions before accepting the formula's output as the PM's EAC.

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'Most Likely' EAC (2 of 3)

For example, the CPI_{cum} Formula assumes that the schedule efficiency has no effect on cost and that the contractor will continue to perform at the same efficiency for the remaining portion of the contract. However, the contractor may have made management or process improvements that are likely to boost performance efficiency over the remainder of the contract. On the other hand, it is possible that the remaining work on the contract is particularly risky, making it likely that the contractor's future efficiency will be lower than experienced to date.

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'Most Likely' EAC (3 of 3)

Therefore, rather than depending purely on formulas, PMs usually develop their own methodologies to build up their "most likely" EAC, taking into consideration the contractor's performance to date, management efforts to improve performance, and risks associated with the remaining work.

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Knowledge Review

The following Knowledge Review allows for multiple correct answers. Select one or more answers that best correspond, then select the Submit button and feedback will appear.

In program reports, Program Managers must usually report:

a. "Best case" (optimistic) EAC

b. "Worst case" (pessimistic) EAC

c. Optimal EAC

d. "Most likely" EAC

Correct.

In program reports, Project Managers must usually report a "best case" (optimistic), "worst case" (pessimistic), and "most likely" EAC.

Knowledge Review

The following Knowledge Review is a matching question. Select a letter associated with the answers below and type that letter in the space next to the best corresponding phrase or statement. Then, select the Submit button and feedback will appear.

Match the following formulas with their descriptions:

1. Is often used to calculate the "best case" or "floor" EAC.

2. Is often used to calculate the "worst case" EAC.

a. CPI_{cum} formula

b. $CPI_{cum}*SPI_{cum}$ formula

Correct!

The CPI_{cum} formula is often used to calculate the "best case" or "floor" EAC, while the $CPI_{cum}*SPI_{cum}$ formula is often used to calculate the "worst case" EAC."

Knowledge Review

The following Knowledge Review is a multiple choice question. Only one answer is correct; select the best answer and feedback will immediately appear.

In developing a "most likely" EAC, a PM should do all of the following EXCEPT:

a. Take into consideration the contractor's performance to date, management efforts to improve performance, and risks associated with the remaining work.

b. Rely strictly on numeric formulas in developing their "most likely" EAC.

c. Develop an EAC that is based on the conditions most likely to prevail during contract performance.

d. Consider developing their own methodologies to build up their "most likely" EAC.

Correct!

Only statement b does not apply to development of a "most likely" EAC." While a formula can be used as the basis for developing a "most likely" EAC, PMs should carefully consider the formula's underlying assumptions before accepting the formula's output as the PM's EAC.

Using EV Information in Budget Formulation

Programs that collect earned value information on their contracts can use this information in building their future program budgets and in assessing the adequacy of their current program budget. Contract Performance Reports (CPRs) provide cost data that the program office can use to calculate its own Estimate at Completion (EAC). The contractor will also report its EAC on the CPR.

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Adding Profit or Fee to EAC
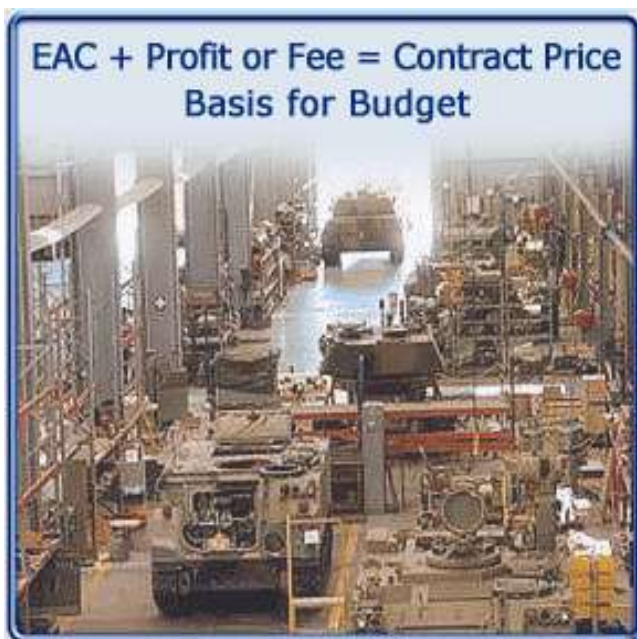
It is important to note that EACs do not include the contractor's profit or fee. However, the government's budget for the contract must certainly account for this. Therefore, in determining the budgeting requirement for a contract, an appropriate amount of fee or profit must be added to the estimated cost (EAC) to determine a revised estimate of the total contract price. The revised contract price estimate can then be used as the basis for adjusting budget requests as necessary to account for contract overruns or underruns.

Evaluating Schedule Slip
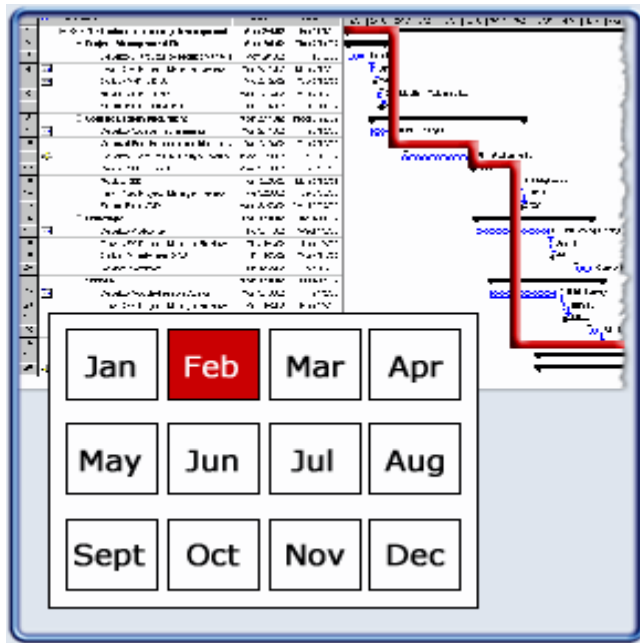
The EV data provided in the CPR should also be examined for indications of possible schedule slip. Negative schedule variances should be investigated in light of the critical path to determine the probability and magnitude of any projected schedule slip so that the timing and/or amount of budget requests can be adjusted appropriately.

Knowledge Review

The following Knowledge Review is a True or False question. Select the best answer and feedback will immediately appear.

The Estimate at Completion (EAC) should include profit or fee information.

a. True

b. False

Correct!

EACs do NOT include the contractor's profit or fee. Therefore, in determining the budgeting requirement for a contract, an appropriate amount of fee or profit must be added to the estimated cost (EAC) to determine a revised estimate of the total contract price.

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Knowledge Review

The following Knowledge Reviews are multiple choice questions, based on the scenario below. Only one answer is correct; select the best answer and feedback will immediately appear.

How much would the program have been permitted to budget for this contract at contract award?

Open Calculator

Scenario

You are a budget analyst for the Starburst Missile Defense Program in August 2002. You are to provide the new Program Manager, Colonel Grayhehr with a report on the funding status of the Barracuda Industries contract. This is a Cost Plus Fixed Fee (CPFF) RDT&E contract that was awarded in April 2001. Contract performance began 16 months ago and is scheduled to be completed in July 2003. The contract has the following characteristics: Estimated Cost = $20M and Fixed Fee = $3M. The most recent EVM data (through end of June 2002) shows BAC = $20M, BCWP = $9M, BCWS = $12M, ACWP = $10M, $CPI_{cum} = 0.90$, and $SPI_{cum} = 0.75$.

a. $12M

b. $20M

c. $23M

d. $25M

Correct!

You should budget for the most probable price of the contract. For a CPFF contract, this would be Estimated Cost ($20 million) + Fixed Fee ($3 million) = $23 million.

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Knowledge Review

What is the BEST (most optimistic) Estimate at Completion (EAC) for this contract?

EAC Formulas   Open Calculator

Scenario

You are a budget analyst for the Starburst Missile Defense Program. Time now is August 2002. You have been assigned to provide the new Program Manager, Colonel Grayhehr with a report on the

funding status of the Barracuda Industries contract. This is a Cost Plus Fixed Fee (CPFF) RDT&E contract that was awarded in April 2001. Contract performance began 16 months ago and is scheduled to be completed in July 2003. The contract has the following characteristics: Estimated Cost = $20 million and Fixed Fee = $3 million. The most recent EVM data (through end of June 2002) shows BAC = $20M, BCWP = $ 9M, BCWS = $12M, ACWP = $10M, CPI_{cum} = 0.90, and SPI_{cum} = 0.75.

a. $20.0M

b. $22.2M

c. $26.3M

d. $26.7M

Correct!

EAC_{best} is calculated as: ACWP + (BAC - BCWP)/CPI_{cum} = EAC_{best}

or $10 million + ($20 million - $9 million)/0.90 = $22.2 million.

EAC Formulas

EAC=Actual Cost of work to date + remaining work/ Cost Efficiency

EAC=ACWPcum + (BAC-BCWPcum)/ CPIcum

EAC=Actual Cost of work to date + remaining work/ Cost Efficiency

EAC=ACWPcum + (BAC-BCWPcum)/ CPIcum X SPIcum

 ACWPcum = Cumulative Actual Cost of Work Performed

BAC = Budget at Completion (total Budget Cost of Work Schedule at completion of work)

BCWPcum = Cumulative Budgeted Cost Performance Index

Knowledge Review

What is the WORST (most pessimistic) Estimate at Completion (EAC) for this contract?
EAC Formulas   Open Calculator

Scenario

You are a budget analyst for the Starburst Missile Defense Program. Time now is August 2002. You have been assigned to provide the new Program Manager, Colonel Grayhehr with a report on the funding status of the Barracuda Industries contract. This is a Cost Plus Fixed Fee (CPFF) RDT&E contract that was awarded in April 2001. Contract performance began 16 months ago and is scheduled to be completed in July 2003. The contract has the following characteristics: Estimated Cost = $20 million and Fixed Fee = $3 million. The most recent EVM data (through end of June 2002) shows BAC = $20M, BCWP = $ 9M, BCWS = $12M, ACWP = $10M, CPI_{cum} = 0.90, and SPI_{cum} = 0.75.

a. $20.0M

b. $22.2M

c. $26.3M

d. $26.7M

Correct!

*EAC_{worst} is calculated as: ACWP + (BAC - BCWP)/(CPI_{cum}*SPI_{cum}) = EAC_{worst}*

*or $10 million + ($20 million - $9 million)/(0.90*0.75) = $26.30 million.*

Knowledge Review

Assuming that the "most likely" Estimate at Completion (EAC) for this contract is $24.5M, how much should the total budget for this contract now be? Open Calculator

Scenario

You are a budget analyst for the Starburst Missile Defense Program. Time now is August 2002. You have been assigned to provide the new Program Manager, Colonel Grayhehr with a report on the funding status of the Barracuda Industries contract. This is a Cost Plus Fixed Fee (CPFF) RDT&E contract that was awarded in April 2001. Contract performance began 16 months ago and is scheduled to be completed in July 2003. The contract has the following characteristics: Estimated Cost = $20M and Fixed Fee = $3M. The most recent EVM data (through end of June 2002) shows BAC = $20M, BCWP = $ 9M, BCWS = $12M, ACWP = $10M, CPI_{cum} = 0.90, and SPI_{cum} = 0.75.

    a. $24.5M
    b. $25.2M
    c. $26.3M
    d. $27.5M

Correct!

You should budget to the most probable price of the contract as follows: Most Likely EAC ($24.5 million) + Fixed Fee ($3 million) = Estimated Price at Completion ($27.5 million).

Lesson Summary (1 of 5)

Congratulations! You have completed the Earned Value Lesson. The following topics were presented in this lesson:

- Earned Value Management:
  - Relates the scope of the work to its associated budgets and schedule.
  - Measures the work progress in objective terms.
  - States the value of the work completed in dollars, or other measurable units.
  - Allows the Program Manager (PM) to manage risk through early identification of contract performance issues.
- EV information is obtained from contractors through deliverables:
  - Contract Performance Report (CPR). Using as many as five report formats, CPR reporting is usually reserved for relatively high-risk contracts.
  - Integrated Master Schedule (IMS).
  - Both the CPR and IMS are required for cost or incentive contracts (i.e., non-Firm-Fixed-Price) subcontracts, intra-government work agreements, and other agreements valued at or greater than $20 million in then-year dollars.

Lesson Summary (2 of 5)

The following topics were also presented in this lesson:

- Budgeted Cost of Work Scheduled (BCWS) is the cumulative amount budgeted for work by a given date, or the budgeted value of work planned.
- Budgeted Cost of Work Performed (BCWP), or Earned Value (EV), is the sum of the amount budgeted for the tasks accomplished to date.
- Actual Cost of Work Performed (ACWP) is the actual costs incurred in accomplishing the tasks completed to date(EV).
- Budget at Completion (BAC) is total budgeted value of the work planned through the end of the project.

Lesson Summary (3 of 5)

The following topics were also presented in this lesson:

- Schedule Variance (SV) is the difference between BCWP and BCWS. A negative SV means that less work was accomplished than originally planned, so the project is potentially behind schedule.
  - Negative schedule variances should be investigated in light of the critical path to determine the probability and magnitude of any projected schedule slip.
- Cost Variance (CV) is the difference between BCWP and ACWP. A negative CV means that the cost of the work performed was more than originally estimated, so the project is over budget.
- Schedule Performance Index (SPI) is a performance factor metric of the contractor's schedule efficiency to date, and is calculated as SPI = BCWP/BCWS. An SPI of less than 1 means that the contractor has been less efficient than planned.
- Cost Performance Index (CPI) is performance factor metric of the contractor's cost efficiency, and is calculated as CPI = BCWP/ACWP. A CPI of less than 1 means that the contractor has been less efficient than originally planned.

Lesson Summary (4 of 5)

The following topics were also presented:

- Estimate at Completion (EAC) is the PM's estimate of what the total cost of the contract will be upon completion of all work. In program reports, PMs must usually report a "best case" (optimistic), "worst case" (pessimistic), and "most likely" EAC.
- The CPIcum Formula is often used to calculate the "best case" or "floor" EAC:

  $EAC = ACWP_{cum} + (BAC - BCWP_{cum})/CPI_{cum}$.
- The $CPI_{cum} \times SPI_{cum}$ Formula is used when there is reason to believe that schedule performance will also impact cost performance. For projects that are behind schedule, it is often used to calculate the "worst case" EAC:

  $EAC = ACWP_{cum} + (BAC - BCWP_{cum})/(CPI_{cum} \times SPI_{cum})$.
- A PM's "most likely" EAC usually is not based solely on a formula, and often takes into consideration contractor performance, management efforts to improve performance, and risks associated with the remaining work.

Lesson Summary (5 of 5)

Finally, the following topic was also presented in this module:

- Using EV information in budgeting: The program office should use EV data to update its budget estimates. Keep in mind that EAC does not include the contractor's profit or fee; an appropriate amount must be added to the estimated cost (EAC) to determine the revised contract price estimate. This price provides the basis for a revised budget request.

This page completes the lesson. Select a lesson from the Table of Contents to continue.