NATIONAL RECONNAISSANCE OFFICE

Integrating Earned Value Analysis and Independent Cost Estimating for Large, Multiyear System Procurements

May 2011

FREEDOM'S SENTINEL IN SPACE

Who We Are

✦ National Reconnaissance Office (NRO)

✦ At the program level, the Cost Analysis Improvement Group (CAIG) provides objective, independent pre-investment decision analysis and in-process program management decision support capabilities.

✦ These capabilities are delivered through the CAIG's *Cost Estimating and Analysis* and *Earned Value Management* collective skill set and evolving knowledge base.

✦ Cost Estimating and Analysis and Earned Value are:

- Foundational building blocks of proper Program Management
- Utilized throughout program execution providing benefits to multiple stakeholders

Cost Analysis Improvement Group (CAIG)

- ✦ Earned Value Center of Excellence (ECE) was moved from the Deputy Director Systems Integration & Engineering (DDSI&E) to the NRO Cost Group (NCG) which changed its name to the Cost Analysis Improvement Group (CAIG)

- ✦ CAIG created March 2008

- ✦ Effort to systematize important program insight tools of Earned Value Management (EVM) and Independent Cost Estimates (ICE)

NCG ➕ DDSI&E ECE ➖ CAIG

Program Background

+ Case Study: Multiyear NRO Satellite Program

  - Program Critical Design Review (CDR) Independent Cost Estimate (ICE) was decreased from previous ICE

  - Used Earned Value (EV) data as a cross check

    + Looked at cumulative level data

    + No Deep Dive

  - Shortly after the ICE, the program experienced a schedule slip and rebaseline

+ What we were tasked with:

  - Approach task from a joint EV/ICE team perspective

  - Determine if there were EV indicators that could have predicted future program performance and schedule slip that might effect the Independent Cost Estimate (ICE)

Program EVM Analysis

+ Were there warning signals prior to changing the ICE?
  - Reviewed EV data as of that timeline (Authorization to Proceed (ATP) to Rebaseline)
  - Initial review using top level and cumulative data did not indicate a major issue
  - Further EV analysis, what we looked at:
    + Went back to basics and analyzed "current" month data
    + Performance Indices – SPI , CPI, Variance
    + Management Reserve depleted or "MR burn down"
    + Estimate At Complete (EAC) and Budget At Complete(BAC) totals, month to month
    + Performed a non-traditional review of program plan changes (BCWS) over time

+ Earned Value data was provided in the Contract Performance Report (CPR)

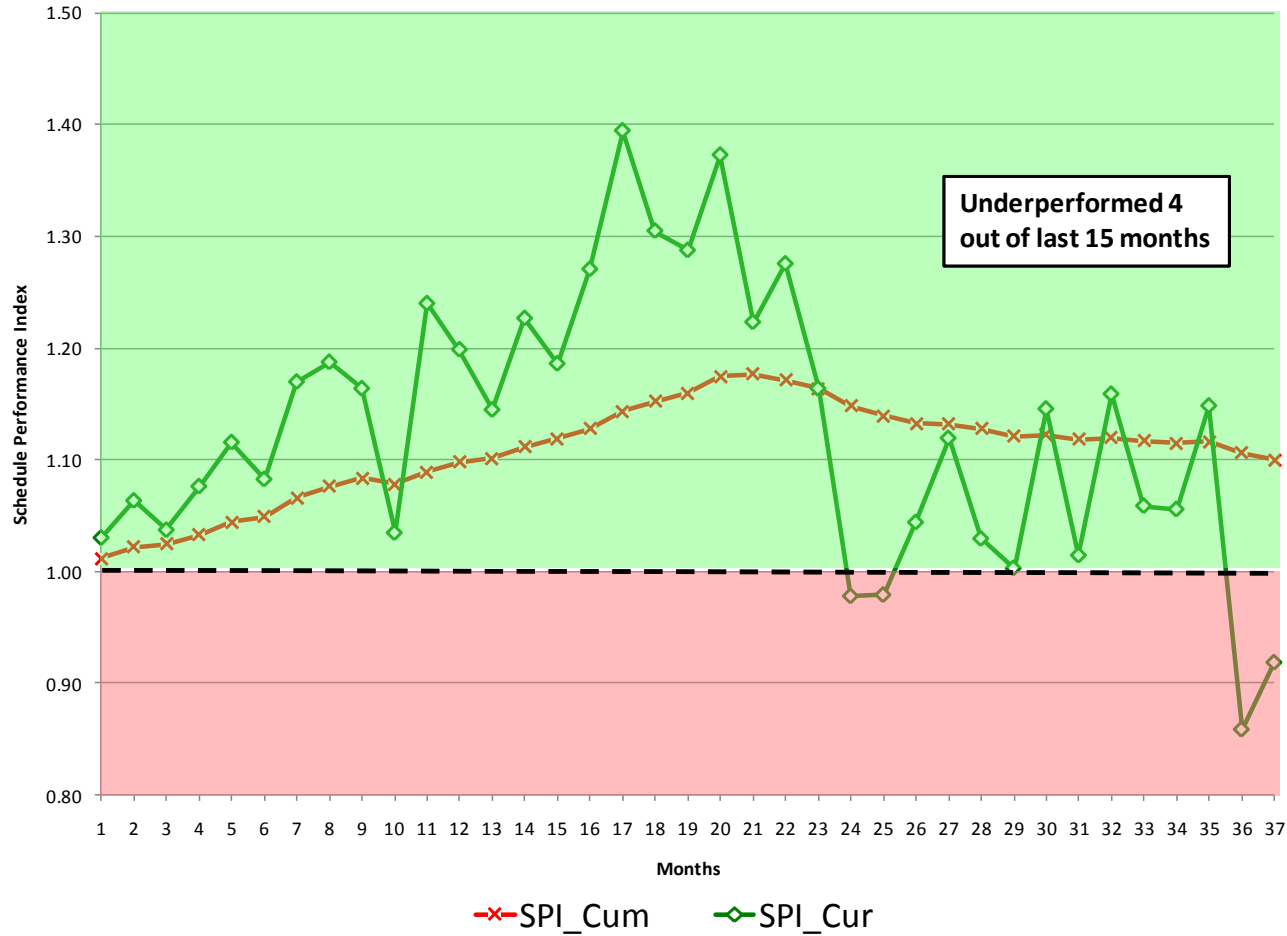+ Analysis using the wInsight tool and Access data base

Case Study: Cost Performance Index (CPI)
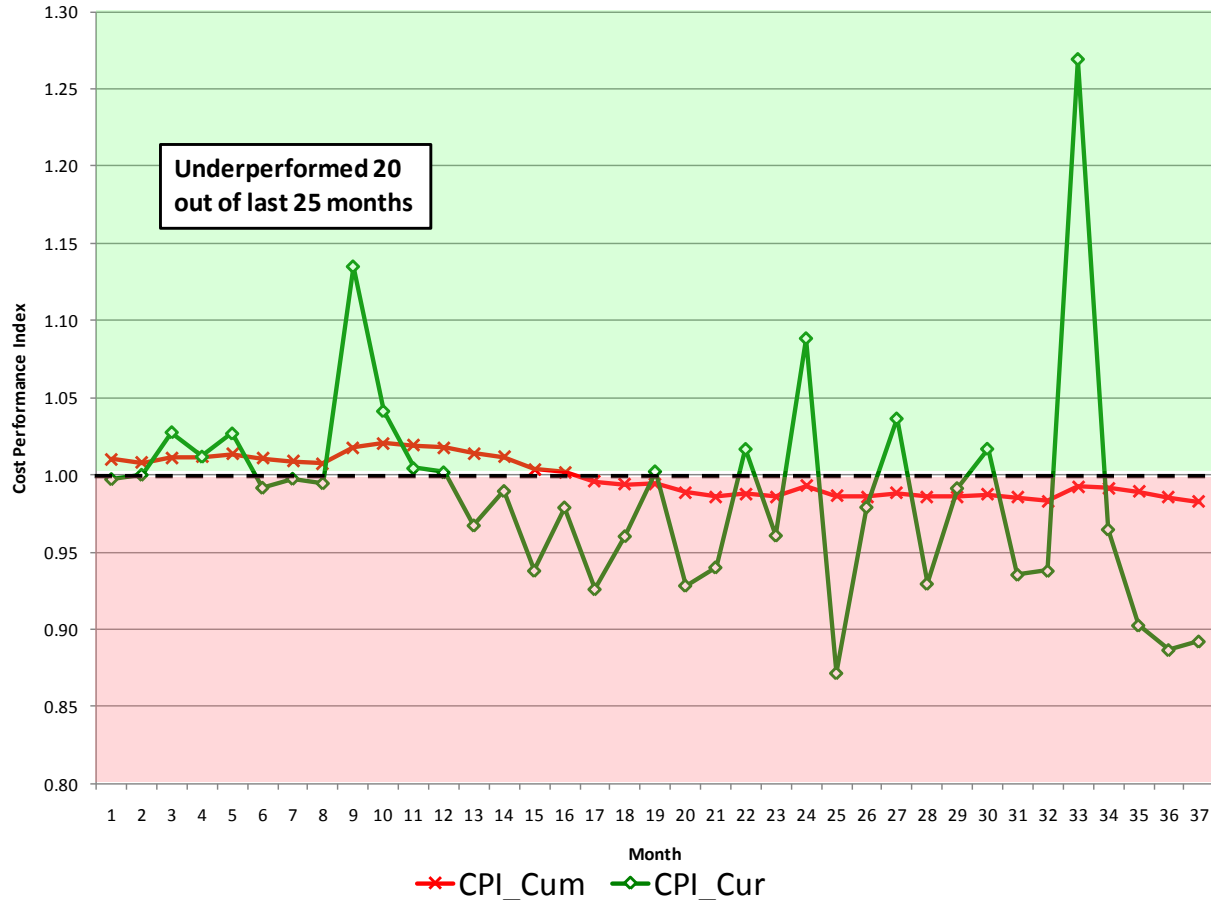
Trends are easier to see in the current data than the cumulative data, especially in the near-term.
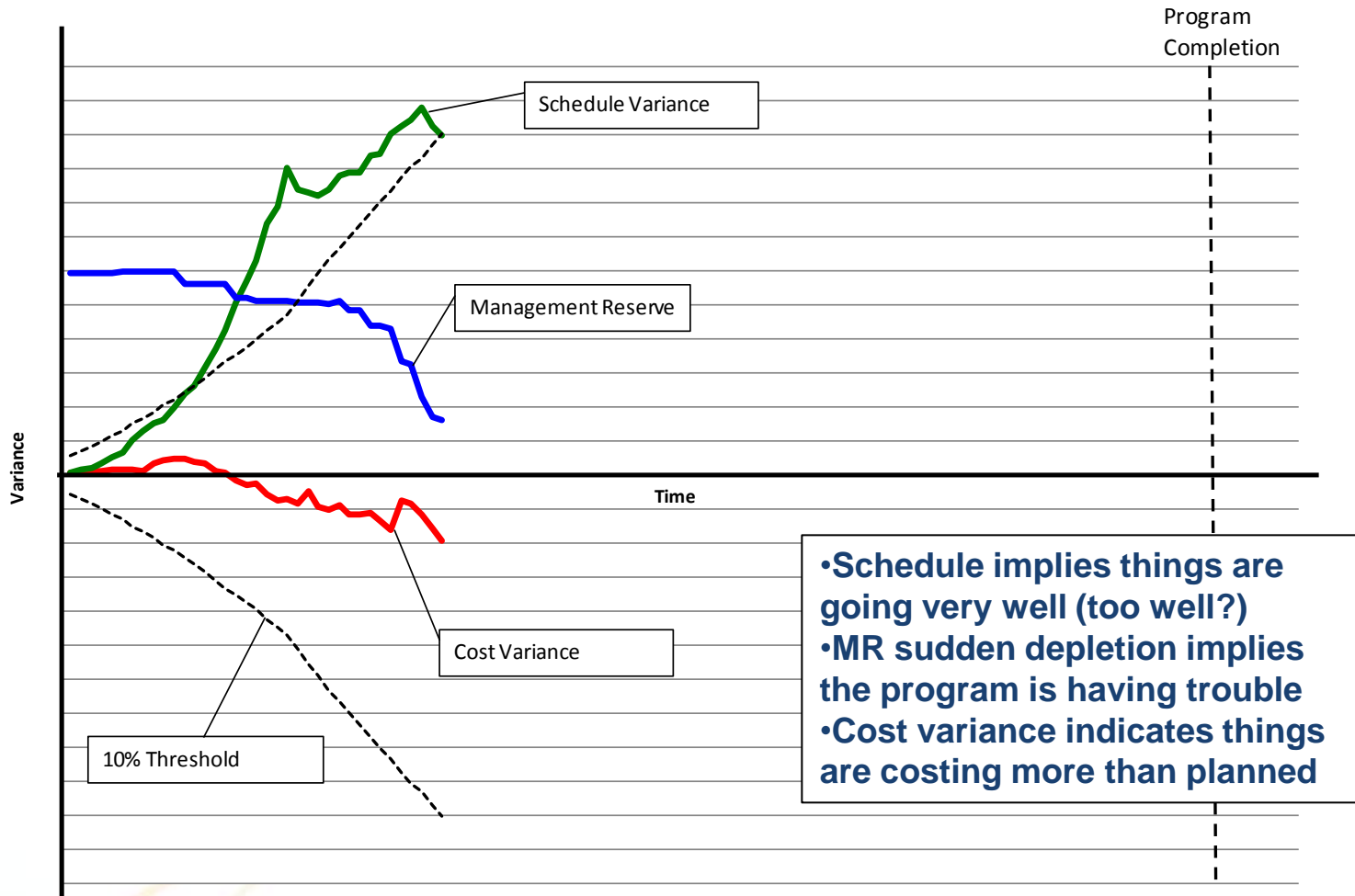
Case Study: Schedule Performance Index (SPI)

Underperformed 4 out of last 15 months

Trending is easier to see in the current data than the cumulative data, especially in the near-term.

A Closer look: Trends vs. 10% Variance Threshold

Program Completion

Schedule Variance

Management Reserve

Variance

Time

Cost Variance

10% Threshold

- **Schedule implies things are going very well (too well?)**
- **MR sudden depletion implies the program is having trouble**
- **Cost variance indicates things are costing more than planned**

Big Picture: Indicators are contradictory

ICE and EV Approaches

✦ Earned Value is a <u>project management technique</u> that has the unique ability to combine measurements of technical performance, schedule performance, and cost performance within a single integrated methodology. It provides an early warning of performance problems while there is time for corrective action on the <u>contract</u>.

✦ Independent Cost Estimate (ICE):

- <u>Life Cycle</u> Cost Estimate developed by an <u>independent</u> organization
- <u>Objective</u> assessment of the program's <u>most likely</u> cost
- Provides an unbiased test of the reasonableness of the <u>program</u> life cycle cost estimate
- <u>Formulates</u> the basis of the budget
- Connects with the <u>government program manager</u> to align risks (cost and technical),associated with the project

✦ ICE and EV have different Work Breakdown Structures (WBS)

✦ Traditional EV metrics use the budgeted cost for program tasks

- Budgeted Cost of Work Scheduled (BCWS) – places tasks in a timeline plan (within EV rules)
- Budgeted Cost of Work Performed (BCWP) – tracks when tasks actually claim credit for performance

Integrated EV and ICE Techniques Approach

- ✦ Trying to find common ground and add value to either or both processes

- ✦ The basic EVM analysis shows pending program issues

- ✦ The complete program plan (Authorization To Proceed to Complete) was charted for each reporting period

- ✦ A complete breakout of Budgeted Cost of Work Scheduled (BCWS) was developed in a matrix form in order to track changes in the program's plan

- ✦ This analysis revealed other, unanticipated clues that may have flagged the program's performance

- ✦ We created line graphs provide a visual representation of the transition of BCWS

Program Plan Matrix
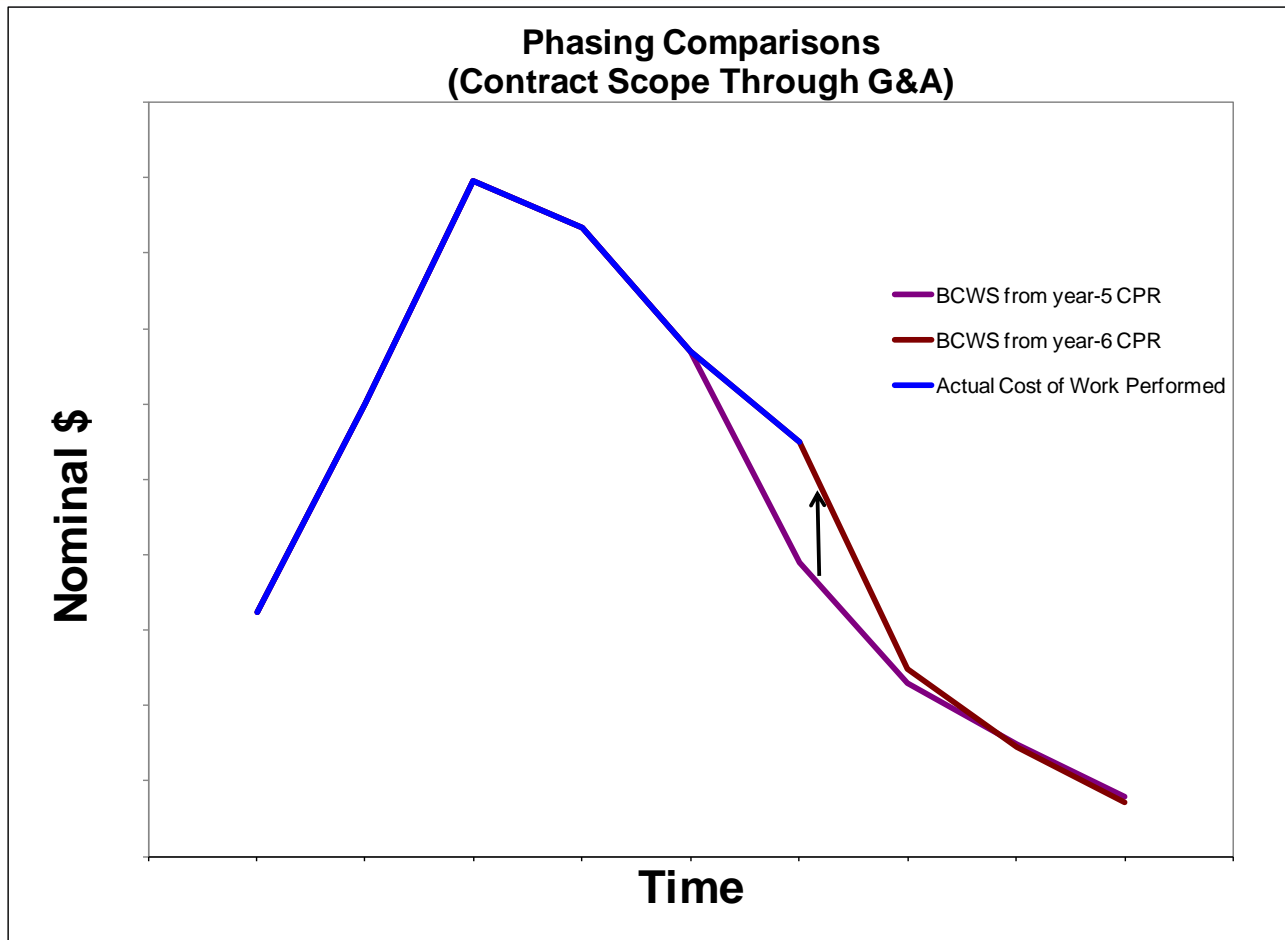
✦ Example Program Plan Matrix for a 15 Month program

BCWS / Reporting Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	BAC/EAC	
Dec	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	15.00	Dec
Jan	1.00	1.20	1.40	1.20	1.10	1.05	1.05	1.00	1.00	1.00	0.90	0.90	0.80	0.75	0.65	15.00	Jan
Feb		1.20	1.50	1.30	1.25	1.15	1.10	1.00	1.00	0.85	0.80	0.80	0.75	0.70	0.60	15.00	Feb
Mar			1.60	1.40	1.35	1.20	1.15	1.00	1.00	0.80	0.70	0.68	0.67	0.65	0.60	15.00	Mar
Apr				1.50	1.40	1.35	1.20	1.05	0.92	0.75	0.65	0.63	0.60	0.60	0.55	15.00	Apr
May					1.45	1.40	1.30	1.10	0.92	0.70	0.60	0.60	0.58	0.55	0.50	15.00	May
Jun						1.50	1.35	1.14	0.98	0.70	0.56	0.50	0.55	0.52	0.45	15.00	Jun
Jul							1.50	1.30	0.98	0.60	0.50	0.48	0.46	0.47	0.46	15.00	Jul
Aug								1.40	1.20	1.20	1.10	1.20	1.10	1.15	1.00	19.10	Aug
Sep									1.25	1.20	1.00	1.10	1.20	1.15	1.05	19.10	Sep
Oct										1.20	1.00	1.10	1.20	1.15	1.05	19.10	Oct
Nov											1.10	1.05	1.15	1.15	1.05	19.10	Nov
Dec												1.05	1.25	1.10	1.00	19.10	Dec
Jan													1.30	1.05	1.00	19.10	Jan
Feb														1.00	1.05	19.10	Feb

✦ Our case study had tasks at the end of the program that were effectively losing budget (BCWS) to offset near term budget and scope increases

> **For month 6: 50% (=1.5/1.0) increase over original baseline**
> **Only 7% (=1.5/1.4) increase from last reporting period**

Case Study: Change in Plan, by Year

**Phasing Comparisons
(Contract Scope Through G&A)**

Legend:
- BCWS from year-5 CPR
- BCWS from year-6 CPR
- Actual Cost of Work Performed

Y-axis: **Nominal $**

X-axis: **Time**

✦ Notice that each successive plan, the peak gets higher AND the tail gets lower. The net effect is a "stable" total estimate with less money to complete integration and test.

View this slide in presentation mode to see chart animations.

Case Study: Change in Plan, by Year

Phasing Comparisons (Contract Scope Through G&A)

Legend:
- BCWS from 1st CPR
- BCWS from year-2 CPR
- BCWS from year-3 CPR
- BCWS from year-4 CPR
- BCWS from year-5 CPR
- BCWS from year-6 CPR
- Actual Cost of Work Performed

Y-axis: Nominal $
X-axis: Time

✦ Notice that each successive plan, the peak gets higher AND the tail gets lower. The net effect is a "stable" total estimate with less money to complete integration and test.

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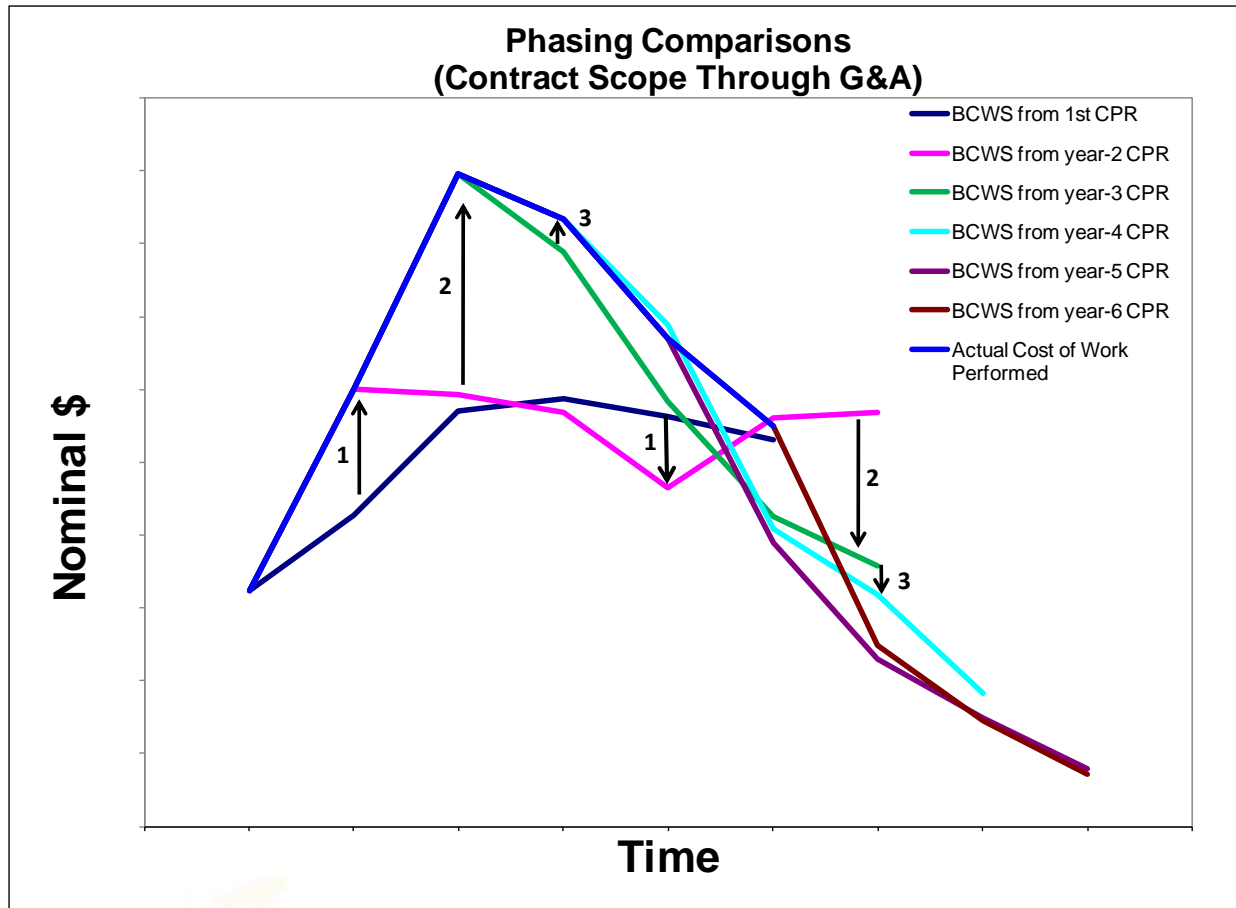
Conclusions

+ Exhaust the basics!

+ Frequent baseline changes…

  • May be difficult to see with traditional EV metrics

  • Can mask the severity of cost growth in traditional EV metrics

    + Try evaluating the BCWP to the original BCWS, not the most recent

  • May indicate difficulty establishing and executing a plan

  • May indicate troubles with the baseline

Next Steps…

+ Measure EV performance with ICE estimates

+ Ongoing research to integrate the EV and cost analysis information

Parting Thought:

When we measure variance (cost or schedule) are we measuring program performance
or their ability to estimate future cost and schedule plan?

Acronym List

+ ATP – Authority to Proceed
+ BAC – Budget at Completion
+ BCWP – Budgeted Cost of Work Performed
+ BCWS – Budget Cost of Work Scheduled
+ CPI – Cost Performance Index
+ CPR – Contract Performance Report
+ EAC – Estimate at Completion
+ EV – Earned Value
+ ICE – Independent Cost Estimate
+ MR – Management Reserve
+ SPI – Schedule Performance Index
+ WBS – Work Breakdown Structure