DOE PROJECT MANAGEMENT NEWS
Promoting Project Management Excellence

DIRECTOR'S CORNER

As we continue our series of articles on the ten management subprocesses identified in the Integrated Project/Program Management (IP2M) Maturity and Environment Total Risk Rating (METRR) using EVMS, we shift our focus to the Analysis and Management Reporting Subprocess Area. Effective variance analysis will help the project team recognize trends, identify potential opportunities and threats, and take proactive steps to maximize the potential for successful project delivery. You can learn more about the Analysis and Management Reporting subprocess area in the article on page 6.

The Empower module of the Project Assessment and Reporting System (PARS) contains many tools to assist a Federal Project Director (FPD) or project team with variance and trend analysis. Using the Variance Analysis Dashboard in Empower, the FPD or project team can quickly obtain a summary by work breakdown structure (WBS) element key metrics such as % complete, % spent, schedule variance (SV), cost variance (CV), actual cost of work performed (AWCP), and estimate to complete (ETC).

Lower-level cost and schedule variances can be assessed to establish a pattern of performance specific to each WBS and to quickly determine those areas requiring additional attention. By leveraging Empower capabilities, the FPD and project team have a wide variety of tools to diagnose existing problem areas as well as to predict future performance. Learn more about variance and trend analysis in the article on page 2.

Don't forget to check out the EVMS Training Snippet of the Month: Snippet 5-1, *Periodic and Comprehensive Estimate at Completion (EAC),* which discusses the similarities and differences in conducting a periodic or monthly EAC versus a comprehensive or bottom up EAC. Finally, mark your calendars! Planning is underway for the 2023 DOE Project Management Workshop to be held on April 11th – 12th, 2023, followed by a third day on April 13th, which will be split between Project Controls and Program Office breakout sessions. Additional information on the Workshop and the registration process will follow shortly.

Stay safe, happy holidays and Keep Charging!

Paul Bosco

VARIANCE AND TREND ANALYSIS

Andy Buzbee, Office of Project Analysis (PM-20) and Brian Kong, Office of Project Controls and Policy (PM-30)

This article examines two key components of performance analysis, namely variance and trend analysis of earned value management system (EVMS) data. The basis for this discussion is the EVMS as referenced in [DOE-PM-SOP-05-2020](#)[1] in addition to portions of the [GAO Cost Estimating and Assessment Guide](#) [2]. The *Empower* module of the Project Assessment and Reporting System (PARS) is integral for both variance and trend analysis. *Empower* contains key reports, charts and indices related to this analysis; however, detailed discussion of *Empower* broad capabilities is beyond the scope of this article. Nonetheless, the reader is encouraged to experiment and learn the tools of the *Empower* module on their own. In a broad sense, performance analysis consists of the following assessments: data validity, schedule health, analysis of variances, analysis of trends, and forecasting of future performance. Variance and trend analysis are the focus of this article.

Variance Analysis. Variance analysis is the identification and explanation of the top cost and schedule drivers and typically involves investigation of cumulative information. This is the point at which the effort and time to approve a baseline serves its purpose to determine the extent project performance has varied from the original plan. The *Empower* variance analysis dashboard as shown in Figure 1 provides a summary by work breakdown structure (WBS) element key metrics such as % complete, % spent, schedule variance (SV), cost variance (CV), actual cost of work performed (ACWP), and estimate to complete (ETC).
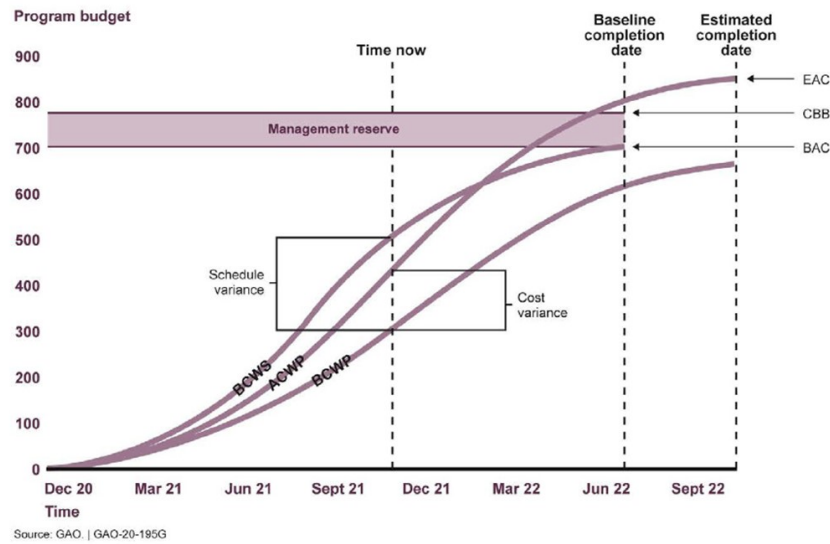

Figure 2. Program View of Earned Value Management Data

This dashboard also contains four trend columns for SV current, CV current, SV cumulative, and CV cumulative. This tool allows a project manager, Federal Project Director, or project management analyst to assess lower-level cost and schedule variances, establish a pattern of performance specific to each WBS and to quickly determine a project's problem areas. Management can use this information to make decisions regarding where appropriate corrective actions should be applied in addition to determining the magnitude of potential problems.

Figure 2 shows the schedule and cost variance areas on a traditional EVMS graph. As shown along the "time now" line, variance analysis can provide answers to the following questions:
1. How much planned work should be completed by now—what is the budgeted cost of work scheduled (BCWS)?
2. How much work has been done—what is the earned value for work performed (BCWP)?

Figure 1. Empower Variance Dashboard

[1]DOE-PM-SOP-05-20, Earned Value Management System (EVMS) and Project Analysis Standard Operating Procedure (EPASOP), 1/14/2020

[2]GAO-20-195G, GAO Cost Estimating Guide, March 2020

3. How much has the completed work cost—what is the actual cost of work performed (ACWP)?
4. What is the total planned cost—what is the budget at completion (BAC)?
5. What is the expected cost—what is the estimate at completion (EAC)?

It must be noted that all of the values mentioned above are only valid for the one slice in time labeled "time now" and that these values will change as the project progresses. The next question is how do these metrics change over time, i.e., how have they changed to get to this point and how will they change in the future?

Trend Analysis. The widespread practice of collecting information and attempting to spot a pattern is one definition of trend analysis. In project management, trend analysis is a mathematical technique that uses historical results to predict future outcomes, which is achieved by tracking variances in cost and schedule performance. A trend can be assumed to be linear using formal regression analysis, a statistical technique to aid interpretation of data. Again, the *Empower* module can be a great asset to gain understanding of trends within individual project WBS's. In the example shown in Figure 3, one quickly notices the erratic plot of WBS 01.03.01 Conventional Facilities Construction, and the obvious questions are what happened at roughly 50% complete and will this erratic performance continue?

Figure 4 is another example of an *Empower* chart of CV and SV variance over time and it clearly shows that schedule variance is driving the overall trend analysis. After a pattern of performance is identified, it may be used to predict or forecast future performance. GAO recommends graphing the data to identify trends, identify remaining work, and calculating a range of EACs to compare with available budget. These steps should be completed in sequence because each builds upon the previous one. Trends provide valuable performance information which is important for accurately predicting costs and schedule at completion. As mentioned earlier, linear regression may be a useful tool to establish trend patterns.

Let us refer back to a basic EVMS graph of BCWP, BCWS, and ACWP in Figure 5. As shown, this example project has a total project cost (TPC) of roughly $75 million and that both cumulative ACWP and BCWP reached approximately 95% of the TPC in August 2021, fifteen (15) months before the approved CD-4 date of September 30, 2023 (the project is currently 99% complete). Several observations include the close correlation between work performed (BCWP) and actual costs (ACWP) at time now indicating minimal cost variance (CV) and that comparison of the work performed with work scheduled (BCWS) shows that schedule variance (SV) was greater than CV.
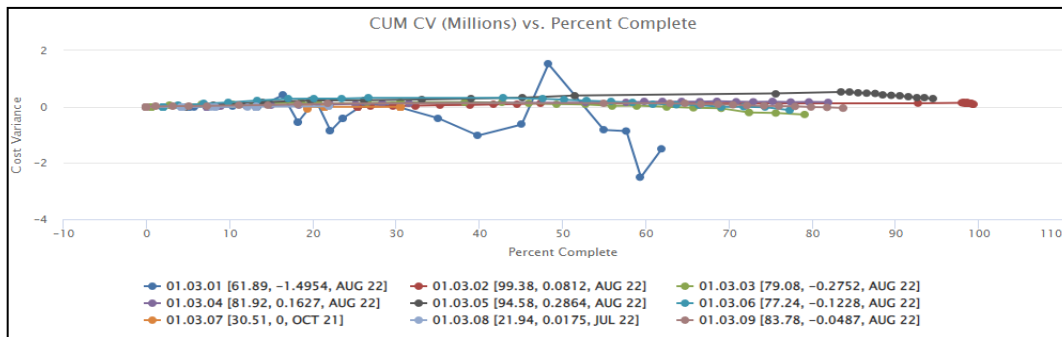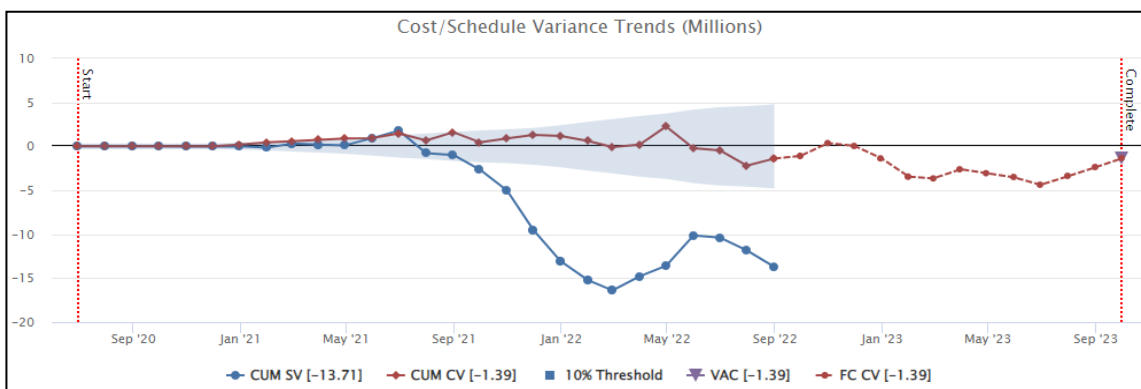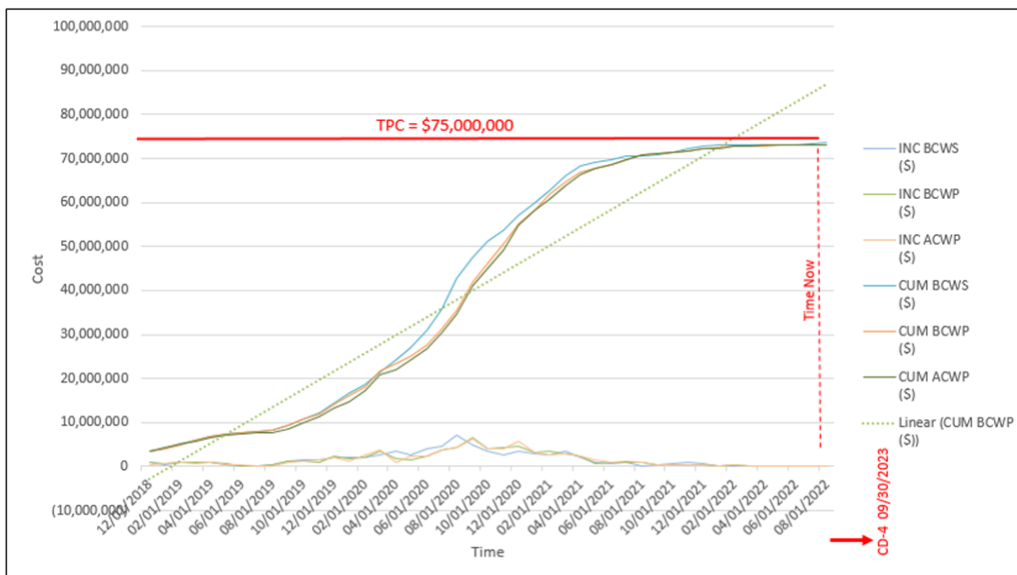
Figure 3. CV versus % Complete

*Figure 4. Cost and Schedule Variance Over Time*

Figure 5. EVMS Chart for a Well Performing Project

The second observation is a peak in incremental work performed (BCWP), work scheduled (BCWS), and actual costs (ACWP) during August 2020 (roughly 50% of project duration) which is expected for a well-executed project. The standard "S" shape is typical due to slower rate of work performed during the earlier and later stages of a project. The third observation is the linear trend line (graphical feature) for the BCWP cumulative data. This is important for predictive or forecasting accuracy. In Figure 5, this trend line intersects the TPC line in approximately February 2022, indicating the project could finish before the planned completion and CD-4 date.

Figure 6 illustrates how the estimate at completion (EAC) can be estimated by comparing ACWP and BCWP trendlines at any stage of a project. As a reminder, EAC utilizes the cost performance index (CPI) to estimate costs at completion. Two of the most utilized formulas are: EAC = ACWP + (BAC-BCWP)/CPI or more simply EAC = BAC/CPI, as shown in Figure 6. This project may reach project completion (CD-4) in May 2024 approximately 17 months after the approved CD-4 date of December 2022. Additionally, the EAC is predicted to be roughly $304 million, or roughly $30 million over the Total Project Cost (TPC) and Budget at Completion (BAC).

Figure 6. EVMS Chart for a Challenging Project

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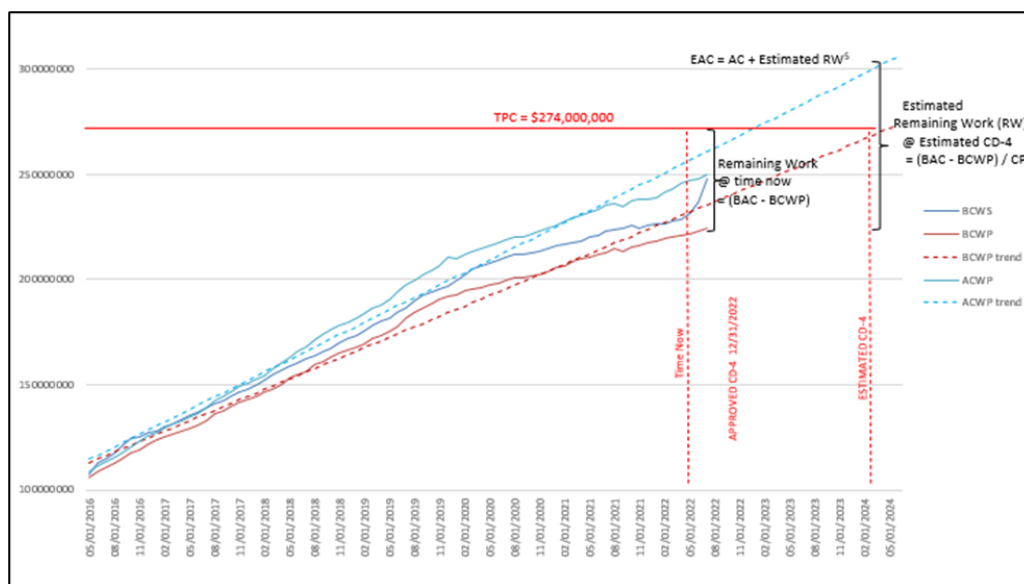
[3] CPI = Cost Performance Index = BCWP / ACWP

[5] RW = Remaining Work = BAC- BCWP

Cumulative Versus Period-Specific Trends. This article's final trend analysis concept involves looking at specific periods of performance as opposed to the cumulative results. Major league baseball is a good example — would one rather predict a pennant winner based on the complete 162 game record or a team's record from mid-July to the end of the season? Project performance can be similar in that contractors have distinct periods of good and poor performance. Predicting future performance might be most accurate considering the most recent six or twelve-month period or from when a project was re-baselined.

Take for example Figure 7. As shown, BCWP and ACWP are well correlated but are significantly less than the planned value (BCWS), resulting in a small CV and a significant SV. The key question is: can this project recover? The TPC and BAC are not graphed based on the detailed analysis of the previous example; however, one can clearly see how using the 6-period BCWP trend will result in more favorable EAC and estimated completion date than the cumulative BCWP trend.

In fact, at "time now" there is a $4.8 million difference between the two trend lines, and six months into the future this difference will grow to $9.8 million. It should be noted in this example that the estimated completion date is December 2024, the TPC is $95 million, and that the predicted completion date and EAC will differ significantly according to which trend line is used for the calculations.

Conclusion. As mentioned at the beginning of this article, users are encouraged to experiment and learn about the *Empower* capabilities separately from the ideas presented here. *Empower* capabilities of being able to isolate variances within a project's WBS, and to use graphical trend analysis, gives the project manager, Federal Project Director, and project analyst a wide array of tools to diagnose existing problem areas as well as to predict future performance.

*Figure 7. Forecasting Differences
Using Cumulative vs. 6-Period Trends*
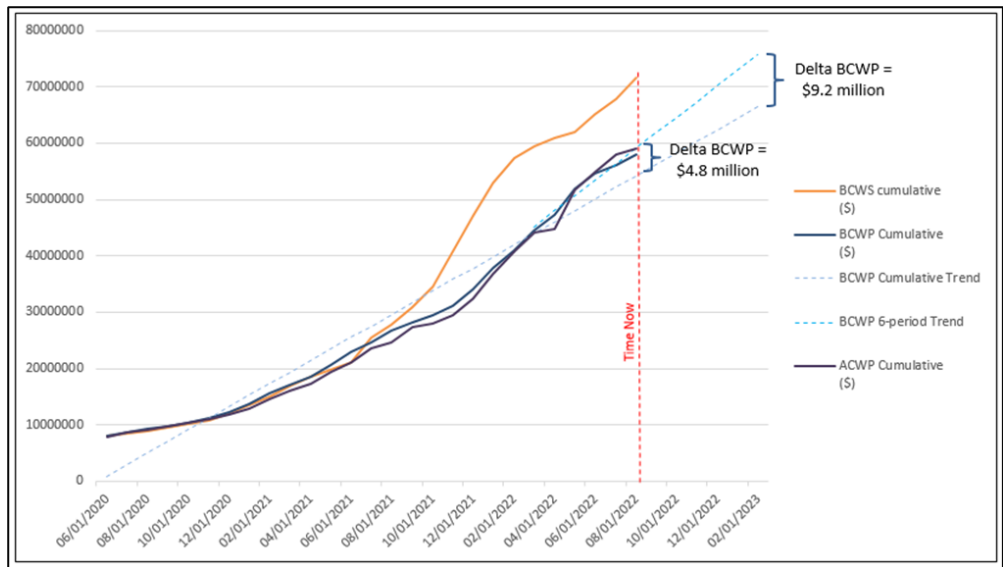
Congratulations to our newly certified FPDs!

Level III

Tom Fletcher (EM)

Fred Overbay (NA)

Level IV

Tom Fletcher (EM)

IP2M METRR—Analysis and Management Reporting

Daniel Goldsmith, Office of Project Controls and Policy (PM-30)

This is the fourth in a series of articles focused on the ten management subprocess areas identified in the *Integrated Project/Program Management (IP2M) Maturity and Environment Total Risk Rating (METRR) using EVMS*. The purpose of these articles is to introduce and explore each of the subprocess areas and their respective attributes. This month's article will focus on the Analysis and Management Reporting subprocess area (F). The ten management subprocesses, each further defined by a total of 56 attributes, are as follows:

A. Organizing (*November 2022*)
B. Planning and Scheduling (*August 2022*)
C. Budgeting and Work Authorization
D. Accounting Considerations
E. Indirect Budget and Cost Management
F. Analysis and Management Reporting
G. Change Control
H. Material Management
I. Subcontract Management
J. Risk Management (*September 2022*)

The IP2M METRR is an assessment mechanism developed as part of a Department of Energy (DOE)-sponsored joint research study led by Arizona State University (ASU), representing 15+ government and industry organizations (https://ip2m.engineering.asu.edu/). The IP2M METRR defines maturity levels for each of the 56 attributes across the ten management sup-processes to facilitate a consistent method for not only assessing the compliance of an earned value management system (EVMS) with industry standard EIA-748, but also to ensure that project/program participants are working with current, accurate, complete, repeatable, auditable, and compliant data and information to manage their work, leading to successful project/program performance.

The Analysis and Management Reporting subprocess area is focused primarily on variance analysis, implementation of corrective actions, and the

There are a total of 5 attributes that make up this subprocess area:

F.1. Calculating Variances
Variances are calculated, traceable, and reconcilable with source inputs from the EVMS and the accounting system.

F.2. Variances to Control Accounts (CAs)
Variance analysis exceeding thresholds that have an impact on the project are analyzed and reported for each CA.

F.3. Performance Measurement Information
Performance measurement data are summarized from the CA level to the WBS and OBS level, and support management needs and customer reporting.

**F.4. Management Analysis and Corrective Actions**
Analysis and corrective actions are documented, approved, and used monthly with managerial actions and are commensurate with risks identified to the project.

F.5. Estimates at Completion (EAC)
CA EACs and the range of project level EACs are generated at least monthly and commensurate with the risk identified to the project.

These 5 attributes account for approximately 11% (109 pts) of the 1,000 total possible points of the maturity model at level 5 (breakout can be seen in Figure 1 below).

Figure 1. Weighting of All 10 Subprocesses
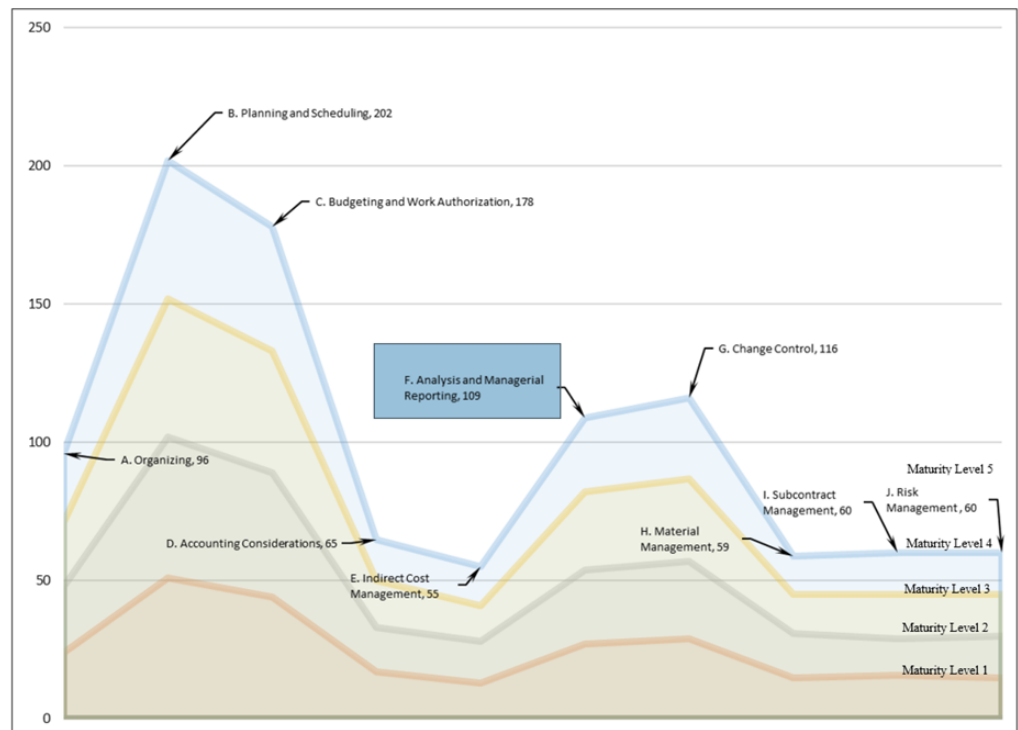
The individual attribute weights range from 17 to 26 points, with three of the five attributes (F.3, F.4, and F.5) in the list of the top 20 attributes with highest available points, which tells us that each attribute in this area is critical and should not be overlooked or minimized.

The first two attributes focus on variances, ensuring that the project identifies and analyzes variances (cost and schedule) on at least a monthly basis. Part of the verification involves checking that the EVMS method used to derive budgeted cost for work performed (BCWP) is the same technique that was applied when the associated work was planned and resourced. This is **critical to identifying the root causes of the variances and establishing the proper corrective actions that solve the issue and prevent it from reoccurring**. Another key tenant within these two attributes is verifying that thresholds for variance analysis are defined, and when variances exceed documented thresholds, the **impacts to the project for each flagged CA have been analyzed, documented, and reported**.

The third attribute focuses on performance measurement data. The data and associated variances should be summarized from the CA level through the work breakdown structure (WBS) and organizational breakdown structure (OBS) levels for proper management oversight and to support managements needs as well as customer reporting.

This is especially important in establishing budget integrity and reconciliation; **it ensures that the information being reported to customers is from the same source as used by internal contractor management**.

The fourth attribute hones in on the analysis and corrective actions related to variances that tripped established thresholds. It checks that corrective actions are tracked to closure and investigates if **management uses the EVMS performance data to make decisions commensurate with risks identified on the project.**

The fifth attribute checks that EACs are generated at least monthly and are **proportionate to the identified project risks**. There are several associated checks and metrics to confirm the realism and validity of the EACs. Another key consideration in this area is how the indirect cost performance impacts the overall project cost. This requires reviewing the direct/indirect rates to ensure they are up-to-date and used to value ETC resources based on the most current rate tables. This is critical for ensuring that the latest estimates take into account the current rates for accurate reporting of the projects expected costs.

More detailed descriptions of these and other attributes and criteria are contained in the DOE PM's *Compliance Assessment Governance (CAG)*.

EVMS Training Snippet of the Month:
Periodic and Comprehensive Estimate at Completion (EAC)

Click here to view EVMS Training Snippet 5-1: Periodic and Comprehensive Estimate at Completion (EAC) video.
Click here to view EVMS Training Snippet 5-1: Periodic and Comprehensive Estimate at Completion (EAC) PowerPoint Slide.

Summary: This EVMS Training Snippet, sponsored by the U.S. Department of Energy's Office of Project Management discusses the process and results associated with Periodic and Comprehensive EACs. The purpose is to provide a common understanding within DOE and among DOE contractors, and to provide consistency in understanding the differences and similarities in conducting a Periodic or monthly EAC versus a comprehensive or bottom up EAC.

Continuous Learning Points (CLPS): Reviewing one hour of snippets will equate to one CLP. To receive credit, FPDs can submit a CLP request under the PMCDP menu in their ESS account. All others may send an email (indicating the snippets viewed) through their respective supervisor to DL-PM-40 to receive a certificate with the appropriate CLPs awarded.

You can find additional EVMS Training Snippets and PowerPoint slide downloads at the following links:

https://go.usa.gov/xubjT OR https://go.usa.gov/xubjm

PMCDP Training Schedule

Where's the PMCDP training schedule? It is not here, so where is it?

The FY 2023 PMCDP training schedule is built from inputs received since August 2022 to the PMCDP FY2023 Training Needs Analysis (TNA). The schedule is being finalized and will be posted in January 2023. All classes will be offered at least once with many being offered multiple times, based on the demand indicated in the analysis/survey data. One way to ensure the schedule includes courses you need is to complete the PMCDP FY2023 Training Needs Analysis (TNA). The survey includes all virtual PMCDP courses except the COR training which is available through the Federal Acquisition Institute (FAI) Cornerstone On Demand (CSOD). PMCDP on demand courses are not included in the survey and are available through the Learning Nucleus.

You can complete the survey only one time as your email contact information is saved along with your course selections for the coming year. All the course selections are accumulated in the TNA data results to show the demand for training. When the courses you indicated you need in the coming year become available, you will receive a notice alerting you to register for the upcoming class. Remember, the classes are virtual; so, you will need to schedule the training into your daily work plan.

If you haven't completed the FY2023 Training Needs Analysis (TNA), please do so by December 30, 2022. Your input will be added to the TNA survey data and you will be notified when classes you need become available.

Mark your calendar!

2023 DOE Project Management Workshop

Washington DC   *April 11-12, 2023**   *Registration Begins in February*

* Plus: Optional Project Controls Session April 13, 2023

The PM Workshop overlaps with the National Cherry Blossom Festival (March 20 – April 16, 2023) so book your hotel early and enjoy Washington DC in the Spring! Ctrl+Click to follow the hotel link:

2023 DOE Project Management Workshop Room Block_ Hilton Washington DC National Mall

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Contact Us!

The Office of Project Management welcomes your comments on the Department's policies related to DOE Order 413.3B. Please report errors, omissions, ambiguities, and contradictions to: PMpolicy@hq.doe.gov. Propose improvements to policies at: https://hq.ideascale.com.

If you have technical questions about PARS, such as how to reset your password, please contact the PARS Help Desk at: PARS_Support@Hq.Doe.Gov. And, as always, PARS documentation, Frequently Asked Questions (FAQs) and other helpful information can be found at Support : PARS Support (doe.gov). The current PARS reporting schedule is located on PM-MAX at the following link: https://community.max.gov/x/m4lIY.

Need information to apply for FPD certification? The Certification and Equivalency Guidelines (CEG) can be found here: https://community.max.gov/x/IQd1Qw.

Can't put your finger on a document or information you were told is available on PM-MAX? Looking for information on DOE Project Management? Submit your questions and queries to: PMWebmaster@doe.gov.

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If you would like to contribute an article to the Newsletter or want to provide feedback, contact the Editor at DL-PM-40.