Analysis of Earned Value Data

In Depth Training for EV Analysts

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ASC/FMCE
Questions to be Answered

PAST
Are we on schedule?
Are we on cost?
What are the significant variances?
Why do we have variances?
Who is responsible?
What is the trend to date?

PRESENT

FUTURE
When will we finish?
What will it cost at the end?
How can we control the trend?

We analyze the past performance..........to help us control the future
Analysis Roadmap

- Validity check of data
- Calculate variances
  - focus on significant variances
  - current or cumulative
- Graph and analyze trends
- Look at comparative data
- Analysis of schedule trends, critical path
- Examine written analysis by contractor
- Look at work remaining versus risk in project
- Solicit input from IPTs
- Assess realism of contractor’s EAC
- Calculate independent EAC
- Formulate plan of action

what are the drivers?
what can we do about them?
Validity Check of Data

• Elements on report should total properly
  – Total BAC should equal CBB (compare to contract)
  – Format 1 totals should match Format 2 totals
  – Refer to AFMCPAM 65-501 for further checklists
• Are variances that meet the reporting threshold explained in Format 5?
• For any element:
  – Is any negative data entered for BCWS, BCWP, ACWP?
    • should be explained in Format 5
    • no negative data can be entered for BAC or LRE
  – Does ACWP exceed LRE? (should not)
  – If 100% complete, does LRE equal ACWP? (should)
  – Does BCWP or BCWS exceed BAC? (should not)
  – Is BAC or LRE equal 0? (should not)
  – Did BAC or LRE change from prior month?
    • if significant, look for explanation
Variance Calculation
Types of Variances

• Values can be expressed as either current period or cumulative
  – current tends to be more volatile
  – use cum data to show trends
• Easy rule of thumb:
  negative value = BAD     positive value = GOOD
  index < 1.0 = BAD       index > 1.0 = GOOD
• Absolute
  – expressed in terms of dollars or hours (e.g., -$1,000)
  – may not be able to tell significance from this amount
• Percent
  – relates absolute variance to a base (e.g., -35%)
  – shows significance
• Index
  – compares one value to another in a simple ratio
  – if you are on plan, index = 1.00
Sample Data to Analyze

Cumulative data

<table>
<thead>
<tr>
<th></th>
<th>BCWS</th>
<th>BCWP</th>
<th>ACWP</th>
<th>BAC</th>
<th>EAC</th>
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</thead>
<tbody>
<tr>
<td>Computer</td>
<td>2,000</td>
<td>1,800</td>
<td>1,900</td>
<td>4,000</td>
<td>4,500</td>
</tr>
<tr>
<td>Radar</td>
<td>230</td>
<td>155</td>
<td>195</td>
<td>240</td>
<td>195</td>
</tr>
<tr>
<td>FLIR</td>
<td>550</td>
<td>750</td>
<td>690</td>
<td>1,000</td>
<td>1,500</td>
</tr>
<tr>
<td>Total</td>
<td>2,780</td>
<td>2,705</td>
<td>2,785</td>
<td>5,240</td>
<td>6,195</td>
</tr>
</tbody>
</table>
Schedule Variance ($)

**SCHEDULE VARIANCE** is the difference between work scheduled and work performed (expressed in terms of budget dollars)

**formula:** \[ SV \$ = BCWP - BCWS \]

**example:**

\[ SV = BCWP - BCWS = \$1,800 - \$2,000 \]

\[ SV = -\$200 \] (negative = behind schedule)

The computer has a schedule variance of -$200
Schedule Variance (%)

Convert SCHEDULE VARIANCE to a percentage

formula: \[ SV\% = \frac{BCWP - BCWS}{BCWS} = \frac{SV\$}{BCWS} \]

example: \[ SV\% = \frac{-200}{2,000} = -10\% \]

The computer has a schedule variance of -$200, which equates to -10%
Cost Variance ($)

Cost Variance is the difference between budgeted cost and actual cost

**formula:** \[ CV \$ = BCWP - ACWP \]

**example:**
\[ CV = BCWP - ACWP = $1,800 - $1,900 \]
\[ CV = -$100 \] (negative = cost overrun)

The computer has a cost variance of $-100
Cost Variance (%)

Convert COST VARIANCE to a percentage:

formula: \[ CV\% = \frac{BCWP - ACWP}{BCWP} = \frac{CV\ $}{BCWP} \]

equation: \[ CV\% = \frac{-100}{1,800} = -6\% \]

The computer has a cost variance of $-100, which equates to -6%
Price vs. Usage

• In elements with a significant amount of recurring material, contractor should break CV $ into price vs. usage variance

• problem: I used 10 more widgets than I planned on (58 - 68), and spent $30 more per unit than planned ($300 - $330)

• Price variance = (price difference)*(actual number of units)
  = -$30 * 68 = -$2,040

• Usage variance = (usage difference)*(original price)
  = -10 * $300 = -$3,000

• Total cost variance = -$2,040 + -$3,000 = -$5,040

may also perform similar analysis for labor (labor rate vs. hours) or for overhead (rate vs. volume)
Variance at Completion (VAC) ($)

BAC
what the total job is supposed to cost

EAC
what the total job is expected to cost

VARIANCE AT COMPLETION is the difference between what the total job is supposed to cost and what the total job is now expected to cost.

FORMULA: \[ VAC \, \$ = BAC - EAC \]

Example: \[ VAC \, \$ = $4,000 - $4,500 \]
\[ VAC \, \$ = -$500 \] (negative = projected overrun)
Variance at Completion (VAC) (%)

Convert VARIANCE AT COMPLETION to a percentage:

FORMULA: \[ VAC \% = \frac{BAC - EAC}{BAC} = \frac{VAC}{BAC} \]

Example: \[ VAC \% = \frac{-500}{4,000} = -13\% \]

The computer has a VAC of -$500, which equates to -13%
Management Reserve (MR)

• If you expect the contractor to use all MR before the end of the contract:
  – add MR to BAC when calculating % complete, % spent, % scheduled
  – add MR to BAC when calculating statistical EACs
  – if you add it, **be consistent** and add to all formulas
A special note about Indirects

- Typically, indirect loads (overheads, Gen & Admin, COM) make up 40 - 50% of a contract’s cost
- To ignore the impact of these rates would be foolhardy
- Understand the business assumptions that go into these rates
- Have contractor perform rate vs. volume analysis
  - example:
    - Manufacturing overhead total CV:  \(-$3,200K\)
    - impact due to actual rate:  \(-$ 500K\)
    - impact due to volume (loss of commercial business):  \(-$2,700K\)
- Have DCMC analyst support you with analysis of indirect variances
- Assess impact of future rate changes on outyear costs
Performance Indices

COST PERF INDEX (CPI) = $\frac{BCWP}{ACWP}$

SCHED PERF INDEX (SPI) = $\frac{BCWP}{BCWS}$

"GOOD"

"BAD"

TIME

CPI

SPI
Sample Data Indices

CPI = $1,800 \div $1,900 = 0.95

SPI = $1,800 \div $2,000 = 0.90
Where are the significant variances?

<table>
<thead>
<tr>
<th></th>
<th>BCWS</th>
<th>BCWP</th>
<th>ACWP</th>
<th>SV</th>
<th>SV%</th>
<th>SPI</th>
<th>CV</th>
<th>CV%</th>
<th>CPI</th>
<th>BAC</th>
<th>EAC</th>
<th>VAC</th>
<th>VAC %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer</td>
<td>2,000</td>
<td>1,800</td>
<td>1,900</td>
<td>(200)</td>
<td>-10%</td>
<td>0.900</td>
<td>(100)</td>
<td>-6%</td>
<td>0.947</td>
<td>4,000</td>
<td>4,500</td>
<td>(500)</td>
<td>-13%</td>
</tr>
<tr>
<td>Radar</td>
<td>230</td>
<td>155</td>
<td>195</td>
<td>(75)</td>
<td>-33%</td>
<td>0.674</td>
<td>(40)</td>
<td>-26%</td>
<td>0.795</td>
<td>240</td>
<td>195</td>
<td>45</td>
<td>19%</td>
</tr>
<tr>
<td>FLIR</td>
<td>550</td>
<td>750</td>
<td>690</td>
<td>200</td>
<td>36%</td>
<td>1.364</td>
<td>60</td>
<td>8%</td>
<td>1.087</td>
<td>1,000</td>
<td>1,500</td>
<td>(500)</td>
<td>-50%</td>
</tr>
<tr>
<td>Total</td>
<td>2,780</td>
<td>2,705</td>
<td>2,785</td>
<td>(75)</td>
<td>-3%</td>
<td>0.973</td>
<td>(80)</td>
<td>-3%</td>
<td>0.971</td>
<td>5,240</td>
<td>6,195</td>
<td>(955)</td>
<td>-18%</td>
</tr>
</tbody>
</table>

Worst SV ($) : computer
Worst SV (%) : radar
Worst CV ($) : computer
Worst CV (%) : radar
Worst VAC ($) : computer, FLIR
Worst VAC (%) : FLIR
## Sorting on Variances

Analysis software tools (e.g. wInsight or Performance Analyzer) allow you to quickly sort on any column and spot the significant problems.

<table>
<thead>
<tr>
<th>WBS</th>
<th>DESCRIPTION</th>
<th>Proj Ofcr</th>
<th>%Comp</th>
<th>%Spent</th>
<th>CPI</th>
<th>CV</th>
<th>CV %</th>
<th>VAC</th>
<th>VAC %</th>
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<tbody>
<tr>
<td>1</td>
<td>3600 PCC</td>
<td>Zepka</td>
<td>28.99</td>
<td>34.09</td>
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<td>-296.2</td>
<td>↔</td>
<td>-187.2</td>
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<td>2</td>
<td>3200 COMMUNICATIONS</td>
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<td>34.63</td>
<td>41.03</td>
<td>0.844</td>
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<td>-130.8</td>
<td>-18.49</td>
<td>↔</td>
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<tr>
<td>3</td>
<td>G&amp;A GEN &amp; ADMIN</td>
<td>Price</td>
<td>33.67</td>
<td>36.11</td>
<td>0.932</td>
<td>↓</td>
<td>-45.2</td>
<td>-7.26</td>
<td>↔</td>
</tr>
<tr>
<td>4</td>
<td>2200 SYS ENGINEERING</td>
<td>Brown</td>
<td>85.04</td>
<td>94.35</td>
<td>0.901</td>
<td>↓</td>
<td>-26.4</td>
<td>-10.95</td>
<td>↔</td>
</tr>
<tr>
<td>5</td>
<td>3800 I &amp; A</td>
<td>Troop</td>
<td>35.40</td>
<td>37.08</td>
<td>0.955</td>
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<td>-4.75</td>
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<td>45.70</td>
<td>48.51</td>
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<tr>
<td>7</td>
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<td>Price</td>
<td>71.62</td>
<td>75.23</td>
<td>0.952</td>
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<td>-17.4</td>
<td>-5.03</td>
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<tr>
<td>8</td>
<td>5200 MANAGEMENT DATA</td>
<td>Simmons</td>
<td>84.18</td>
<td>98.10</td>
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<td>9</td>
<td>3100 SENSORS</td>
<td>Smith</td>
<td>20.87</td>
<td>21.49</td>
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<td>-10.6</td>
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<tr>
<td>11</td>
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<td>Hall</td>
<td>60.82</td>
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<td>MR MGT RESERVE</td>
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<td>0.00</td>
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<td>↔</td>
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<td>UB UNDIST BUDGET</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>↔</td>
<td>0.00</td>
<td>↔</td>
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<td>15</td>
<td>COM COST OF MONEY</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>↔</td>
<td>0.00</td>
<td>↔</td>
<td>0.0</td>
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<td>41.13</td>
<td>1.000</td>
<td>↔</td>
<td>0.00</td>
<td>↔</td>
<td>0.0</td>
</tr>
<tr>
<td>17</td>
<td>OV OVERHEAD</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>↔</td>
<td>0.00</td>
<td>↔</td>
<td>0.0</td>
</tr>
<tr>
<td>18</td>
<td>6100 TEST FACILITIES</td>
<td>Smart</td>
<td>100.00</td>
<td>98.02</td>
<td>1.020</td>
<td>↔</td>
<td>2.0</td>
<td>1.98</td>
<td>↔</td>
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<td>3500 COMP PROGRAMS</td>
<td>Pino</td>
<td>46.46</td>
<td>44.66</td>
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<td>↓</td>
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<td>↔</td>
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<td>6300 PCC TEST</td>
<td>Bond</td>
<td>23.13</td>
<td>22.64</td>
<td>1.021</td>
<td>↓</td>
<td>4.2</td>
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<td>↔</td>
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<td>39.79</td>
<td>1.053</td>
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<td>12.6</td>
<td>5.02</td>
<td>↔</td>
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<td>Tideman</td>
<td>27.57</td>
<td>24.33</td>
<td>1.133</td>
<td>↓</td>
<td>78.2</td>
<td>11.73</td>
<td>↓</td>
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</table>
Guidelines

- Start by looking at significant variances ($ and/or %) in **CUM** data
  - warning: cum data may mask recent negative variances
- Don’t ignore the significant, positive variances
  - what is the explanation?
    - example:
      - the contractor took earnings for material (BCWP), but the actuals (ACWP) have not yet hit. This variance would reverse itself in the next cycle.
- Look at **CURRENT** period variances
  - can indicate start of trend, or significant change
    - example:
      - element may still have a positive CUM variance, but the current period data shows a significant negative variance
- Variances that are very early (<5% complete) may be misleading
- How do I know if it is serious?
  - variance greater than +/-10%
  - sudden trend change
  - analysis software will flag serious variances for explanation
Additional screening hints

- **BCWR**
  - Budgeted Cost of Work Remaining (BCWR) = BAC - BCWP
    - calculated automatically by software
  - shows if there is a significant amount of work remaining or not
    - companion check: percent complete
- Use BCWR and % Complete to screen out elements that are very close to finishing, are too early to look at, or elements that are too minor
  - examples:
    - example 1: BCWR is $2K, % complete is 55%    TOO MINOR
    - example 2: BCWR is $100K, % complete is 97%   TOO CLOSE TO END
    - example 3: BCWR is $2,400K, % complete is 2%  TOO EARLY, BUT WATCH
    - example 4: BCWR is $2,000K, % complete is 38%  LOOK AT VARIANCES
- Focus your analysis efforts on significant elements
Graph and Analyze Trends
Tips for Trend Analysis

Cum charts show overall trend... are you getting better, or worse?

Current charts show the months where there were significant performance problems.
Total Program Variances

Analysis:
Both cost and schedule trends have been negative for several months, and declined this month.

Management Reserve is .4M (2% of PMB).

Contractor expects to finish on budget (0% VAC).
Program Office expects -2.2 VAC, or -11%, and expects cost performance to decline.
Trend Chart for Elements

Analysis:
Cost: this element experienced significant cost problems in Aug, Oct, Nov. Shows some recovery, but still a serious cost variance. Reason why:

Schedule: this element showed early schedule problems, but recovered and was significantly ahead of schedule in Oct. Recent performance has declined and now slightly behind schedule. Why:

VAC: Contractor revised (decreased) LRE in Nov and claims only -3% at complete. DOESN'T MATCH COST PERFORMANCE.
Show performance against technical performance

Is there a correlation between technical performance and earned value performance?

Can poor technical performance be used to predict schedule and cost problems?

Use appropriate trend data. What is technical driver that would drive performance data?
CPI and SPI

<table>
<thead>
<tr>
<th>Year</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
<th>JAN</th>
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<tbody>
<tr>
<td>1992</td>
<td>0.700</td>
<td>0.800</td>
<td>0.900</td>
<td>1.000</td>
<td>1.100</td>
<td>1.200</td>
<td>1.150</td>
<td>1.000</td>
<td>1.051</td>
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<td>1993</td>
<td>0.996</td>
<td>0.987</td>
<td>0.927</td>
<td>1.011</td>
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<td>0.891</td>
<td>0.947</td>
<td>0.948</td>
<td>0.932</td>
<td>0.941</td>
</tr>
</tbody>
</table>

Index of Dollars

CPI

SPI
EAC Realism

MEGA HERZ ELEC & VEN F04695-86-C-0050 RDPR FPI
Element: 3600
Estimates at Completion
Name: PCC

<table>
<thead>
<tr>
<th></th>
<th>1992</th>
<th>1993</th>
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<tr>
<td></td>
<td>APR</td>
<td>MAY</td>
</tr>
<tr>
<td>Dollars</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In Millions</td>
<td>5.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Shows changes in BAC and LRE.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Compares budget vs. contractor’s LRE.

Software calculates EAC based on cum CPI. Compare this to the LRE.

Analysis: contractor increased the budget for this element twice.
Contractor also increased the LRE twice, but NOT AS MUCH as the BAC.
Based on past performance as reflected in the Cum CPI forecast for EAC, the contractor’s LRE is UNREALISTIC.
Keep an eye on Management Reserve

Cost/Schedule Variance Trends
Program: Mohawk Vehicle
Contract: MOH-2
Contractor: MEGA HERZ ELEC & VEN
Project: F04695-86-C-0050 RDPR FPI
AS OF: JAN 93

- Cost Variance: -0.5
- Schedule Variance: -0.4
- Management Reserve: 0.4

10% Thresholds:
- Cost Var Est @ Completion: PO = -2.2
- Start/Comp Dates: KTR = 0.0

Compare MR changes to cost variances.

**CAUTION:** MR should not be applied to offset cost variances.

Both MR and UB should be explained in Format 5.
Comparative Data
Schedule Status

% scheduled = \( \frac{BCWS}{BAC} \times 100\% \) = \( \frac{2,000}{4,000} \) = 50%

% completed = \( \frac{BCWP}{BAC} \times 100\% \) = \( \frac{1,800}{4,000} \) = 45%

I should have completed 50% of the total work.
I only completed 45% of the total work.
budget status

\[ \% \text{ spent} \ (\text{original budget}) = \frac{\text{ACWP}}{\text{BAC}} \times 100\% \]

compare:

\% \text{ spent} \ vs. \ % \text{ complete}

example: 48\% \text{ spent vs. } 45\% \text{ complete}
Compare CV to VAC

Example 1: CV -6%  VAC -13%
I project that performance will get worse and result in a bigger overrun

Example 2: CV -15%  VAC -8%
I project that performance will get better. I'll have better cost efficiencies in the future than I do now.

Example 3: CV -12%  VAC -12%
I project that performance will stay the same
Compare color coding for CV versus VAC.

Flag all elements for further analysis that rate CV a different color than VAC, but especially those with a red CV and green VAC.

Elements with a red SV coding and green CV coding may indicate an emerging problem.

Note: software allows you to establish color thresholds.
Analysis of Schedule
Schedule Analysis

- Early warning: schedule variances are usually an early warning of cost variances to follow
- Schedule variances in EVMS should be seen as indicators and warnings
- True schedule analysis should be performed on the integrated master schedule
  - Analysis of critical path activity
  - Work with program office schedule analyst
  - Performance data and formal schedule should indicate same problems and risk areas
- Some software allows you to synch the master schedule and performance data for an integrated assessment
Either technique can be used to convert SV from dollars to approximate months. Note that this is dependent on average of work scheduled and is only an approximation.

Draw a parallel line from BCWP back to intersect BCWS, then drop down to read off the X axis (time).

**Equation:**

\[
\text{Months ahead or behind} = \frac{\text{SV} \ \$}{\text{Average monthly BCWS} \ \$}
\]
Examine written analysis
• **Format 5 variance analysis should address:**
  - separate discussion of CV, SV (current and cum) and VAC
  - clear description of reason for variance
  - quantity variances (e.g., price vs. usage)
  - be specific, not general
  - corrective action
  - technical, schedule, and cost impacts
  - impact to estimate at completion
  - should be written by CAM!
What is a significant variance?
- % variance (e.g., >10%)
- $ variance (e.g., >$50,000)
- critical path element
- risk/complexity
- impact to other elements
- Top 10, Top 20, etc.
- contractor defined
Work Remaining vs. Risk
### Format 5 Narrative Report

**Element Code:** 25       **Project Officer:** BUETTGENBACH  
**Element Name:** AVIONICS IPT  **Office Symbol:** 25

**Schedule Variance:**  
**Month:** $0K  
Avionics is essentially on schedule.

**Cumulative:** ($54K)  
Cumulative negative variance is due to the following. .........

**GCAM, Robert Gemin, 6 Oct. 97**

I consider this month’s assessment accurate and complete. Looking forward one could expect additional variances for the following reasons:

SV may increase temporary due to late delivery of...  … SV will still appear for the upcoming months.

CV will increase in the upcoming month for two reasons.  …  ..
Look Ahead

- Government control account managers (GCAMs) should keep up to date on what the PMB looks like for their element
  - “IBR” should be seen as continuous process
  - Continue the dialogue with contractor counterparts
    - Sample:
      - “I know that we failed the reliability test this month. What impact will this have on the remaining schedule and budget?”
    - Don’t wait until the formal report is received
- GCAMs are the technical managers, and understand the nature of the technical risks ahead
  - Are developing problems in the performance report analyzed and included in the formal risk plan?
  - Are items in the formal risk plan analyzed for cost and schedule impacts?
  - Are highly probable risk elements included in the EAC?
  - Is the system engineer evaluating the integration of all elements?
- Program office may wish to perform a formal Integrated Risk Assessment on the program
Soliciting input from the IPTs
Analysis within the Program Office

• Assign to technical managers within program offices
  – Government Control Account managers (GCAMs)
• Conduct monthly team variance meetings
• Open, honest communication essential
  – Oral, e-mail, and face-to-face discussions
  – Continuing dialogue dramatically improves Format 5
• Early warning analysis
  – Top level cost and schedule analysis by EVMS and schedule analysts
    • analysts should actively seek input from IPTs
  – CAM/GCAM analysis at lowest level
    • analysis should be loaded into network for availability to entire team
• Work closely with DCMC team
• Share results of analysis with contractor
Program Manager Ownership

- Program managers/IPT leads should be able to access complete data base from their desk
  - typical question: “What is this trend telling me?”
  - PMs go directly to CAMs/GCAMs for details
  - program managers should focus on significant trends
  - program managers should receive EVMS training
- Program managers chair variance analysis meetings
  - not a financial function
  - should lead dialogue with contractor
- EVMS metrics should be fully integrated into program reviews
  - internal to company
  - to government program office

experience shows….

if a program manager shows that he uses EVMS to manage, then the IPTs will follow. It is very difficult for the IPTs to maintain interest on a long term basis without this leadership.
Assessing EAC Realism
What will be the final cost?

- **Estimate at Completion (EAC)**
  - defined as actual cost to date + estimated cost of work remaining
  - contractor develops comprehensive EAC at least annually
    - reported by WBS in cost performance report
  - should examine on monthly basis
  - consider the following in EAC generation
    - performance to date
    - impact of approved corrective action plans
    - known/anticipated downstream problems
    - best estimate of the cost to complete remaining work
  - also called latest revised estimate (LRE), indicated final cost, etc.

\[
\text{ACWP} + \text{ETC} = \text{EAC}
\]
How can I assess EAC realism?

• **Method 1: look at trend chart**
  
  – compare BAC vs. LRE vs. Cum CPI forecast
  – portrays size of gap between contractor’s projected performance and past performance

Standard EAC chart
How can I assess EAC Realism?

- **Method 2:** compare following data

\[
\text{CPI}_{\text{cum}} \quad (\text{past cost efficiency}) = \frac{\text{BCWP}}{\text{ACWP}}
\]

\[
\text{TCPI-LRE} \quad (\text{projected efficiency needed to come in at LRE}) = \frac{\text{Work Remaining}}{\text{Estimate Remaining}} = \frac{\text{BAC} - \text{BCWP}}{\text{LRE} - \text{ACWP}}
\]

**EAC Realism View**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>% Compl</th>
<th>CV</th>
<th>VAC</th>
<th>VAC</th>
<th>BAC</th>
<th>LRE</th>
<th>EAC (CPI)</th>
<th>CPI</th>
<th>TCPI-LRE</th>
<th>CPI to LRE</th>
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</thead>
<tbody>
<tr>
<td>1  SYS ENGINEERING</td>
<td>85.04</td>
<td>↓</td>
<td>+</td>
<td>0.0</td>
<td>283.4</td>
<td>283.4</td>
<td>314.4</td>
<td>0.901</td>
<td>2.650</td>
<td>-1.749</td>
</tr>
<tr>
<td>2  ENG DATA</td>
<td>38.51</td>
<td>↓</td>
<td>+</td>
<td>0.0</td>
<td>32.2</td>
<td>32.2</td>
<td>44.1</td>
<td>0.729</td>
<td>1.303</td>
<td>-0.573</td>
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<tr>
<td>3  DATA</td>
<td>72.60</td>
<td>↓</td>
<td>+</td>
<td>-16.0</td>
<td>127.0</td>
<td>143.0</td>
<td>151.5</td>
<td>0.838</td>
<td>1.055</td>
<td>-0.216</td>
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<tr>
<td>4  COMMUNICATIONS</td>
<td>34.63</td>
<td>↓</td>
<td>+</td>
<td>-87.0</td>
<td>2,043.0</td>
<td>2,130.0</td>
<td>2,420.8</td>
<td>0.844</td>
<td>1.034</td>
<td>-0.190</td>
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<tr>
<td>5  PCC</td>
<td>28.99</td>
<td>↑</td>
<td>+</td>
<td>-187.2</td>
<td>5,800.6</td>
<td>5,987.8</td>
<td>6,822.4</td>
<td>0.850</td>
<td>1.027</td>
<td>-0.177</td>
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<tr>
<td>6  PROJ MANAGEMENT</td>
<td>62.79</td>
<td>↓</td>
<td>+</td>
<td>-34.0</td>
<td>1,384.6</td>
<td>1,418.6</td>
<td>1,482.1</td>
<td>0.934</td>
<td>1.056</td>
<td>-0.122</td>
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</table>

**Rule of thumb:** should be within 5% of each other (0.05)
How can I assess EAC Realism?

• **Method 3:** Compare various statistical forecasts

<table>
<thead>
<tr>
<th>Statistical and Independent Forecasts</th>
<th>6 PER AVG</th>
<th>3 PER AVG</th>
<th>CUM CPI</th>
<th>CUR CPI</th>
<th>COST &amp; SCH</th>
<th>LINEAR REG 6</th>
<th>PERF FACTOR</th>
<th>USER EAC</th>
<th>CPI*SPI</th>
<th>MICOM EAC</th>
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<tr>
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<td>6329.8</td>
<td>5800.6</td>
<td>5376.4</td>
<td>5024.3</td>
<td>5652.6</td>
<td>383.8</td>
<td>5699.8</td>
<td>0.0</td>
<td>6202.1</td>
<td>5470.0</td>
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<td>6 PER AVG</td>
<td>6329.8</td>
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<td>5376.4</td>
<td>5024.3</td>
<td>5652.6</td>
<td>383.8</td>
<td>5699.8</td>
<td>0.0</td>
<td>6202.1</td>
<td>5470.0</td>
</tr>
<tr>
<td>CUR CPI</td>
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<td>5024.3</td>
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<tr>
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<td>6866.0</td>
</tr>
<tr>
<td>LINEAR REG 6</td>
<td>383.8</td>
<td>5934.1</td>
<td>6314.3</td>
<td>7339.1</td>
<td>7056.1</td>
<td>6267.5</td>
<td>6202.1</td>
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<td>6822.4</td>
<td>6866.0</td>
</tr>
<tr>
<td>PERF FACTOR</td>
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<td>5671.9</td>
<td>5761.5</td>
<td>6322.3</td>
<td>6267.5</td>
<td>6202.1</td>
<td>6202.1</td>
<td>0.0</td>
<td>6822.4</td>
<td>6866.0</td>
</tr>
<tr>
<td>USER EAC</td>
<td>0.0</td>
<td>0.0</td>
<td>5455.8</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>CPI*SPI</td>
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<td>7522.7</td>
<td>6872.5</td>
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<td>MICOM EAC</td>
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<td>5470.0</td>
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<td>6855.3</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

From 6 period summary report

- for the current month, EACs range from 6,157K to 7,040K
- Contractor’s EAC was 5,988K
Calculate an Independent EAC
Survey says…..

- over 800 military programs show that …..

no program has ever improved performance better than the following EAC calculation

\[ EAC = \frac{BAC}{CPI} \]

at 15% complete point in program

no one pays enough attention in the early stages!
Why do we need accurate EACs?

- **Variance at Completion vs. Contractor Loss**
  - **Positive VAC:**
    - EAC < BAC  underrun contractor gain
  - **Negative VAC:**
    - EAC > BAC  share area  contractor partial loss
    - EAC > ceiling overrun contractor loss (100%)

- **Government develops top level EAC for comparison**
  - government will limit progress payments if EAC is greater than ceiling
  - government needs forecast of fund requirements

- **May still have time to change the final outcome**
One method: statistical formulae

- Common EAC Formulae:

\[
EAC = \frac{BAC}{CPI}
\]

\[
= ACWP_{cum} + \text{Budgeted Cost of Work Remaining} \frac{CPI_3}{CPI}
\]

\[
= ACWP_{cum} + \text{Budgeted Cost of Work Remaining} \cdot 0.8(CPI) + 0.2(SPI)
\]

\[
= ACWP_{cum} + \text{Budgeted Cost of Work Remaining} \cdot CPI \times SPI
\]
Other methods of EAC calculation

- “Grass Roots” or formal EAC
  - detailed build-up from the lowest level detail
  - hours, rates, bill of material, etc.

- Average of statistical formulae

- Show range of EACs (optimistic, most probable, pessimistic)

- Complete schedule risk analysis for remaining work, estimate work remaining
Formulate a Plan of Action
What to do next...

• Have a process for integrated analysis within program office
  – Include DCMC team
  – What does the program manager need to see on a regular basis?
    • what format? (briefing, memo, or on-line)
  – Provide regular training, workshops, etc.

• Make sure that the analysis gets into the right hands
  – Use flash data to alert the program manager ASAP
    • try to get Format 1 or 2 data as soon as possible
  – Program management team should be using it to control program
  – EVMS analysis should be integrated into program management type reviews
  – Provide a feedback copy to the contractor and to DCMC
Mutual Goal: Effective Variance Analysis

- Make it meaningful
  - avoid routine explanations
- Make it timely
  - flash data allows for real time discussions
- Make it streamlined
  - significant variances
- Make it right
  - work with contractor to get the information we need
- Get the information to the right players
Forward Look - Focus on the Right Things

Where we’ve been

Time now

CPI
Cum SV$
Cum CV$
Variance explanation
3 month avg
SPI
COST HISTORY

Where we’re going

Schedule risk
BCWR
Technical risk
ETC
TCPI-LRE
TCPI-BAC
Projected variances
COST AVOIDANCE
USE DATA FOR DECISION MAKING

• Behind Schedule

  - How critical is schedule?
  - Can I afford to work overtime to recover?
  - Can I do tasks concurrently?
  - Are there technical innovations which could speed up the process?
  - Am I “gold plating” instead of just meeting requirements?
  - Should I do a schedule risk assessment to project impact to program?

• Over Cost

  - Can I reschedule tasks? (Timephasing)
  - Is there a less costly facility I can use?
  - Are there tasks which can be deleted?
  - Should the element be added to my risk management profile?
Special Topics
Setting up an Early Warning System

- Flash data received ASAP, no written analysis
- EVMS and schedule managers review data
- Teleconference with DCMC
  - evaluate cost and schedule variances
  - evaluate trends
  - evaluate against program master schedule
- Prepare top level analysis to program manager and IPT leads
  - recommend elements for further analysis
- GCAMs discuss their elements with CAMs
  - write up own variance analysis
- Don’t wait until you get the report to communicate!
New Advances in Software Analysis Tools

CPR & SCHEDULE

CAM

PAPER

GCAM

CPR & SCHEDULE
Let software tools do the number crunching
Joint Use of Software Tools

- **Trend Analysis - Where Have we Been?**
  - Lowest WBS level or IPT level
  - color codes, charts
- **Projection of future - How Bad Can it Get?**
  - EAC trends
  - comparison of cost efficiencies
- **Focus on problems - What are the significant drivers?**
  - Sort by elements, trends, CAM names
  - autosync to program schedule
- **Format 5 Analysis - What are we doing about it?**
  - Joint analysis, corrective plans, risk mitigation
- **Report generator**
  - all formats
  - can go paperless