

EVMS Training Snippet Library: Applied Predictive Analysis



Office of Acquisition and Project Management (APM) MA-60
U. S. Department of Energy
July 2014

Achieving Management and Operational Excellence

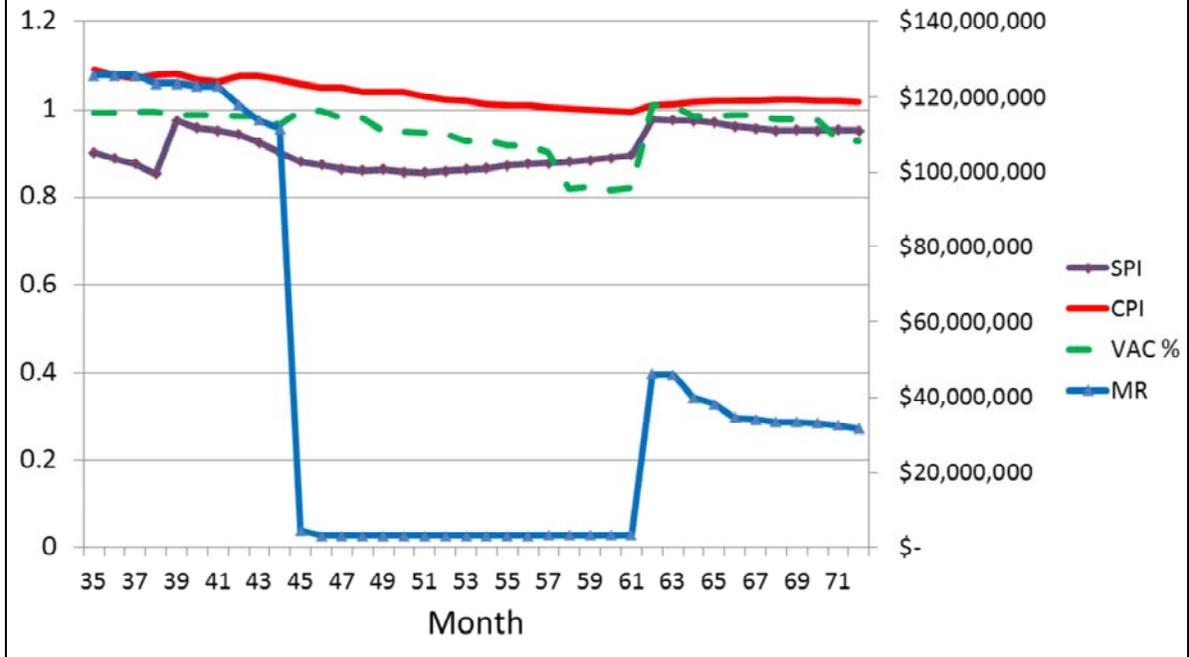
This EVMS Training Snippet, sponsored by the Office of Acquisition and Project Management (OAPM) provides examples of using PARS II analysis reports to examine current performance and use it to predict future performance.



- **Multi-year Cost Plus Incentive Fee Construction Project**
- **Analysis Timeframe:**
 - Approximately 50% to 90% Complete
 - Months 37 through 72
- **Original PMB: \$1.050B**
- **Current PMB: \$1.073B**
- **Current EAC: \$1.151B**

Before we review the PARS II analysis reports, we need to understand the Project scenario used in this Snippet. We have a multi-year Cost Plus incentive Fee construction project. The timeframe of our analysis is between 50 to 90% complete. The original Performance Management Baseline (PMB) was \$1.050B, the current PMB is \$1.073B, and the current EAC is \$1.151B.

Historical SPI, CPI, VAC %, and MR Curves



These are the curves associated with the project used in this historical scenario. The sharp increases and decreases in the MR, VAC, and cost variance values are all concerning. This project cost growth exceeded the total project cost. The intent of this snippet is to use the reports in PARS II that would help us find the issues before a surprise breach.

Analysis Reports – Project Analysis SOP



Page 4

The screenshot shows the PARS II Reports folder structure. The left sidebar contains the following items:

- PARS II
- OVERSIGHT & ASSESSMENT
- PROJECT PERFORMANCE
- ALL REPORTS
- SSS Reports

The main content area shows the "SSS Reports" folder expanded, displaying the following subfolders:

- Analysis Reports
- Data Validity Check
- Schedule Health Assessment
- Variance Analysis
- Trend Analysis
- EAC Reasonableness
- Predictive Analysis
- APM DepSec Monthly Reports

When conducting project analysis, there is a wealth of information at your fingertips in the PARS II Reports folder entitled “Analysis Reports – Project Analysis SOP”. In bold on the slide are the subfolders used to organize the reports into buckets identified for different aspects of the analysis process as explained in the DOE OAPM’s EVMS Project Analysis Standard Operating Procedure. Under each bucket are the individual reports that support that phase of project analysis. These reports are also explained in detail in the OAPM Snippets Training Library, Group 5.

Analysis Reports – Project Analysis SOP



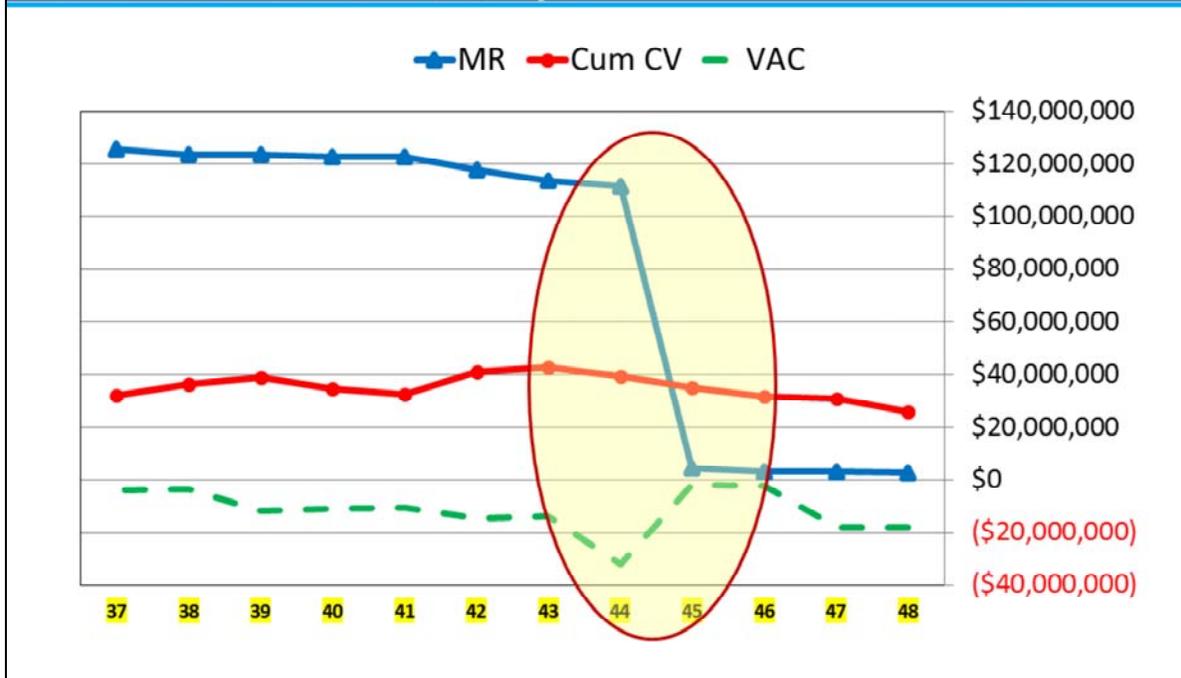
Page 5

- **Data Validity Check**
 - EV Data Validity (WBS Level)
 - Retroactive Change indicator (6-Mo, PMB Level)
- **Schedule Health Assessment**
 - Schedule Missing Logic (Activity Level)
 - Relationship Leads and Lags Report
 - Schedule Relationship Types (Activity Level)
 - Schedule Hard Constraints (Activity Level)
 - Schedule Total Float Analysis (Activity Level)
 - Schedule Duration Analysis (Activity Level)
 - Invalid Forecasts and Actual Dates (Activity Level)
 - Schedule Hit or Miss Report
- **Variance Analysis**
 - EV Project Summary (6-Mo, PMB Level)
 - Performance Analysis (WBS Level)
 - Variance Analysis Cumulative (WBS Level)
- **Trend Analysis**
 - Baseline Volatility – Past and Near-Term (PMB Level)
 - EV Project Summary (6-Mo, PMB Level)
 - MR Balance v. CV, VAC, & EAC Trends
 - Management Reserve (MR) Log
 - Performance Index trends (WBS Level)
 - Variance Analysis Cumulative (WBS Level)
- **EAC Reasonableness**
 - CPI vs. TCPI (PMB Level)
 - EV Data Validity (WBS Level)
 - Performance Index Trends (WBS Level)
- **Predictive Analysis**
 - Funding Status (Monthly at Project Level)
 - IEAC Analysis (WBS Level)

For the purposes of this Snippet, we will focus on just a few of these reports to demonstrate how quickly you can identify performance concerns and anticipate what will happen over time when certain actions are taken. The scenarios covered in this Snippet are unfortunately not uncommon on DOE projects. Thus they are worthy of close examination and support lessons learned.

PARS II MR Balance v. CV, VAC, EAC

MR vs. Cum CV & VAC Graph



Using the PARS II MR Balance versus the CV, VAC, EAC Trends Report, and clicking on the MR versus. CV and VAC tab, we see this graph for the period of time from month 37 through month 48.

What does this graph tell us? Well, the most obvious change is in the blue MR line. Between months 44 and 45, the MR balance fell from \$112M to \$4.5M. That tells us that \$107.5M worth of MR was applied to the baseline in one month. We also see that the Variance at Completion, that is the Budget at Completion minus the Estimate at Completion, improved during that same month. When an infusion of MR reduces the Variance at Completion, it is a sign that the MR was used to offset variances, either past or anticipated. Either way, this is a red flag.

Ask follow-up questions to the project manager based on this report.

- Regarding the Management Reserve:
 - What caused the use of the \$107.5M management reserve? What are the current and projected risks? Is remaining MR adequate to cover those risks? If not, will the EAC be updated?
- Regarding the Variance at Completion:
 - What caused the VAC go down? The expectation is that with MR application, the VAC would not change because as the amount of budget for new work is allocated, the EAC would increase accordingly.

Either way, there are questionable practices at play that require further investigation and

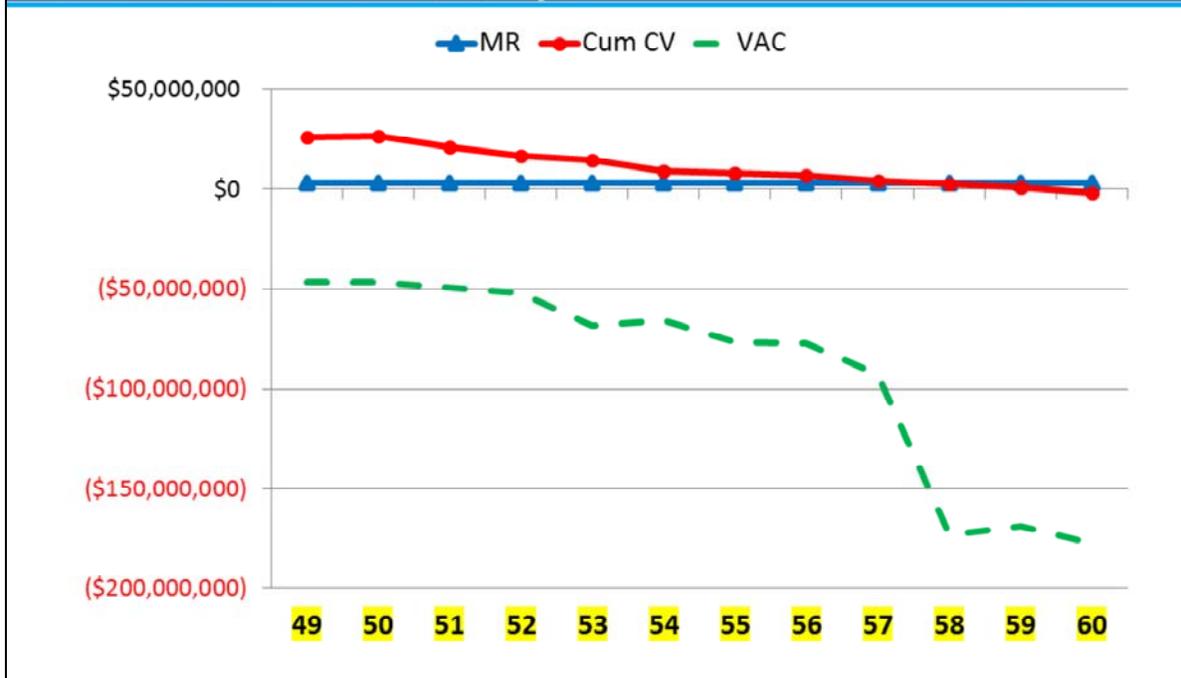
analysis.

We also see that although the Variance at Completion appeared to improve in Period 45, it didn't last long. Two months later it fell again.

Let's look at the next 12 month period for this project.

PARS II MR Balance v. CV, VAC, EAC

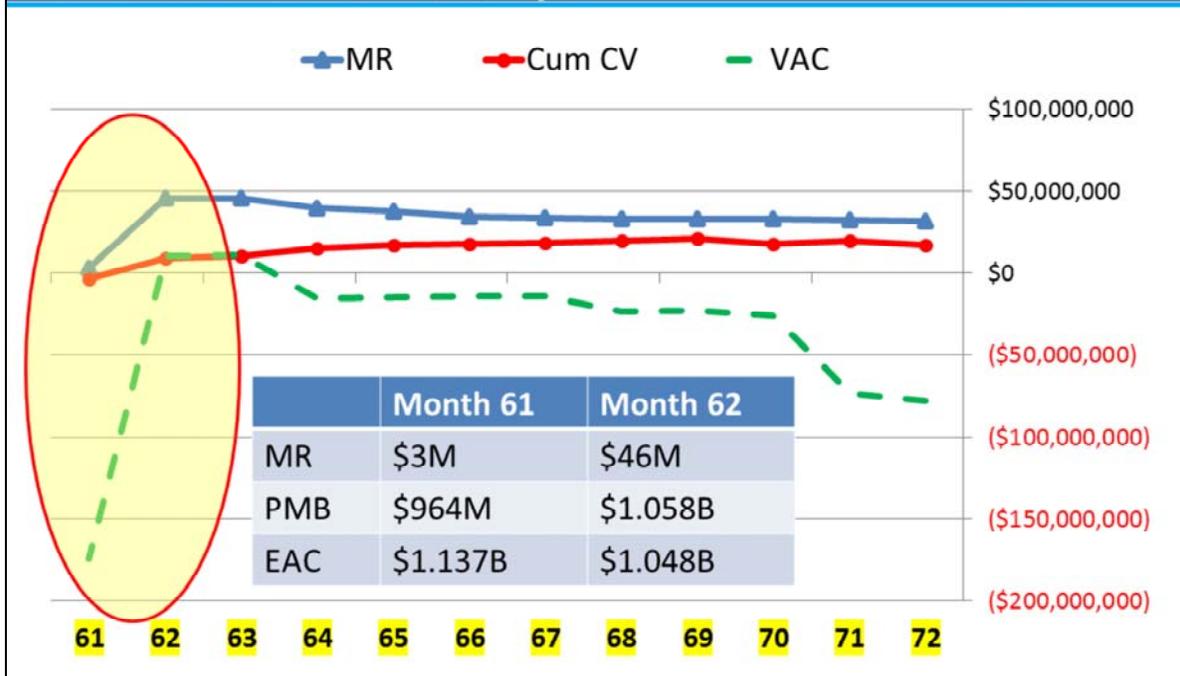
MR vs. Cum CV & VAC Graph



Looking at the next 12 months of data, months 49 through 60, we see that the Variance at Completion continues to fall, from \$47M to \$178M. Why is that happening? One suspicion is the lack of MR available to apply for the wrong reasons; that is for the sole purpose of offsetting past or future variances, the Estimate at Completion continues to grow. It could also mean that without any MR to properly manage additional scope within the existing Statement of Work in the contract and/or Project Execution Plan, the contractor is forced to carry everything as a variance when it may have been legitimate to use MR for realized risks.

PARS II MR Balance v. CV, VAC, EAC

MR vs. Cum CV & VAC Graph



Looking at the next 12 months of data, months 61 through 72, we see that the Variance at Completion suddenly improved between month 61 and month 62, from an overrun of \$174M to an underrun of \$11M. Why is that happening? A review of the monthly data for these periods shows that MR was replenished, from \$3M to \$46M. We also see that the PMB increased from \$964M to \$1.058B. And somehow the Estimate at Completion actually decreased from \$1.137B to \$1.048B.

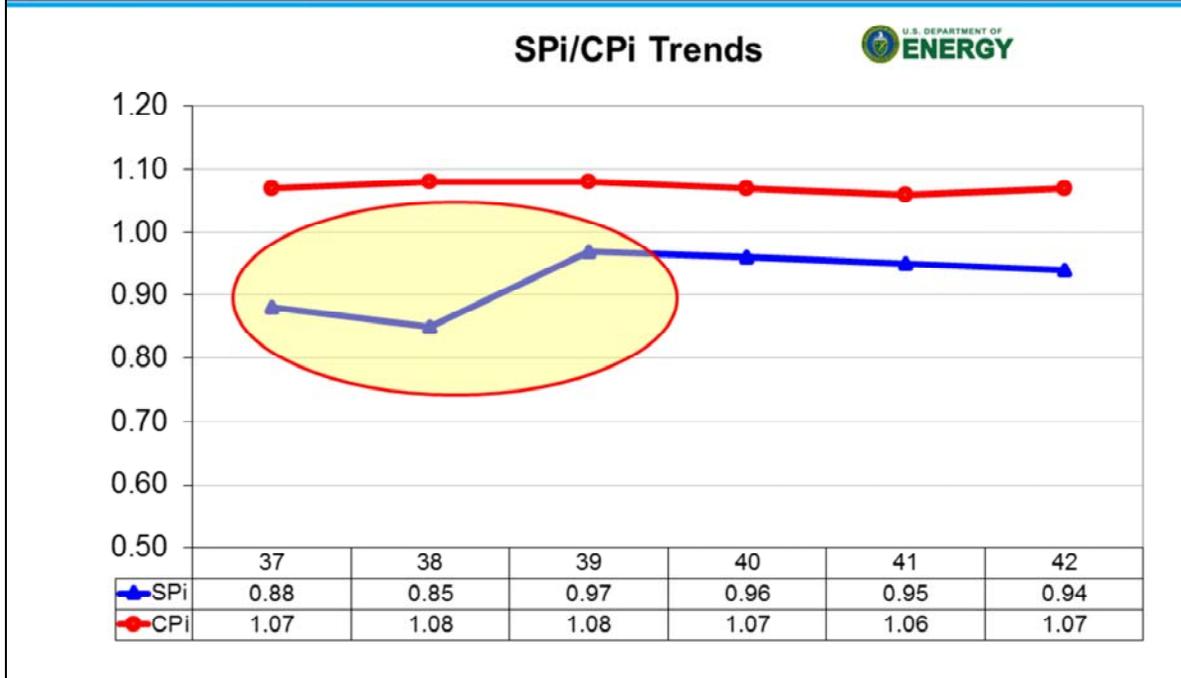
The behavior in the curves may have resulted from an addition of contingency funds to the project to cover contractor cost overruns, but which was improperly used to increase contractor budget despite addition of no new contract scope. As a result, the negative VAC was eliminated, true performance was masked, and an inaccurate EAC was reported. Please refer to snippet 4.3 for further explanation of MR, contingency, budget and funds.

The questions to ask would be:

1. Why were variances eliminated when the BCP was executed primarily to address a cost overrun?
2. Why did the EAC go down when the PMB increased?

PARS II Performance Index Trends

SPI CPI Trend Chart



Here we see the PARS II Performance Index Trends Report, and we selected the SPI CPI Trend Chart. This report can be selected at any WBS level; here we selected it at the PMB level.

Notice the behavior of the SPI line (in blue). It had a dip and then a spike from the 2nd to the 3rd month of the six month curve. Since this chart is plotting cumulative values, a significant dip and spike in the cumulative is a red flag. Let's look at the Project Summary Report to see if we can determine what is happening.

PARS II EV Project Summary (6-Mo; PMB Level)



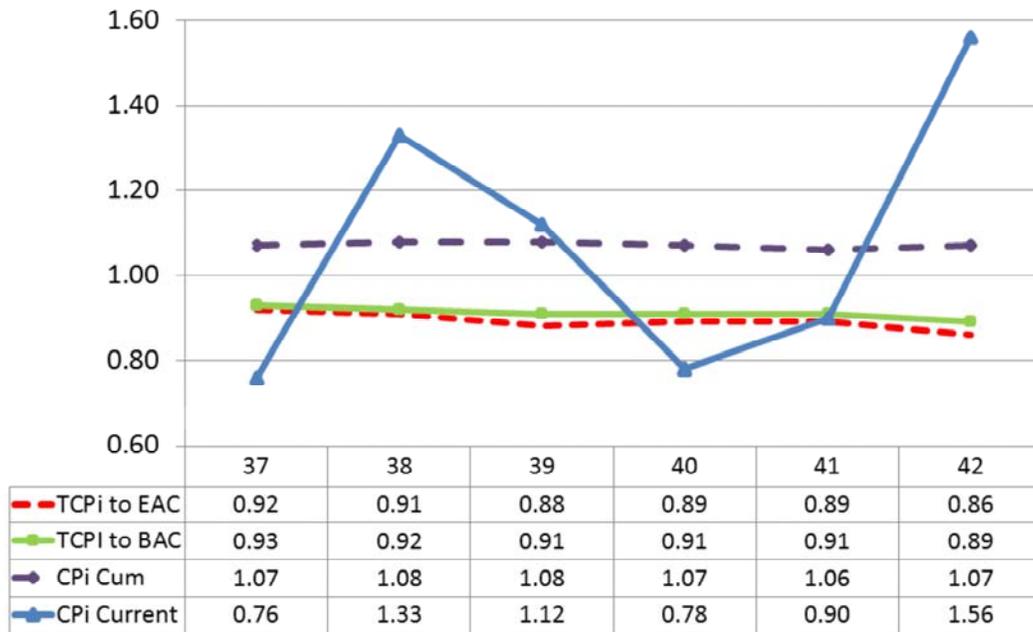
Current Period

	37	38	39	40	41	42
BCWS	\$16,672,881.87	\$35,011,538.35	(\$50,732,354.67)	\$24,372,152.98	\$22,471,989.74	\$29,721,499.31
BCWP	\$8,128,979.93	\$17,277,337.68	\$22,463,529.82	\$15,067,551.19	\$17,663,784.89	\$22,936,483.56
ACWP	\$10,656,339.89	\$12,998,827.70	\$20,086,746.73	\$19,289,230.79	\$19,606,216.65	\$14,719,804.51
SV	(\$8,543,901.94)	(\$17,734,200.68)	\$73,195,884.49	(\$9,304,601.80)	(\$4,808,204.85)	(\$6,785,015.73)
SV%	-51.24%	-50.65%	-144.28%	-38.18%	-21.40%	-22.83%
SPI	0.488	0.493	-0.443	0.618	0.786	0.772
CV	(\$2,527,359.97)	\$4,288,509.98	\$2,376,783.09	(\$4,221,679.60)	(\$1,942,431.76)	\$8,216,679.06
CV%	-31.09%	24.82%	10.58%	-28.02%	-11.00%	35.82%
CPI	.763	1.330	1.118	0.781	0.901	1.558

When we compare the monthly SPI to the Cumulative SPI, we see that during the month there was a significant spike, the monthly SPI was negative point 443. What that means is that there was a retroactive change to the BCWS. When looking at the Current Period BCWS, we see it is negative \$50,732,354. The earned value, or the BCWP, was positive \$22,463,529. Does it make sense that there was negative work planned, and a positive amount of work was completed? When retroactive changes are made to the plan, it impacts the performance indices and makes it difficult to use them as predictors. Such changes need sufficient explanation, and underlying causes should be investigated, identified and corrected.

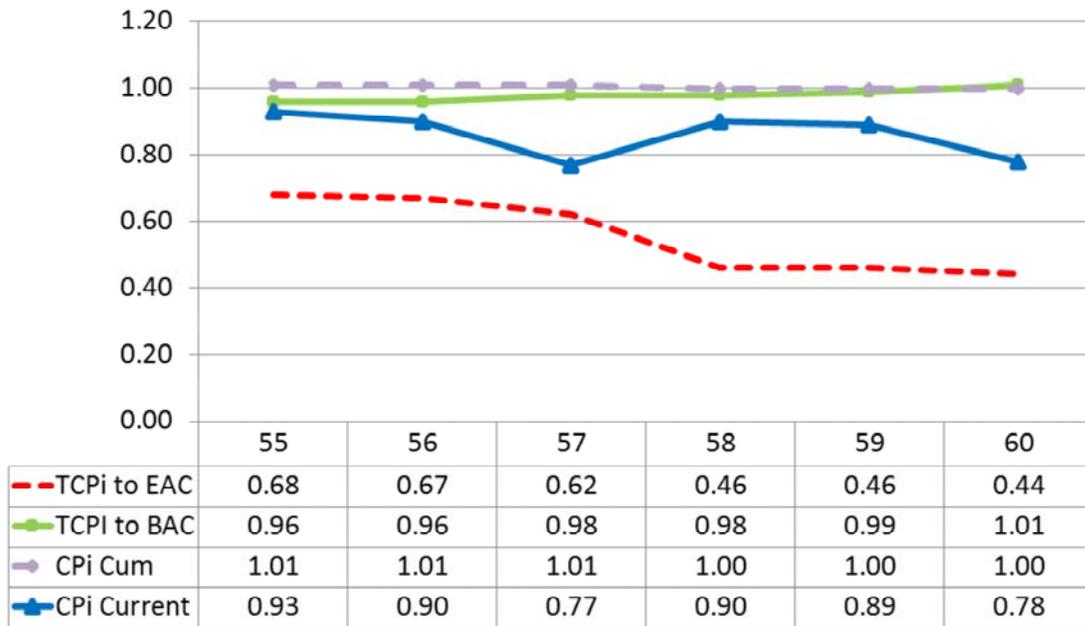
Also take a look at the current period CPI. It, too, is fluctuating greatly over the six month period. Let's examine the CPI and TCPI curves next.

PARS II CPI vs. TCPI (PMB Level)



Here are the CPI curves for the same timeframe as we were just looking at. This is around the 50% to 60% completion point. We are seeing significant monthly fluctuations in the current period relative to cost performance. The cumulative is very high, well over 1.0. It appears that the contractor, if he continues at this rate, will come in well under the BAC. We know that because the TCPI to BAC is less than the performance that has been achieved for the first 50% of this project. But the fluctuation gives us some doubts. Let's jump to the end of the project in the next slide to see how things are going.

PARS II CPI vs TCPI (PMB Level)



Now we are late in the project, around 85% to 90% completion. What is this graph telling us? The current period CPI is unstable, with fairly significant swings. The Cumulative CPI, used to smooth out the curve, shows it is falling very slowly. But the most surprising information on the graph is that the TCPI to EAC is extremely low. That tells us that the contractor's EAC is very pessimistic, and that given the cumulative CPI of 1.0, the contractor only has to achieve a performance of less than .5 to achieve the EAC. In other words, the contractor is predicting he will only be half as efficient for the remainder of the project, approximately 10% left to go, as he was for the entire 90% so far. Does that sound like a realistic EAC to you?



- **PARS II reports are extremely helpful in identifying trends**
- **When the data seems suspect, investigate**
 - There is a 'cause' for the 'effect'
 - When the curves have a dip or spike, there is a reason
- **By checking a few PARS II reports, it becomes easy to see what actions set off red flags and corrupts the performance indices**
- **Actions like replenishing MR, using MR to offset variances, retroactive changes to the plan all have immediate but short lasting impacts – they are not fixes for effectively and efficiently managing project performance**

In summary, we have seen that PARS II reports are extremely helpful in identifying trends. When the data seems off or suspect, investigate because there is a root cause for every subsequent effect to the EVM data curves or performance indices.

Learn what actions are good fixes in terms of project management and be able to identify those actions that are only a temporary band aid approach and which set off red flags. Actions such as replenishing MR, using MR to offset variances, and retroactive changes to the plan all have immediate but short lasting impacts; they are not long term fixes to effectively and efficiently manage the project and complete it successfully within the approved scope, cost and schedule baseline.

DOE OAPM EVM Home Page



Page 14

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Earned Value Management (EVM) is a systematic approach to the integration and measurement of cost, schedule, and technical (scope) accomplishments on a project or task. It provides both the government and contractors the ability to examine detailed schedule information, critical program and technical milestones, and cost data.

- EVMS Surveillance Standard Operating Procedure (ESSOP) - 26 Sep 2011 (pdf)
- EV Guideline Assessment Templates - (MS Word)
- DOE EVMS Cross Reference Checklist - (pdf)
- DOE EVMS Risk Assessment Matrix - (MS Word)
- Formulas and Terminology "Gold Card" - Sep 2011 (pdf)
- Slides from the OECM Road Show: Earned Value (EV) Analysis and Project Assessment & Reporting System (PARS II) - May 2012 (pdf)
- DOE EVM Guidance

EVM TUTORIALS

Module 1 - Introduction to Earned Value (pdf 446.86 kb) July 17, 2003

This module is the introduction to a series of online tutorials designed to enhance your understanding of Earned Value Management. This module's objective is to introduce you to Earned Value and outline the blueprint for the succeeding modules. This module defines Earned Value management. It looks at the differences between Traditional management and Earned Value management, examines how Earned Value management fits into a program and project environment, and defines the framework necessary for proper Earned Value management implementation.

<http://energy.gov/management/office-management/operational-management/project-management/earned-value-management>

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For information relative to EVMS procedures, templates, helpful references, and training materials please refer to OAPM's EVM Home page. Check back periodically for updated or new information.