Estimating Cost at Completion - Judgment & EV Information

Cost estimating is often called a "black art" and, too often, estimates are structured to fit some predetermined idea of a number that is politically salable. When ranges of estimates are prepared, opponents of the program tend to focus on the high end while proponents want to look at the low end. In the final analysis, most cost estimates are "products of management judgment". They are affected by political considerations, budgetary considerations, important upcoming events, such as technical reviews, and other factors. There is also the feeling that more/better information will be available next month or next quarter, so perhaps the estimate update should wait until then.

Advocates of Earned Value Management have been accused of concentrating too much on historical information while the program manager, company management and the customer are more interested in what lies ahead and what the final cost will be. However, to figure out what the cost will be at completion requires an evaluation of the work remaining, and to determine how much work is remaining requires a solid understanding of where the program is now. Earned Value Management provides that essential information because earned value represents the amount of work accomplished in terms of the overall program target. Subtracting earned value from the program target cost reveals the budget value of the work remaining.

At the conclusion of this lesson, you will be able to estimate the cost to complete a project using earned value data.

Assumptions & Baseline Achievement

All estimating is based on assumptions. If the assumption is that this program is just like the last program, historical data provides the estimate. If it is similar, but more complex, a complexity factor can be applied to make the estimate more realistic.

The Earned Value Management baseline represents the plan for doing the program and considerable effort is expended to make it a meaningful, workable plan. It is updated as the program moves along to incorporate changes in scope or direction, and revised to compensate for problems experienced along the way.

Assuming that the baseline validity is maintained, a reasonable estimate of cost at completion can be derived by simply adding the baseline budget for work remaining to the actual costs to date or by adding the cumulative cost variance to the program target cost. **Figure 11-1** (next page) illustrates this approach.

NOTE: The DAU Gold Card, available in the Course Library, provides a handy quick reference to many EVM terms and EVM metrics. It may be helpful to print the Gold Card.

DAU Gold Card Translation:

(translates the word picture into mathematical formulas)

EAC = ACWP cum + Work Remaining
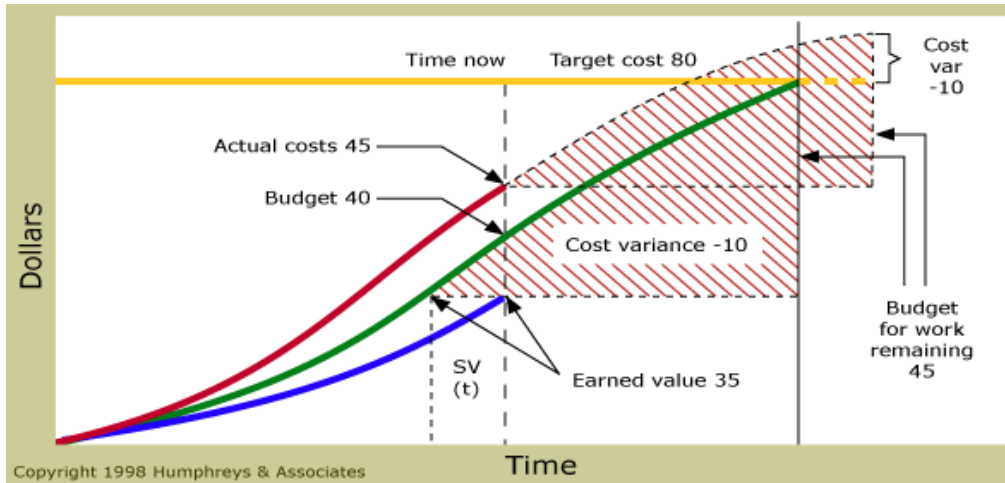
or

EAC = ACWP cum + (BAC - BCWP cum)

This calculation implies the assumption that all remaining work will be accomplished as planned (at 100% efficiency or CPI = 1.0).

Figure 11-1: Estimate Based on Baseline Achievement

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Figure 11-1 shows how an estimate based on the baseline achievement, (if baseline validity is maintained), can be derived, by either adding the baseline budget for work remaining to the actual costs to date, or by adding the cumulative cost variance to the program target cost.
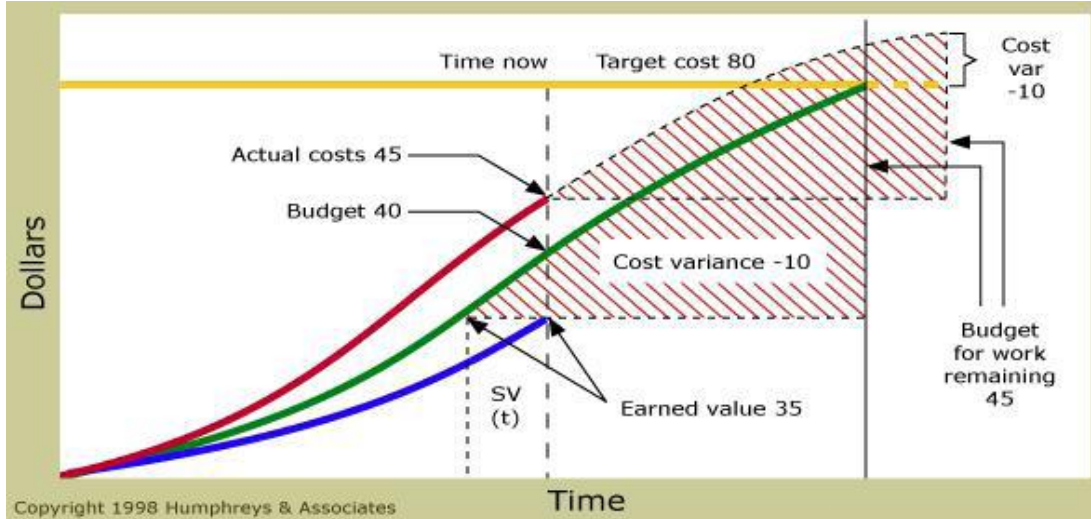
Cost Performance Index (CPI)

Figure 11-1: Estimate Based on Baseline Achievement (previous page) showed how the target cost (80) minus earned value (35) equals the budget for work remaining (45). Actual costs (45) plus the budget for work remaining (45) equals the estimate at completion (90). Since the current cost variance is -10, if the plan is achieved, the cost variance will not change and when added to the target cost, also provides an estimate at completion of 90; target cost (80) plus the cost variance (10).

If, however, the program has been overrunning, using the baseline plan from now to completion represents improved performance, and an explanation should be provided as to how this improvement will be achieved. Studies of hundreds of programs have revealed that program performance does not tend to improve. In fact, once a program passes the 15% - 20% completion point, performance almost never surpasses the average performance to date, and often gets worse. Average performance to date can be easily calculated by dividing the cumulative earned value by the cumulative actual costs. The resultant value is called the Cost Performance Index (CPI) and a number less than 1 reflects unfavorable cost performance. For example, a CPI of 0.85 means that for every dollar spent, only 85 cents worth of work is getting done. Dividing the program target cost by the CPI of 0.85 will provide a cost estimate that reflects a continuation of performance to date to the end of the program. Program managers, in reports to senior management, should be asked to explain any estimate lower than that derived using the CPI approach. **Figure 11-2** illustrates this CPI technique on the next page.

Figure 11-1

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Cost Performance Index (CPI)

The average cost efficiency with which work has been performed. The CPI is computed by dividing the earned value by the actual costs.

CPI = BCWP / ACWP

DAU Gold Card Translation:
(translates the word pictures into mathmatical formulas)

CPI cumulative Method $EAC = ACWP\ cum + \dfrac{(BAC - BCWP\ cum)}{CPI\ cum}$

or

$EAC = BAC / CPI\ cum$

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This calculation implies the assumption that all future work will be accomplished at the same level of efficiency (Cost Performance Index) as all the work that has already been performed to date.

Long Description

Formula for calculating EAC. The EAC equals the BAC divided by the CPI cumulative. The CPI cumulative equals the ACWP cumulative plus the quantity BAC minus BCWP cumulative divided by the CPI cumulative.

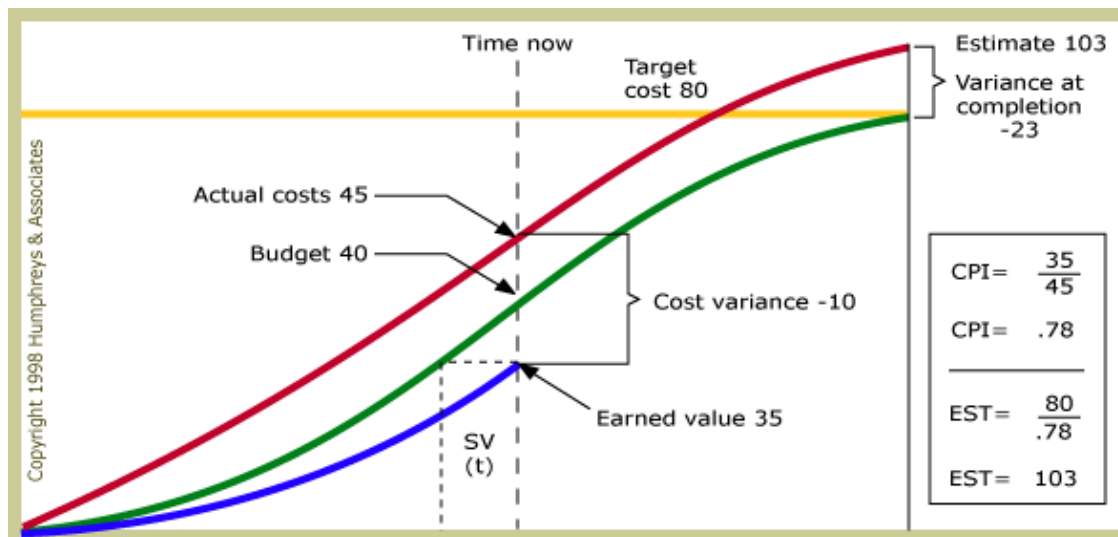## Figure 11-2: Estimate Based on Continuance of Actual Performance

Figure 11-2 illustrates an estimate based on the Continuance of Actual Performance.

Long Description

Figure 11-2: Estimate Based on Continuance of Actual Performance is the same graph as Fig 11-1, with the addition of the CPI and EST calculations. CPI = 35/45 or .78; and EST = 80/.78 or 103. Also the difference between the final actual cost curve and the target cost of the budget curve shows a variance at completion of -23.

CPI vs. Combined Cost and Schedule Performance

Figure 11-2 (previous page) illustrates the CPI technique where the earned value (35) is divided by the actual costs (45) to produce a CPI (0.78). Dividing the target cost (80) by the CPI (0.78) results in an estimate for the program of 103. This approach is simply a linear extrapolation and does not take schedule projections into consideration. In essence, it assumes that if the program is 29% overrun today, it will be 29% overrun at completion. If desired, a CPI can be calculated for a recent period of performance (e.g., last 6 months) if there is reason to believe it would produce a higher quality estimate.

If dividing earned value by actual costs provides a cost performance index, then dividing earned value (35) by the cumulative budget (40) provides a schedule performance index (SPI) (0.88). If the program is not only overrunning cost, but is also behind schedule, additional cost impact can be expected either due to potential schedule slippage or from acceleration of the effort to finish on time; both alternatives cost money. Multiplying the CPI (0.78) by the SPI (0.88) provides a composite index (0.69) that can be applied to the budget for work remaining (45 divided by 0.69 equals 65) and added to the actual costs (45) to produce yet another estimate (110). **Figure 11-3** (next page) illustrates this concept.

This calculation implies the assumption that all future work will be accomplished at the same level of efficiency (Cost Performance Index) as all the work that has already been performed to date.

Long Description

Formula for calculating EAC: The EAC equals the BAC divided by the CPI cumulative. The CPI cumulative equals the ACWP cumulative plus the quantity BAC minus BCWP cumulative divided by the CPI cumulative.

(SPI)

SPI or Schedule Performance Index reflects the efficiency scheduled effort is being accomplished based on the plan. The SPI is computed by dividing the earned value by the budgeted cost for work scheduled (BCWS).

$SPI = BCWP / BCWS$

Composite Index

Long Description

Three formulas: First is EAC equals the Actuals to date plus the quantity Work Remaining divided by the Composite Index. The second is Budgeted work remaining equals Target minus BCWP cummulative. The third is Composite EAC equals ACWP cummulative plus the quantity BAC minus BCWP cummulative divided by the product of CPI cummulative and SPI cummulative.

Figure 11-3: Estimate Based on Combined Cost and Schedule Performance
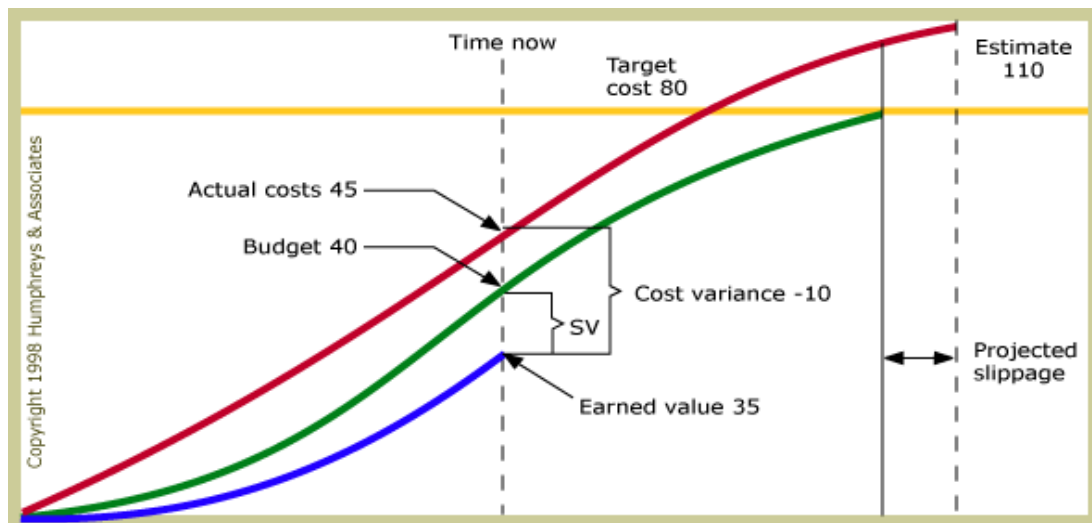

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Figure 11-3 illustrates an estimate based on the combined cost and schedule performance.

Long Description

Figure 11-3: Estimate Based on Combined Cost and Schedule Performance is the same graph used in Figure 11-2, with the final actual cost projected out to 110. The vertical area on the graph between the end of the budget curve and the actual cost curve is labeled Projected slippage.

EAC Calculations and Assumptions

Thus a range of estimates (90, 103, 110) can be derived quickly and easily from the Earned Value Management data elements of budget, earned value and actual costs. These estimates should not be used as the final cost estimates, but as a sanity check for cost estimates derived through other methods, such as engineering estimates, grass roots estimates, parametric estimates, other statistical estimates, and estimates based on management experience.

The following presentation is an essential supplement to the above discussion of EAC calculations: EAC Calculations & Assumptions (Click the link to download the PowerPoint file or access a narrated version of this presentation from the following web site; Estimate at Completion) We strongly recommend that you review this presentation before attempting the EAC-related questions in the Knowledge Review and Final Exam.

At least annually, the contractor should perform a comprehensive estimate of cost at completion using a variety of estimating techniques. This estimate is needed in support of business base projections, the annual financial plan, and baseline revisions and cash flow management. The statistical techniques described above are used to update the estimate as time passes and as a cross-check against unrealistic projections.

Estimate at Completion Knowledge Review

Given the following program data,

CPR Data June 2000 and Schedule Data June 2000
BCWS = $82.2M. Overall schedule slip of 8 months
BCWP = $70.5M and Critical path impact milestone 5 months slip
ACWP = $95.4M
BAC = $105.5M

Select the answer that reflects your calculated EAC (answers are approximate).

○ $105M

◉ $145M

○ $95.4M

○ $185M

Corrrect.

End of Lesson

You must click the **Next** button in order to receive credit for this lesson.