Earned Value Management System (EVMS) and Project Analysis Standard Operating Procedure (EPASOP)

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1. PURPOSE. This EVMS and Project Analysis Standard Operating Procedure (EPASOP) serves as a primary reference for PM-20 when conducting project-level data analysis at the PMB level to support Monthly Project Assessments and other assessment needs. The results of the analysis and tools herein also support PM-30 EVMS Compliance Review data analysis (reference ECRSOP), and other project assessments where EVM data is contractually required. This SOP refers to several Project Assessment and Reporting System (PARS) reports and provides instruction on interpretation of data to support project performance, predictive analysis, and identification of concerns with the contractor's EVMS.

2. APPLICABILITY. This SOP applies to PM-20 and PM-30 and is available for use outside PM.

3. RELEASABILITY – UNLIMITED. This SOP is approved for public release.

4. SUPERSEDES. This SOP supersedes the EPASOP dated March 2014.

5. EFFECTIVE DATE. This SOP is effective immediately.

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1.0 INTRODUCTION

The Department of Energy's Office of Project Management (PM) PM-20 Project Analysts perform project-level analysis to support their Independent Monthly Project Assessments that are entered in PARS. This EVMS and Project Analysis Standard Operating Procedure (EPASOP) provides guidance on the analysis process, using key PARS Empower dashboards, views, charts, and reports, as well as the PARS Project Summary excel file to adequately assess the contractor's EV cost and schedule data at the Performance Measurement Baseline (PMB) level which is a step towards Performance Baseline (PB) analysis. Refer to the Project Analyst Desk Guide in PM-MAX for guidance to prepare the Monthly Project Assessment. This SOP may also be helpful for others (contractor, FPD, Program) who conduct project performance at the PMB level and/or where EVMS knowledge and application are required.

For programs containing multiple projects, this project analysis plan focusing on conducting the analysis at the lowest level to identify performance issues at the project, Work Breakdown Structure (WBS), and Control Account (CA) levels. It is not unusual when conducting analysis at too high of a level to miss a growing concern on one project's performance that was masked by another project's favorable performance.

An integral part of successful project management is having current, accurate, complete, repeatable, auditable, and compliant data. Project managers and their teams perform best when they are well informed. The goal of EVM analysis is to provide consistent and timely insight to project status in order to enable timely, effective management decisions. In conjunction with conducting project analysis, the health of the contractor's EVMS is assessed through analysis of cost and schedule data. This SOP covers analysis primarily from a project performance level; however, where a contractor's EVMS compliance may be of concern, the Project Analyst should alert PM-30 so they may conduct more detailed testing of data using compliance tests in the ECRSOP. These areas are identified in this SOP by the following text: ***Concerns in this area not only apply to Project performance but also to systemic concerns with the contractor's EVMS.***

2.0 PROJECT ANALYSIS PLAN

The framework for analysis outlines sequential steps taken when conducting project-level analysis using the Contractor's data uploaded in PARS in accord with PARS Contractor Project Performance (CPP) Upload Requirements Document. The PMB is a time-phased budget plan for accomplishing work, against which project performance is measured. The PMB includes all effort as described in the Statement of Work (SOW) or Project Execution Plan (PEP), from CD-2 through Post CD-4 closeout effort. Post CD-4 activities are comprised of all activities chargeable against project costs including data deliverables, such as PARS reporting, Lessons Learned, and Initial Closeout Report submittal (ref. DOE O 413.3B, Table 2.4).

By following this Analysis Plan, the Analyst can assess EVMS data validity, identify sources of current and past performance issues, determine if recent corrective actions were successful in improving performance, and assess baseline stability and reasonableness of the Estimate at Completion. After the analysis is complete, the Analyst can determine, based on issue severity and potential impact to CD-4 and/or Estimate at Completion (EAC), as to which issues warrant being covered in the Monthly Project Assessment.

This framework is applicable to the following types of situations:

- Monthly by the Analyst to gain insight for use in the preparation of monthly project assessments
- During EVMS Compliance Reviews to determine if systemic issues warrant a closer look at the contractor's EVMS
- Prior to any post CD-2 project review, such as Peer Review, EIR, etc.
- Prior to any EVMS-related or project-level briefing with focus on project performance

The analysis framework includes the following processes:

1. Assess data validity
2. Assess schedule health
3. Analyze variances
4. Analyze trends
5. Forecast performance

Consistent with the analysis framework provided in this document, dashboards in PARS Empower are available to any PARS user to support this process. The dashboards, charts, reports, and views referenced in this SOP are listed in Table 1. In addition to these dashboards, the Analyst can check for retroactive changes in a project's Project Summary report Excel Workbook using the Retroactive Changes Worksheet, and EAC Funding Requirements Worksheets.

Table 1. Recommended PARS Empower Dashboards, Charts, Reports, Views

DASHBOARD	CHART	REPORT	VIEW
Data Validity	DOE Data Validity	Validity	DOE Data Validity
Schedule Health	DOE Schedule Health	Schedule Assessment	DOE Schedule Health
Variance Analysis	DOE Variance Analysis	Six Period Summary	DOE Variance Analysis
Trend Analysis	1. DOE Trend Analysis 2. Schedule Execution Indexes 3. MR-UB Trends	1. Earned Schedule 2. BCWS Volatility	1. DOE Trend Analysis 2. Earned Schedule
Forecast	DOE Forecast (EAC to IEACs)	1. Six Period Summary 2. AI Narrative Report (EAC Analysis)	1. DOE Forecast 2. CPI vs TCPI EAC

2.1 ANALYSIS PLAN STEP 1: DATA VALIDITY

Earned value data is ultimately used to manage the project and make informed decisions and projections. The first step of the Analysis Plan is to assess data accuracy and reliability. Data integrity indicators are metrics designed to provide confidence in the quality of the data being provided from the contractor's EVM System. Many of the other metrics described in this EPASOP are designed to provide insight into the performance of a project. If a contractor's data has one or more of the conditions being tested for by these metrics, the Analyst should investigate further and confer with PM-30 for system compliance purposes.

Refer to the Data Validity Dashboard in Figure 1. As the name ‘Data Validity’ suggests, these metrics provide an indication of the validity and accuracy of EVM data produced by the contractor for management decision making. ***Concerns in this area not only apply to Project performance but also to systemic concerns with the contractor’s EVMS.*** When there are issues with the integrity of the data, the data is less useful in terms of further analysis.

OCT 19 WBS Dollars :: DOE Data Validity :: DOE Data Validity

WBS	DESCRIPTION	LL	Level	Element Type	EVM	CAM	DQI Flag	VAR Required	Number of Tasks	Percent Complete	Negative BCWS Cur	Negative BCWP Cur	Negative ACWP Cur	BCWS Cum > BAC	BCWP Cum > BAC	ACWP Cum > EAC	ACWP Cum with no BAC	ACWP Cur with no BAC	BCWP Cum with no ACWP	Completed Work with ETC	Incomplete Work without ETC
3			1				EF	s	8195	91.61	0	0	1	0	0	0	0	0	1	2	0

Figure 1. PARS Empower Data Validity Dashboard

The metrics listed below are discussed in detail in the following paragraphs:

- Negative BCWS, BCWP, or ACWP entries in current period
- $BCWS_{CUM}$ > BAC
- $BCWP_{CUM}$ > BAC
- $ACWP_{CUM}$ > EAC
- $ACWP_{CUM}$ with no BAC
- $ACWP_{CUR}$ with no BAC
- $BCWP_{CUM}$ with no ACWP
- Completed Work with ETC
- Incomplete Work without ETC

The Validity Report in Figure 2 shows the results based on the current period of data.

Validity Report	
WARNING	
No EAC	EAC = 0
BAC change without corresponding EAC change	BAC (cp-1) <> BAC (cp), and EAC (cp-1) = EAC (cp)
Estimate to Complete is zero, yet task is not complete	ETC = 0 and BAC > BCWP (cum)
EAC is optimistic	CV (cum) < VAC
	EAC < CPI Forecast
Original Negotiated Cost plus Negotiated Changes does not equal Current Negotiated Cost	NegCost (orig) - NegCost (cp) - NegChg (cp) > 0
Contract Budget Base + Format 1 Reprogramming Adjustment for Budget does not equal the Format 3 Total Allocated Budget	CBB - ReprogBudg - TAB > 0
Format 3 calculated final BCWS period end (2019-10-31) not consistent with IMS baseline finish date (2022-04-29)	Format 3 current + 6 + out periods not in same period as last schedule (IMS) baseline finish date
INFORMATION	
BAC change	BAC (cp) <> BAC (cp-1)
CUR CPI Forecast is unreliable	ACWP (cp) <= 0 or BCWP (cp) <= 0
3 PER AVG Forecast is unreliable	BCWP (cp-3) <= 0 or ACWP (cp-3) <= 0
6 PER AVG Forecast is unreliable	ACWP (cp-6) <= 0 or BCWP (cp-6) <= 0
CUM CPI Forecast is unreliable	BCWP (cum) <= 0 or ACWP (cum) <= 0
CPI*SPI Forecast is unreliable	BCWS (cum) <= 0 or BCWP (cum) <= 0 or ACWP (cum) <= 0
MICOM Forecast is unreliable	BCWS (cum) <= 0, BCWP (cum) <= 0, BCWP (cp-6) <= 0, or BCWS (cp-6) <= 0
COST & SCH Forecast is unreliable	BCWS (cum) <= 0, BCWP (cum) <= 0, or ACWP (cum) <= 0

Figure 2. PARS Empower Validity Report

2.1.1 NEGATIVE $BCWS_{CUR}$, $BCWP_{CUR}$, $ACWP_{CUR}$

The budgeted cost of work scheduled (BCWS) is the time-phased project budget. The summation of BCWS for all reporting periods equals the total project budget at completion. When the initial baseline is established there should be no instances of negative BCWS. However, as work progresses there may be legitimate reasons for re-planning of budget. Negative BCWP in the current period indicates that previously claimed performance is being backed out. While this might occur due to re-plan actions it should be explained. Negative ACWP in the current period indicates prior charges are being backed out. This may be due to routine accounting adjustments or correction of errors. **Instances of current period negative values should be investigated further to determine the root cause.**

While negative values in the current period may be valid, they should be investigated. Authorized changes to previously reported data must be reflected in the current period BCWS, BCWP, or ACWP – never made retroactively to previously reported periods. The Retroactive Changes Report (in the Project Reports Tab – Project Summary Excel workbook), discussed in greater detail in section 2.1.10, shows when reported history was changed by comparing each monthly upload of data.

2.1.2 $BCWS_{CUM}$ > BAC

The BCWS is the project budget time-phased over the period of performance. The summation of BCWS for all reporting periods should always equal the budget at completion (BAC) for the same level. In other words, the $BCWS_{CUM}$ should equal BAC on the month the project is planned to complete. **If $BCWS_{CUM}$ is greater than BAC, consider this an error in the EVMS and pursue corrective action.**

2.1.3 $BCWP_{CUM}$ > BAC

The budgeted cost of work performed (BCWP) is the amount of BCWS earned by the completion of work to date**. The $BCWP_{CUM}$ may not exceed the value of BAC. The project is considered complete when $BCWP_{CUM}$ equals BAC. If $BCWP_{CUM}$ is greater than the BAC, consider this an error.**

2.1.4 $ACWP_{CUM}$ > EAC

The Estimate at Completion (EAC) consists of two components, the actual costs incurred to date ($ACWP_{CUM}$) plus the estimate of all future costs, i.e. the Estimate to Complete (ETC). **The $ACWP_{CUM}$ can only be greater than EAC if the ETC is negative; i.e. indicating that previously reported ACWP will be reduced. There may be limited cases that would require a negative ETC, although not the norm. If this condition exists, further investigation is required.**

2.1.5 $ACWP_{CUM}$, $ACWP_{CUR}$, or EAC WITH NO BAC

The actual cost of work performed (ACWP) is the total dollars spent on labor, material, subcontracts, and other direct costs in the performance of the contract statement of work. These costs are controlled by the accounting general ledger and must reconcile between the accounting system and EVMS. Work should only be performed if there is a clear contractual requirement. **If there are Work Breakdown Structure (WBS) elements that contain EAC or ACWP but no BAC, consider this an issue that needs to be investigated.**

2.1.6 BCWP WITH NO ACWP

Since work or materials must be paid for, it is not possible to earn BCWP without incurring ACWP. For material receipts not yet billed, the contractor is expected to use estimated actuals to report ACWP in the same period as the BCWP, thus avoiding false variances. This condition may also occur for elements using the Level of Effort (LOE) earned value technique. In this case, it would signify the support work that was planned to occur is not occurring due to some delay. The delay is likely in the work the LOE function would support. **Either way, this condition should be further investigated to determine the root cause.**

2.1.7 COMPLETED WORK WITH ETC

Work is considered complete when the Control Account (CA) or Work Package (WP) $BCWP_{CUM}$ equals BAC. The estimate to complete (ETC) is the to-go portion of the estimate at completion (EAC). **The ETC should be zero if the work is complete, as there should be no projected future cost left to incur.** This condition may exist if labor or material invoices have not been paid yet which indicates improper use of estimated actuals (also referred to as 'accruals'). This situation requires investigation to determine the root cause and corrective action.

2.1.8 INCOMPLETE WORK WITHOUT ETC

This metric is the opposite of section 2.1.7 of this SOP. If work has not been completed, there should be a forecast of the remaining costs to be incurred. **If this condition exists, consider it an error that requires corrective action.**

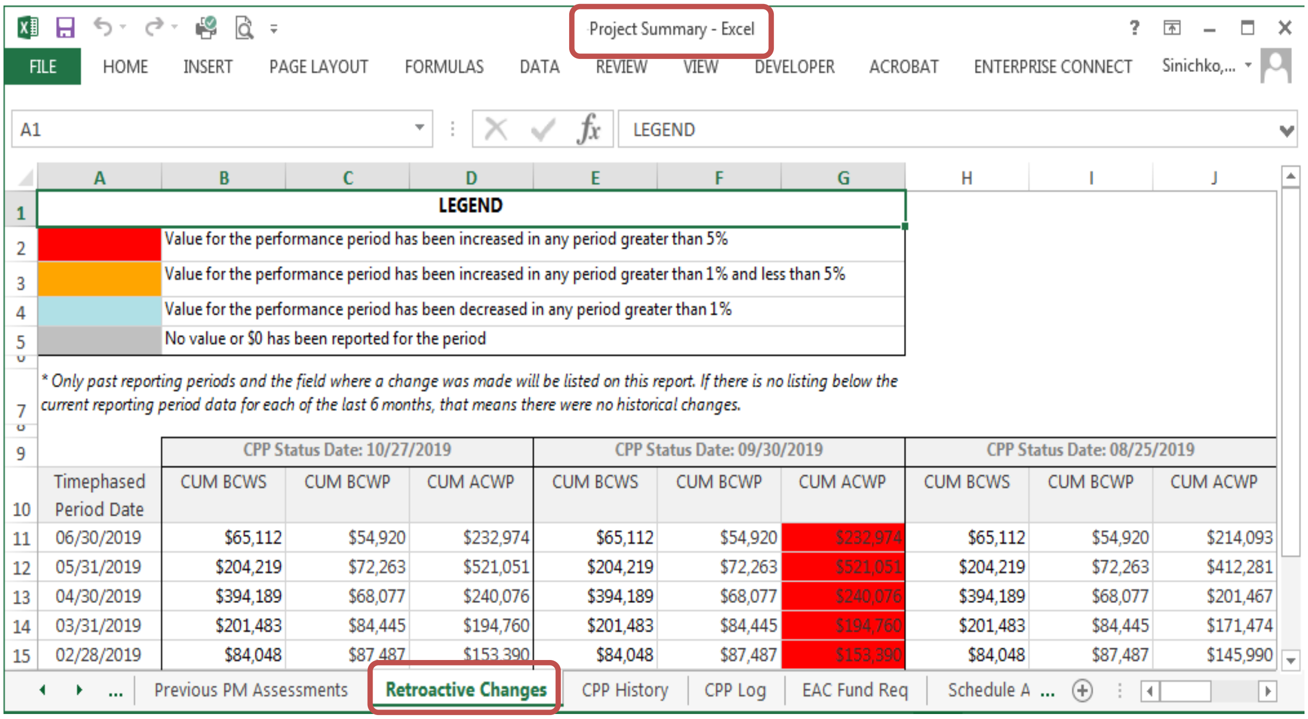
2.1.9 BCWS WITHOUT BCWP AND ACWP

This indicator identifies active open control accounts where work is scheduled in the current period; however, no performance or costs have been reported. **This is not an error but may point to performance issues.**

2.1.10 RETROACTIVE CHANGES

The accuracy of reported data becomes suspect when changes are made to previously reported periods. This is referred to as retroactive changes or changing history and is an EVMS compliance issue. If a contractor determines that previously reported data contained errors or needs to be adjusted, they must reflect the adjustments in the current reporting period. This provides visibility of the change and the contractor also explains the reasons for any changes in the Format 5 of the Integrated Project Management Report (IPMR).

Should a contractor make a change to prior periods instead of in the current period, it would be difficult to monitor without using the PARS Project Summary excel workbook, tab - Retroactive Changes Report (Figure 3). This report is found in PARS, on the left side of the screen, by selecting Project Reports. The report highlights discrepancies in Earned Value data reporting based on the time-phased data reported in the last 6 reporting periods. Only past reporting periods and the field where a change was made are listed on this report. If there is no listing below the current reporting period data for each of the last 6 months, that means no historical changes were made. The report identifies retroactive changes made to previously reported BCWS, BCWP, and ACWP data, as well as negative BCWS values that are planned for future periods. While this report covers a 6-month window, it should be reviewed every 1 to 3 months to allow for real-time investigation.



LEGEND									
[red]	Value for the performance period has been increased in any period greater than 5%								
[orange]	Value for the performance period has been increased in any period greater than 1% and less than 5%								
[light blue]	Value for the performance period has been decreased in any period greater than 1%								
[grey]	No value or $0 has been reported for the period								

* Only past reporting periods and the field where a change was made will be listed on this report. If there is no listing below the current reporting period data for each of the last 6 months, that means there were no historical changes.

	CPP Status Date: 10/27/2019			CPP Status Date: 09/30/2019			CPP Status Date: 08/25/2019		
Timephased Period Date	CUM BCWS	CUM BCWP	CUM ACWP	CUM BCWS	CUM BCWP	CUM ACWP	CUM BCWS	CUM BCWP	CUM ACWP
06/30/2019	$65,112	$54,920	$232,974	$65,112	$54,920	$232,974	$65,112	$54,920	$214,093
05/31/2019	$204,219	$72,263	$521,051	$204,219	$72,263	$521,051	$204,219	$72,263	$412,281
04/30/2019	$394,189	$68,077	$240,076	$394,189	$68,077	$240,076	$394,189	$68,077	$201,467
03/31/2019	$201,483	$84,445	$194,760	$201,483	$84,445	$194,760	$201,483	$84,445	$171,474
02/28/2019	$84,048	$87,487	$153,390	$84,048	$87,487	$153,390	$84,048	$87,487	$145,990

Figure 3. Retroactive Changes: PARS Project Reports, Project Summary, Retroactive Changes Tab

Examples of valid reasons to change previously reported data include:

- Negotiated indirect rates or overhead rate adjustments: While the impact of the rate changes may go back to the beginning of the fiscal year; the sum of the impact is reported in the ACWP for the reporting month that the customer negotiated and authorized the change.
- Clerical errors that effect BCWS, BCWP, and ACWP should be corrected as soon as discovered.
- Work/cost transfers occur when it is discovered that the work was erroneously assigned to an incorrect WBS.
- Work in process termination: When an open work package is not to be completed, BCWS and BAC are set equal to the BCWP.
- Adjustments to previously reported ACWP when actual costs replace estimated actuals.

While these kinds of changes are acceptable, an excessive amount may indicate the system lacks discipline and these changes should be documented. Questions to ask when changes have been identified include:

1. Why was budget removed? Was scope removed?
2. Does the rationale meet EIA-748 Guideline 30, e.g. correction of errors, routine accounting adjustments, effects of customer or management directed changes, or to improve the baseline integrity and accuracy of performance measurement data?
3. Why was the change made to history rather than in current period?

2.2 ANALYSIS PLAN STEP 2: ASSESS SCHEDULE HEALTH

The project schedule and budget are an integrated time-oriented plan for accomplishment of work scope requirements on a project. Schedule planning and control, budget planning and control, work scope definition, and project risk handling are necessary prerequisites for basic and effective project management control. The second step of the analysis plan is to assess the health of the schedule. This step may also be done in preparation for EVMS review, review of a major schedule restructure, and whenever schedule health is a concern. A sample of the DOE Schedule Health Dashboard is provided in Figure 4.

19 WBS Dollars :: DOE Schedule Health :: DOE Schedule Health

WBS	DESCRIPTION	LL	Level	Element Type	EVM	CAM	DQI Flag	VAR Required	Number of Tasks	Percent Complete	No Logic	Lead	Lag	Start Finish Relationship	Start Start Relationship	Finish Finish Relationship	Hard Constraint	High Float	Float < 0	High Duration	Forecast Start < Status Date	Forecast Finish < Status Date	Actual Start > Status Date	Actual Finish > Status Date	Finish Finish Relationship with Actual Finish > Baseline Finish
1	Project		1				EF	sc	13465	99.42	1	0	1	0	50	93	0	0	755	7	0	0	0	0	2536

Figure 4. PARS Empower Schedule Health Dashboard

Concerns in this area not only apply to Project performance but may also to systemic concerns with the contractor's EVMS. The following metrics provide the analyst with a framework for asking educated questions and performing follow-up research. The identification of a triggered metric is not in and of itself synonymous with failure but rather an indicator or a catalyst to dig deeper in the analysis for understanding the reason for the situation. Consequently, correction of that metric is not necessarily required but it should be understood.

2.2.1 LOGIC

Logic, used in the scheduling sense, is the relationship tasks have to each other. The objective of this metric is to ensure each task has at least one predecessor and successor link, i.e. logic links. Discrete tasks must be linked (have predecessors and successors) in order to properly calculate the Total Float in the project. If the logic is missing, the true critical path for the project is unknown. Even if links exist, the logic still needs to be verified to ensure that the links make sense. Incomplete tasks missing predecessors and/or successors are included in this metric. If this metric yields the result of greater than 5%, it should be considered a flag and justifies further investigation of contractor's schedule to understand why missing logic-ties exist in the schedule. The formulas for calculating this metric follow.

To calculate the numerator:

[((# missing predecessors) + (# missing successors)) - (# missing both)] = # of tasks missing logic

To calculate the percentage:

[*# Tasks Missing Logic / Incomplete Task Count*] x 100 <= 5%

2.2.2 LEADS

A lead, also called a negative lag, refers to a relationship whereby the successor activity is scheduled to begin before the predecessor activity has completed. For example, say Task 1 and Task 2 have a Finish-Start relationship, so when Task 1 finishes, Task 2 can start. If when Task 2 is planned, a Lag of -1 is added to the predecessor relationship between Task 1 and Task 2, the schedule would then show that Task 2 must start 1 day prior to the last day Task 1 finished. The negative lag is called a lead. When tasks are logically linked, it is important to determine if any leads exist because the critical path and any subsequent analysis can be adversely affected by using leads. The use of leads distorts the total float in the schedule and may cause resource conflicts. In some cases, these leads are used to artificially compress the schedule which results in distorted total float values which is discussed later in this section. The reason for using leads should be documented and have proper justification (preferably in a "notes" column of the schedule).

This metric identifies the number of logic links with a lead in predecessor relationships for incomplete tasks. The critical path and any subsequent analysis can be adversely affected by using leads. The use of leads distorts the total float in the schedule and may cause resource conflicts. The goal for this metric is 0.

Calculate the numerator by counting the number of logic links with leads. Calculate the denominator, i.e. the number of logic links (sometimes referred to as the Relationship Count) or Logic Links, by counting the number of each of the four relationship types: Finish to Start (FS); Start to Start (SS); Finish to Finish (FF); Start to Finish (SF) in the predecessor OR successor column (but not both to avoid double-counting). Calculate the percentage of leads as follows:

[*# of logic links with Leads / # of logic links*] = 0%

2.2.3 LAGS

Lag refers to a relationship whereby the successor activity cannot start right after the end of its predecessor. The objective of this metric is to ensure that lags are not being used to artificially constrain the schedule. The critical path and any subsequent analysis can be adversely affected by using lags. In many cases, these lag values are appropriately used by the CAMs to represent wait times for government review, waiting for "paint to dry", etc.

The critical path and any subsequent analysis can be adversely affected by using lags. Lags should not be used to manipulate float/slack or to restrain the schedule. If lags are used to force a task to start/finish on a certain date, the schedule is being artificially restrained and this should be considered an instance of non-compliance during surveillance. The reason for using a lag should be documented and have proper justification (preferably in a "notes" column of the schedule) to discern whether the lag is being used in an appropriate manner.

The calculation is based on examining the incomplete tasks and determining the number of logic links with lags. The denominator is the number of incomplete tasks with logic links. The number relationships with lags should not exceed 5%.

[*# of logic links with Lags / # of logic links*] <= 5%

2.2.4 RELATIONSHIP TYPES

The metric provides a count of incomplete tasks containing each type of logic link.

The Finish-to-Start (FS) relationship type ("once the predecessor is finished, the successor can start") provides a logical path through the project and should account for at least 90% of the relationship types being used. The Start-to-Finish (SF) relationship type is counter-intuitive ("the successor can't finish until the predecessor starts") and should very rarely be used, and only with detailed justification. By counting the number of Start-to-Start (SS), Finish-to-Finish (FF), and Start-to-Finish (SF) relationship types, the % of Finish-to-Start (FS) relationship types can be calculated.

[*# of FS Relationships / Relationship Count*] >= 90%

2.2.5 HARD CONSTRAINTS

Schedule constraints inflict a restriction on either the start or end date of a discrete task and/or milestone. Hard constraints anchor a schedule or task in time to a specific date regardless of predecessor logic, i.e. dependencies. Soft constraints anchor a task's start or finish date, but they respect predecessor logic, thus allowing the schedule end date to move to the right should a slip occur. Because hard constraints restrict the schedule, they must be minimized to allow the network schedule to update properly and reflect current status. The calculation used to determine schedule health regarding the use of hard constraints is based on a count of incomplete tasks with hard constraints in use. Hard constraints include: Must-Finish-On (MFO), Must-Start-On (MSO), Start-No-Later-Than (SNLT), & Finish-No-Later-Than (FNLT). Soft constraints include As-Soon-As-Possible (ASAP), As-Late-As-Possible (ALAP), Start-No-Earlier-Than (SNET), and Finish-No-Earlier-Than (FNET).

Divide the total number of hard constraints by the number of incomplete tasks. The number of tasks with hard constraints should not exceed 5%.

$$\text{Hard Constraint \%} = \frac{\text{Total \# of incomplete discrete tasks with hard constraints}}{\text{Total \# of incomplete discrete tasks}} \times 100$$

2.2.6 FLOAT ANALYSIS

Float is the amount of time a predecessor activity can be delayed without impacting its successor. Total Float is the amount of time an activity can be delayed or extended before it impacts the project end date. The highest risk to schedule completion includes those activities with the lowest float values. Conversely, activities with unreasonably high amounts of total float indicate missing activities, missing or incomplete logic, and date constraints. When these things occur, the high total float gives a false sense of a cushion toward meeting the project completion date. The schedule should identify reasonable float, sometimes called slack, so that the schedule's flexibility can be determined and monitored.

When evaluating float values is it important to understand:

- Float/total float should always be greater than or equal to zero.
- Negative float indicates a problem with the schedule's achievability.
- Excessive float usually indicates there is a problem with the logic connections.

The two key metrics to focus on when conducting schedule analysis are discussed in the next two paragraphs, i.e. High Total Float and Negative Float.

<u>HIGH TOTAL FLOAT</u>

An incomplete task with total float greater than 44 working days (2 months) is counted in this metric. A task with total float over 44 working days may be a result of missing predecessors and/or successors. If the percentage of tasks with excessive total float exceeds 5%, the network may be unstable and may not be logic driven.

$$\text{High Total Float \%} = \frac{\text{Total \# of incomplete tasks with high total float}}{\text{Total \# of incomplete tasks}} \times 100$$

<u>NEGATIVE FLOAT</u>

An incomplete task with total float less than 0 working days is included in this metric. It helps identify tasks that are delaying completion of one or more milestones. Negative float also may be an indicator of a constrained activity completion date or activities completed out of sequence. Tasks with negative float should have an explanation and a corrective action plan to mitigate the negative float. Divide the total number of tasks with negative float by the number of incomplete tasks. Ideally, there should not be any negative float in the schedule.

$$\text{Negative Total Float \%} = \frac{\text{Total \# of incomplete tasks with negative total float}}{\text{Total \# of incomplete tasks}} \times 100$$

Empower has additional tools to look at float slips and latest finish. Under Options, make sure under "Set Gantt Options" that "Show Late Finish" and "Show Slips" are turned on. What this does in a Gantt view is add the light grey to black marks which show what the schedule recorded for finish over the past four reporting periods and the red mark which show the late finish, or the point to which if the activity slips, it will be out of float. These values also are available by hovering over the status bar in the Gantt and shows information on the activity to include the current period Finish date, and Finish 1, 2, and 3 which are what the status schedule reported as finish for the past three period prior. The slips in an activity are apparent and shows if an activity is getting close to the late finish.

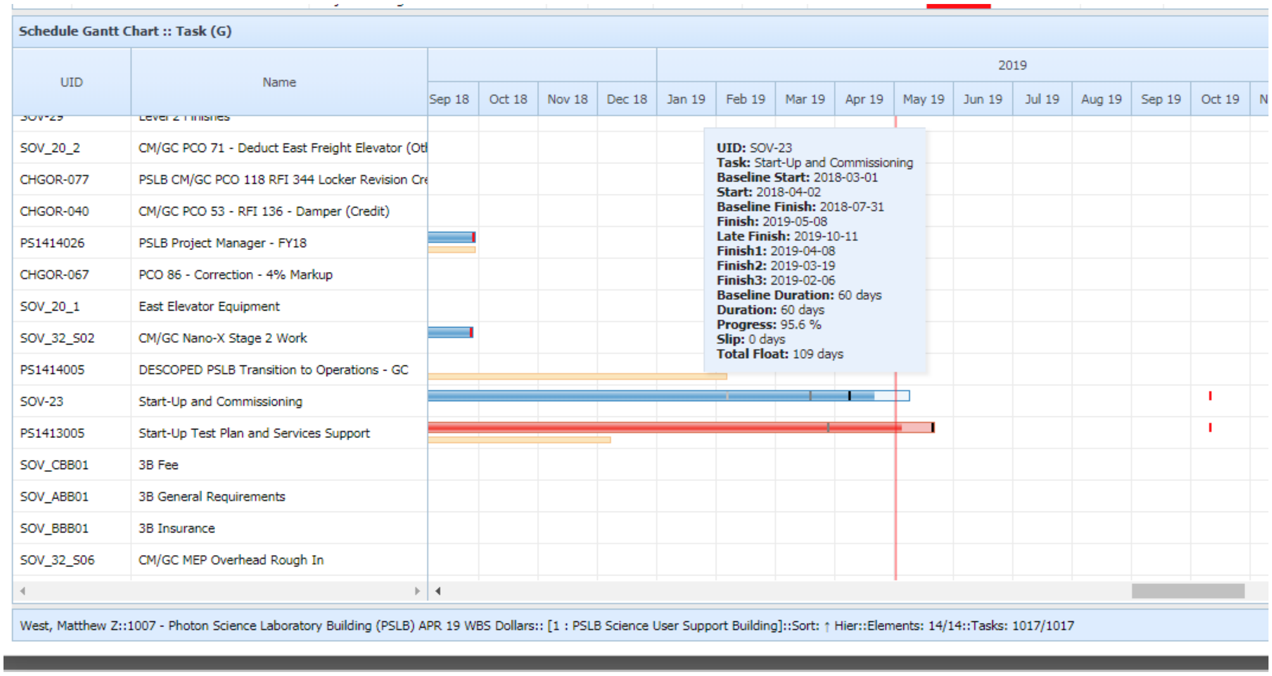


Figure 5. Using Empower to Show Slip and Late Finish

2.2.7 HIGH DURATION

Duration is the estimated amount of time to complete a task. The purpose of monitoring durations is to ensure that baseline durations are realistic and manageable. The rationale behind this metric is that a task with baseline duration greater than 44 working days should be analyzed to determine whether it can be broken into two or more discrete tasks rather than one. By breaking down the tasks into smaller pieces, it is likely that the tasks will be more manageable and provide better insight into cost and schedule performance. However, care should be taken not to break larger tasks into smaller tasks simply to meet a threshold.

Divide the number of incomplete tasks with high duration tasks by the total number of incomplete tasks. The number of tasks with high duration should not exceed 5%.

$$\text{High Duration \%} = \frac{\text{Total \# of incomplete tasks with high duration}}{\text{Total \# of incomplete tasks}} \times 100$$

Note: rather than 44 days, the customer may specify a different value. Therefore, the goal may vary from project to project. This goal should be consistent with accepted system description. In absence of detailed guidance regarding durations of work correlating with EVM techniques, the default is 44 days (which represents 2 months).

2.2.8 INVALID FORECAST DATES

These are shown on the dashboard as Forecast Start < Status Date and Forecast Finish < Status Date. The objective of this metric is to ensure that forecast start and forecast finish dates are being updated for incomplete tasks. A task should have forecast start and forecast finish dates that are in the future relative to the status date (sometimes called the data date) of the IMS. Tasks that have forecast start and/or finish dates that do not meet the criteria are invalid and indicate that the IMS has not been properly statused. Accurate and updated forecast dates are necessary for good project management, for calculating a valid critical path, and for EVMS compliance in general.

There should be zero tasks with invalid forecast start and/or finish dates. The formula is:

[# of tasks with Invalid Forecast Dates / (Incomplete Tasks Count x 2)] = 0%

2.2.9 INVALID ACTUAL DATES

The objective of this metric is to ensure that actual start and actual finish dates are valid. These are show on the dashboard as Actual Start > Status Date and Actual Finish > Start Date. A task should not have actual start and actual finish dates that are in the future relative to the status date of the IMS. Tasks that have actual start and/or actual finish dates that meet the criteria are invalid and indicate that the IMS has not been properly statused. Accurate and updated actual start and actual finish dates are necessary for good project management and for calculating a valid critical path. Additionally, invalid actual dates adversely affect "out of sequence tasks" and ultimately affect meeting the correct forecasting required to be EVMS compliant. There should be zero tasks with invalid actual start and/or actual finish dates. The formula is:

[# of tasks with Invalid Actual Dates / (Incomplete Tasks Count x 2)] = 0%

2.2.10 DOE SCHEDULE ASSESSMENT REPORT

The Schedule Dashboard includes a Schedule Assessment Report in lower right corner, based on each reporting period's data. See Figure 6 below. Also look at the Data Quality Indicator (DQI) report, Figure 7), setting the sort view to lowest level and adding a sum line in the sort view. Select this Sort view sum line and the report will have additional insight on schedule activities (noted with a DQI Flag of S) to include the activity IDs which caused concern.

Schedule Assessment

Linked Tasks	Complete Tasks	Incomplete Tasks	Incomplete Discrete Tasks	Planned Completions	Actual Completions	Relationship Count
2,988	1,773	1,215	1,215	2,565	1,643	4,660

Metric	Description	Goal	Percent	Count
Missing Task Links	Number of tasks not linked to cost elements in the current structure	0 %	0.00 %	0 / 3,962
Invalid Task Links	Number of tasks linked to an invalid cost element in the current structure	0 %	0.00 %	0 / 3,962
Baseline Execution Index	Performance relative to baseline	> 95 %	64.05 %	1,643 / 2,565

Figure 6. PARS Empower Schedule Assessment Report

Data Quality Indicators Report

Ref: DCMA-EA PAM 200.1, EVMS Program Analysis Pamphlet (PAP), Mar 2016
Planning & Scheduling Excellence Guide (PASEG), June 2012
DCMA EVMS Testing Protocols (DETP) 3.0

WARNING		
Zero budget work package	E	PAP, 5.6
ACWP CUM > EAC	E	PAP, 5.14
Budgets not identified by Element of Cost	E	DETP, 09A103a
Account with zero or negative EAC	E	DETP, 27A103a
CUM CV < VAC	E	PAP
BCWS - prior BCWS <> BCWS_c	E	DETP, 30A101d
IMS OBS does not match EV cost tool OBS	E	DETP, 03A101h
IMS WBS does not match EV cost tool WBS	E	DETP, 03A101i
BL IMS WBS does not match EV cost tool WBS	E	Custom
Greater than 7% L1 BAC and 10% L1 BCWS exceeding SV or CV thresholds in three consecutive periods	E	Custom
Number of PP/SLPPs and incomplete WPs without time-phased ETC by EOC	E	Custom
CPI-TCPI > 0.1	F	PAP, 5.13
CPI-TCPI < -0.1	F	PAP, 5.13
Missing Logic (26): UIDs CHGOR-151, CHGOR-161, CHGOR-178, CHGOR-180, CHGOR-188, CHGOR-189, PS1110005, PS1111015, PS1112015, PS1225530, PS1311018, PS1312007, PS1312017, PS1312087, PS1314850, PS1314860, PS1411020, PS1411040, PS1413015_1, PS1413016, PS1414025, PSMS1100, PSMS1375, PSMS1385, SOV-23, SOV-23RT.	S	PASEG, 10.1
No predecessor (19): UIDs CHGOR-151, CHGOR-161, CHGOR-178, CHGOR-180, CHGOR-188, CHGOR-189, PS1110005, PS1111015, PS1112015, PS1225530, PS1314850, PS1314860, PS1411020, PS1411040, PS1414025, PSMS1100, PSMS1375, PSMS1385, SOV-23RT.	S	PASEG, 10.1
No successor (18): UIDs CHGOR-151, CHGOR-161, CHGOR-178, CHGOR-180, CHGOR-189, PS1225530, PS1311018, PS1312007, PS1312017, PS1312087, PS1314850, PS1314860, PS1411020, PS1411040, PS1413015_1, PS1413016, SOV-23, SOV-23RT.	S	PASEG, 10.1
SS relationship (1): UID INSP-1010:INSP-1020.	S	PAP, 4.4
FF relationship (1): UID PS1314705:PS1411000.	S	PAP, 4.4
High float (49): UIDs CD101963 (162d), CD101965 (150d), CD101970 (150d), CHGOR-151 (159d), CHGOR-161 (150d), CHGOR-178 (152d), CHGOR-180 (153d), CHGOR-188 (162d), CHGOR-189 (156d), CLOSE-1030 (171d), INSP-1000 (165d), INSP-1010 (165d), INSP-1020 (165d), INSP-1040 (165d), INSP-1050 (165d), MS-1180 (149d), PS1110005 (142d), PS1111015 (142d), PS1112015 (153d), PS1225530 (153d), PS1311007 (142d), PS1311018 (100d), PS1311038 (142d), PS1311040 (142d), PS1312007 (100d), PS1312017 (142d), PS1312087 (142d), PS1312100 (142d), PS1312105 (142d), PS1312125 (142d), PS1314715 (142d), PS1411020 (142d), PS1411040 (142d), PS1412000 (100d), PS1412005 (100d), PS1412010 (100d), PS1412020 (100d), PS1412040 (100d), PS1413005 (100d), PS1413015_1 (100d), PS1413016 (100d), PS1414025 (149d), PSMS1095 (159d), PSMS1100 (100d), PSMS1365 (142d), PSMS1385 (100d), PSMS1395 (159d), SOV_32_S03 (142d), SOV-23 (109d).	S	PAP, 4.6
Negative float (3): UIDs PS1314705 (-33d), PS1411000 (-53d), PSMS1375 (-53d).	S	PAP, 4.7
High duration (10): UIDs PS1111015 (138d), PS1312105 (186d), PS1314705 (194d), PS1411000 (327d), PS1411020 (149d), PS1413005 (107d), PS1413015_1 (59d), PS1413016 (59d), SOV_32_S03 (52d), SOV-23 (60d).	S	PAP, 4.8
Missed target finish date (233): UIDs CD101920, CD101930, CD101935, CD101960, CHGOR-013, CHGOR-018, CHGOR-019_1, CHGOR-023, CHGOR-030, CHGOR-032, CHGOR-037, CHGOR-038, CHGOR-039, CHGOR-040, CHGOR-042, CHGOR-043, CHGOR-044, CHGOR-047, CHGOR-048, CHGOR-050, CHGOR-052, CHGOR-053, CHGOR-054, CHGOR-055, CHGOR-056, CHGOR-057, CHGOR-058, CHGOR-059, CHGOR-060, CHGOR-061, CHGOR-062, CHGOR-063, CHGOR-064, CHGOR-066, CHGOR-068, CHGOR-069, CHGOR-070, CHGOR-075, CHGOR-076, CHGOR-078, CHGOR-079, CHGOR-080, CHGOR-082, CHGOR-084, CHGOR-086, CHGOR-087, CHGOR-088, CHGOR-091, CHGOR-092, CHGOR-093, CHGOR-094, CHGOR-095, CHGOR-096, CHGOR-097, CHGOR-098, CHGOR-099, CHGOR-101, CHGOR-102, CHGOR-106, CHGOR-107, CHGOR-108, CHGOR-109, CHGOR-111, CHGOR-112, CHGOR-113, CHGOR-114, CHGOR-115, CHGOR-117, CHGOR-118, CHGOR-121, CHGOR-123, CHGOR-126, CHGOR-127, CHGOR-130, CHGOR-131, CHGOR-133, CHGOR-134, CHGOR-136, CHGOR-138, CHGOR-139, CHGOR-141, CHGOR-142, CHGOR-143, CHGOR-144, CHGOR-145, CHGOR-146, CHGOR-149, CHGOR-150, CHGOR-151, CHGOR-152, CHGOR-153, CHGOR-158, CHGOR-160, CHGOR-161, CHGOR-170, CHGOR-171, CHGOR-172, CHGOR-173, CHGOR-174, CHGOR-177, CHGOR-178, CHGOR-179, CHGOR-180, CHGOR-181, CHGOR-182, CHGOR-183, CHGOR-188, CHGOR-189, CLOSE-1000, CLOSE-1010, CLOSE-1020, CLOSE-1030, CLOSE-1040, INSP-1000, INSP-1010, INSP-1020, INSP-1030, INSP-1040, INSP-1050, MS-1180, PS1110005, PS1112015, PS1225191, PS1225192, PS1225194, PS1225195, PS1225205, PS1225220, PS1225230, PS1225490, PS1225500, PS1225510, PS1225515, PS1225530, PS1311007, PS1311018, PS1311038, PS1311040, PS1312007, PS1312017, PS1312085, PS1312087, PS1312100, PS1312105, PS1312119rt, PS1312120, PS1312125, PS1314630, PS1314705, PS1314715, PS1314800, PS1411000, PS1411010, PS1411015, PS1411020, PS1411025, PS1411030, PS1411035, PS1411040, PS1412000, PS1412005, PS1412010, PS1412015, PS1412025, PS1412030, PS1412035, PS1412040, PS1413000, PS1413005, PS1413010, PS1413015_1, PS1413016, PS1413020, PS1413020_1, PS1414015, PS1414025, PSMS1090, PSMS1365, PSMS1370, PSMS1375, PSMS1380, PSMS1385, PSMS1390, PSMS1395, SOV_11_1, SOV_13_1, SOV_15_1, SOV_16_1, SOV_19_1, SOV_20_1, SOV_20_2, SOV_22_7, SOV_26_2, SOV_28_1, SOV_32, SOV_32_1, SOV_32_S01, SOV_32_S02, SOV_32_S03, SOV_32_S04, SOV_32_S05, SOV_32_S06, SOV_32_S07, SOV_32_S08, SOV_32_S09, SOV_A04_2, SOV_A05_1, SOV_A08_1, SOV_A17_1, SOV_AA01, SOV_AB01, SOV_BA01, SOV_CA01, SOV-10_2, SOV-12, SOV-12RT, SOV-14, SOV-16, SOV-18_1, SOV-21, SOV-22, SOV-23, SOV-24RT, SOV-26RT, SOV-27, SOV-27_1, SOV-27_INT4230, SOV-27RT, SOV-28RT, SOV-29, SOV-29_1_a, SOV-29_2, SOV-30	S	PAP, 4.11

Figure 7. PARS Empower Data Quality Report - Lowest Level and Summed

2.3 ANALYSIS PLAN STEP 3: ANALYZE VARIANCES

The next step in conducting EVMS data analysis is to identify and investigate variances. This is the point where all the effort put in to develop an approved baseline plan and determining the status against that plan serves its purpose, i.e. to identify significant variances and analyze causes so corrective actions can be determined and implemented. Variance Analysis is the identification and explanation of the top cost and schedule drivers and typically involves cumulative information. Variance analysis employing current data may also be useful in identifying emerging trends that may signal concern. The WBS elements that significantly contribute to the project cost and schedule variance should be considered in the monthly assessment. Below in Figure 8 is an example of the DOE Data Variance Analysis Dashboard, focusing on schedule variance (SV) Trend, SV_{CUR}, SV_{CUR} Percent, cost variance current (CV_{CUR}) Trend, CV_{CUR}, CV_{CUR} Percent, SV_{CUM} Trend, SV_{CUM}, SV_{CUM} Percent, CV_{CUM}, CV_{CUM} Percent. Use the four Trend columns to quickly assess if a variance is worse than last month (shown by a down arrow), better (up arrow) or same (horizontal arrow). The background color also identifies how favorable to unfavorable the variance is, from blue to green to yellow to red based on criteria (refer to Empower Help Guides).

19 WBS Dollars :: DOE Variance Analysis :: DOE Variance Analysis

WBS	DESCRIPTION	LL	Level	Element Type	EVM	CAM	DQI Flag	VAR Required	Number of Tasks	Percent Complete	SV Cur Trend	SV Cur	SV Cur Percent	CV Cur Trend	CV Cur	CV Cur Percent	SV Cum Trend	SV Cum	SV Cum Percent	CV Cum Trend	CV Cum	CV Cum Percent
1	Project		1				EF	sc	13465	99.42	↓	-115,634	-1.48	↑	-2,110,657	-27.44	↔	-3,607,227	-0.18	↔	77,072,515	3.85

Figure 8. PARS Empower Variance Analysis Dashboard

The Variance Analysis Dashboard provides cost and schedule variance information for the project and identifies WBS elements that contribute and/or offset overall project variances the most. It shows data and a graphical representation of contractor-reported Earned Value data and variances, identifies WBS elements that carry the most impact (positive and negative) on the overall cost and schedule variances, and is used by the Analyst to identify WBS elements that require the most management attention as largest contributors to overall variances.

It is important for the Project Analyst to recognize schedule and/or cost variances at the project level; however, it is just as important to monitor performance at lower levels. The reason is that sometimes poor performance on one WBS element may be offset by good performance on another when the WBS elements are rolled up to the project level.

In conducting analysis, sort the WBS elements by CV% from smallest to largest. If there are WBS elements with negative (unfavorable) CV% they will be displayed at the top of the list. If there are WBS elements with positive (favorable) CV% they will be displayed at the bottom of the list. Select the largest favorable and unfavorable cost drivers and investigate to determine if the contractor has taken steps to identify and correct the root cause behind the unfavorable cost drivers. Likewise, sort the list by SV% and select the largest favorable and unfavorable schedule drivers.

The "5 Whys" technique is an effective tool used in determining what the root cause is versus just the symptoms. "5 Whys" is a questions-asking method used to explore the cause/effect relationships underlying a particular problem, with the goal of determining a root cause of a defect or problem. Often by the fifth question, the root cause is identified and can then be fixed rather than focusing efforts on the symptoms of the true root cause. Using this thought process with variance analysis can guide us to the real root cause and then focus on a corrective action plan that will prevent this process failure from happening again. Figure 9 below identifies some open-ended statements that may help initiate the "5 Whys" process.

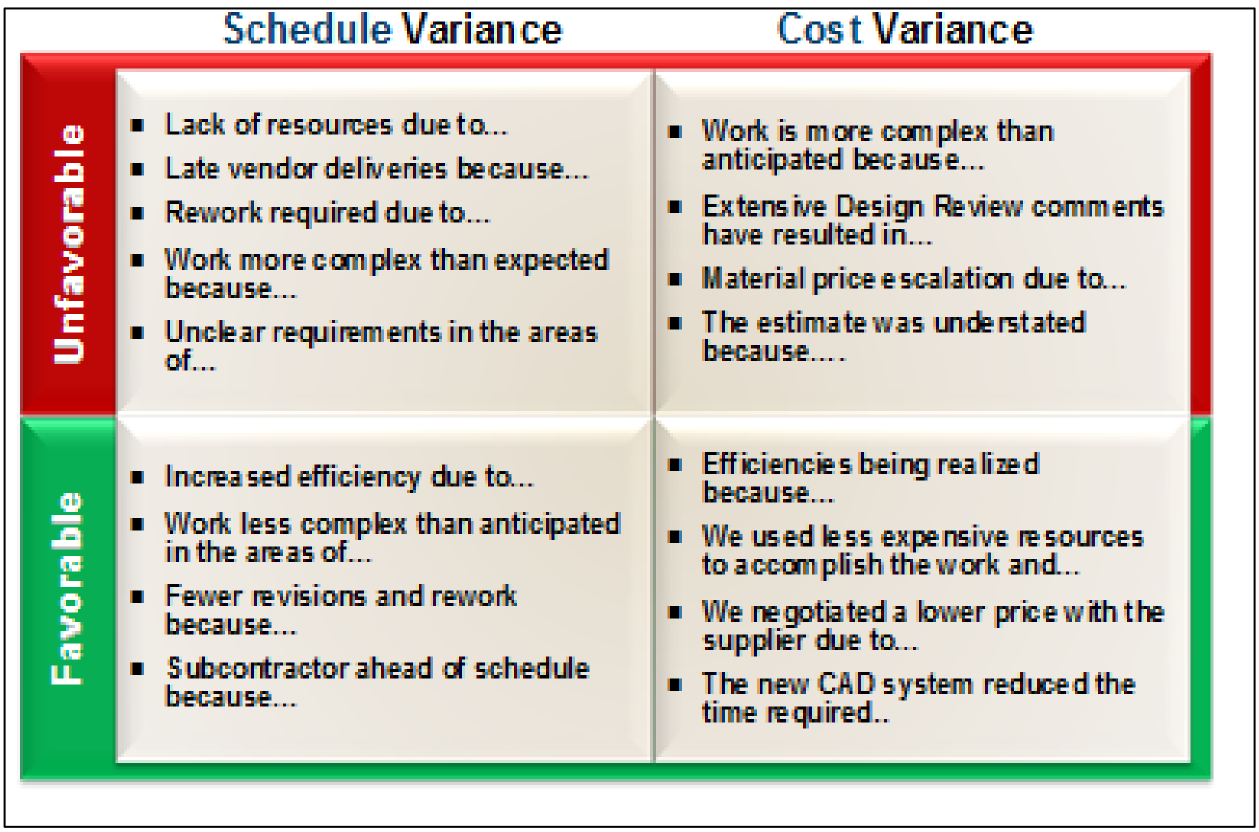


Figure 9. In Search of a Root Cause

2.4 ANALYSIS PLAN STEP 4: ANALYZE TRENDS

After analyzing major variances to ensure corrective actions have been identified to prevent reoccurrence, trend identification helps to see not only if corrective action has been effective (e.g. improvement trends), but also provides visibility into emerging problem areas where variances may not yet be significant.

The types of questions to consider once trends have been identified may include:

- What do the contractor's performance trends indicate over time?
- Is the current level of contractor performance projected to continue and why?
- What performance changes are expected and what are the drivers?
- Are MR and Contingency burn rates and use acceptable or are they used to mask/hide cost overruns?

An example of the Trend Analysis Dashboard is provided in Figure 10.

19 WBS Dollars :: DOE Trend Analysis :: DOE Trend Analysis

WBS	DESCRIPTION	LL	Level	Element Type	EVM	CAM	DQI Flag	VAR Required	Number of Tasks	SPI Cur	SPI Cum Trend	SPI Cum	SPI Cum3	SPI Cum6	CPI Cur	CPI Cum Trend	CPI Cum	CPI Cum3	CPI Cum6	Percent Complete	Percent Spent	BEI	CEI
1	Project		1				EF	sc	13465	0.985	↔	0.998	0.991	0.991	0.785	↔	1.040	0.785	0.802	99.42	95.59	0.995	0.593

Figure 10. PARS Empower Trend Analysis Dashboard

The Trend Analysis Dashboard metrics focus on performance indices SPI, CPI, BEI, CEI which are explained in this section, in addition to others.

2.4.1 SCHEDULE PERFORMANCE INDEX (SPI)

The Schedule Performance Index (SPI) is an efficiency factor representing the relationship between the performance achieved and the initial planned schedule. The SPI for projects without an Over Target Baseline (OTB) is calculated as follows:

$$SPI_{CUM} = \frac{BCWP_{CUM}}{BCWS_{CUM}}$$

An index of 1.00 or greater indicates that work is being accomplished at a rate on or ahead of what was planned. An index of less than 1.00 suggests work is being accomplished at a rate below the planned schedule. An index of less than 0.95 is used as an early warning indication of schedule slippage and should be investigated.

The adjusted SPI for projects with an OTB is calculated as:

$$SPI_{OTB} = (BCWP_{CUM} - BCWP_{OTB}) / (BCWS_{CUM} - BCWS_{OTB})$$

2.4.1.1 EARNED SCHEDULE

The Earned Schedule term for SPI is SPI(t). SPI(t) is the result of dividing the earned schedule by the actual duration. Earned schedule is the amount of time that was originally planned (based on

BCWS duration) to reach the current period BCWP. Actual duration is the amount of time that has elapsed on the project to date. The result of SPI(t) is in units of time rather than SPI which is in units of dollars. Using time units more clearly shows the impact to the planned schedule. Refer to Figure 11.

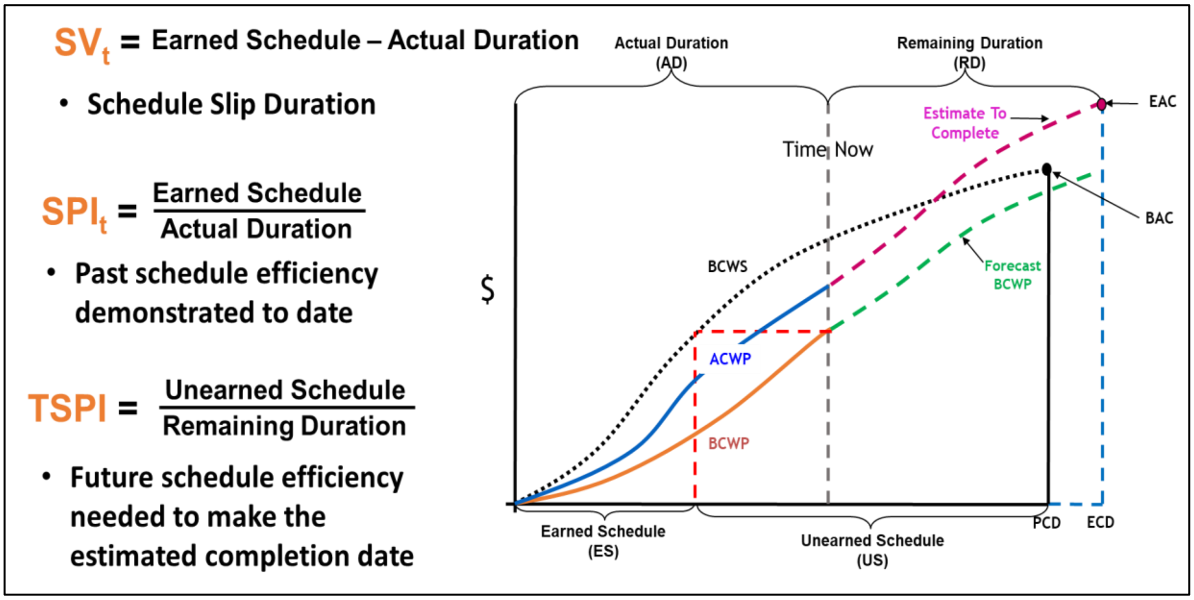


Figure 11. Earned Schedule Formulae and Graph

Like the SPI, an SPI(t) less than 1.0 indicates the effort, on average, is being accomplished at a slower rate than planned. An SPI(t) greater than 1.0 means that the effort, on average, is being accomplished at a faster rate than planned.

The forecasted duration can then be calculated by dividing the baseline duration by the SPI(t). An advantage of using SPI(t) versus SPI is that it maintains its mathematical integrity over the entire project whereas SPI loses effectiveness in the last third of the project because SPI returns to 1.0 at the completion of every project whether it was completed on time or late. Refer to Figure 12.

Earned Schedule is best used after a project has reached 65% complete or more.

MOH-2 JAN 17 WBS Dollars																
HIER	WBS	DESCRIPTION	LL	ET	ESOffset	ESInt	ES	AT	SV(t)	SPI(t)	PD	TspiBcws	ED	TspiEtc	BcwsCum	BcwpCum
1	1000	MOH-2			9	0.741	9.741	10	-0.259	0.974	18	1.032	18	1.032	7,278,600	6,853,000
11	2000	PROJ MANAGEMENT		CA	9	0.737	9.737	10	-0.263	0.974	18	1.033	18	1.033	882,600	869,400
111	2100	PROJ MANAGEMENT	x	WP	9	0.665	9.665	10	-0.335	0.966	18	1.042	18	1.042	294,600	282,600
112	2200	SYS ENGINEERING	x	WP	11	0.061	11.061	10	1.061	1.106	18	0.867	18	0.867	234,600	241,000
113	2300	FUNC INTEGRA	x	WP	9	0.136	9.136	10	-0.864	0.914	18	1.108	18	1.108	353,400	345,800
12	3000	PRIME EQUIP		CA	9	0.699	9.699	10	-0.301	0.970	18	1.038	18	1.038	4,809,200	4,426,600
121	3100	SENSORS	x	WP	1	0.761	1.761	2	-0.239	0.880	10	1.030	10	1.030	397,400	360,800
122	3200	COMMUNICATIONS	x	WP	8	0.977	8.977	10	-1.023	0.898	18	1.128	18	1.128	910,600	707,400
123	3300	AUX EQUIP	x	WP	9	0.415	9.415	10	-0.585	0.942	10	1.000	10	1.000	759,800	666,600
124	3400	ADPE	x	WP	9	0.804	9.804	10	-0.196	0.980	18	1.025	18	1.025	261,200	251,000
125	3500	COMP PROGRAMS	x	WP	10	0.000	10.000	10	0.000	1.000	10	1.000	10	1.000	88,000	90,000
126	3600	PCC	x	WP	9	0.974	9.974	10	-0.026	0.997	18	1.003	18	1.003	1,692,800	1,681,400
127	3700	DATA DISPLAY	x	WP	8	0.669	8.669	10	-1.331	0.867	10	1.000	10	1.000	272,600	159,600

Figure 12. PARS Empower Earned Schedule Sort View

The cautions when using SPI(t) are the same as when using the SPI. Both indices can be manipulated and skewed when non-critical future tasks are completed early. LOE effort can also skew the predictive value so they should be calculated for discrete effort only. Statistics have shown that despite the anomalies, earned schedule calculated at the total project level has shown good predictability of schedule performance and is a useful metric to consider.

2.4.2 SV AND SV(t)TRENDS

The SV trend compares the metric for a specific reporting period (usually monthly) to the same metric in prior reporting periods. An SV trend is favorable if the SV improves in value over the course of multiple reporting periods (i.e., three months). The SV may still be negative (unfavorable) but the trend is improving. Conversely, the SV trend is unfavorable when the SV worsens over time. Again, the SV could be positive (favorable) but the trend is degrading. Tables 2 and 3 provide examples of both trends at, say, a work package or control account level. Refer to Figure 11 for SV(t).

Table 2. Favorable SV Trend (SV improving over time)

Reporting Period	Schedule Variance (SV)
January	-$8K
February	-$7K
March	-$6K

Table 3. Unfavorable SV Trend (SV degrading over time)

Reporting Period	Schedule Variance (SV)
January	$8K
February	$7K
March	$6K

2.4.3 SCHEDULE PERFORMANCE INDEX (SPI) TREND

The SPI trend is a comparison of the metric for this reporting period (usually monthly) to the same metric in prior reporting periods. An SPI trend is favorable if the SPI increases in value over the course of multiple reporting periods. Conversely, the SPI trend is unfavorable if it decreases in value.

2.4.4 CV TREND

Like the SV Trend, the CV Trend is a comparison of the metric for a specific reporting period (usually monthly) to the same metric in prior reporting periods. A CV trend is favorable if a positive CV increases (or negative CV decreases) in value over the course of multiple reporting periods. Conversely, the CV trend is unfavorable if a positive CV decreases (or negative CV increases) in value. Examples are like those provided in the SV Trend tables shown previously.

2.4.5 COST PERFORMANCE INDEX (CPI)

The Cost Performance Index (CPI) is an efficiency factor representing the relationship between the performance accomplished (BCWP) and the actual cost expended (ACWP). The CPI for projects without an OTB is calculated as follows:

$$CPI_{CUM} = \frac{BCWP_{CUM}}{ACWP_{CUM}}$$

An index of 1.00 or greater indicates that work is being accomplished at a cost equal to or below what was planned. An index of less than 1.00 suggests work is accomplished at a cost greater than planned. A cumulative index of less than 0.95 is used as an early warning indicator of cost increase and should be investigated.

When calculating the CPI trend for the past 6 months, the formula is:

$$(BCWP_7 – BCWP_1) / (ACWP_7 – ACWP_1) = \text{CPI 6 Period Cum}$$

The adjusted CPI for projects with an OTB is calculated as follows:

$$CPI_{OTB} = (BCWP_{CUM} - BCWP_{OTB}) / (ACWP_{CUM} - ACWP_{OTB})$$

2.4.6 COST PERFORMANCE INDEX TREND

The CPI Trend is a comparison of the metric for a specific reporting period (usually monthly) to the same metric in prior reporting periods. A CPI trend is favorable if the CPI increases in value over the course of multiple reporting periods. Conversely, the CPI trend is unfavorable if it decreases.

2.4.7 THE RATIO: "PERCENT COMPLETE" TO "PERCENT SPENT"

The Percent Complete and Percent Spent metrics each provide valuable information, but as a ratio they gauge the amount of budget spent in relation to the amount of work completed. The first part of this metric, the numerator, is Percent Complete (%comp). The formula to calculate %comp is as follows:

$$\text{Percent Complete} = (BCWP_{CUM} / BAC) \times 100$$

The value range of %comp is from 0% to 100%. It provides a measure of how far along the project is toward project completion. The second part of the metric, the denominator, is Percent Spent (%spent). The formula to calculate % spent is as follows:

$$\text{Percent Spent} = (ACWP_{CUM} / BAC) \times 100$$

The value range of %spent starts at 0% and since it tracks actual cost, theoretically has no limit. It provides a measure of how far along the project is toward completion. If %spent is over 100%, it indicates a cost over-run condition has been realized.

2.4.8 BASELINE EXECUTION INDEX (BEI)

The Baseline Execution Index (BEI) metric is a schedule-based metric that calculates the efficiency of tasks accomplished when measured against the baseline tasks. It measures actual work accomplished against the schedule baseline by comparing the cumulative number of tasks completed to the cumulative number of "baselined" tasks scheduled to be completed.

If the contractor completes more tasks than planned, then the BEI will be higher than 1.00 reflecting a higher task throughput than planned. Tasks missing baseline finish dates are included in the denominator. A BEI less than 0.95 should be considered a flag and requires additional investigation. The BEI is calculated as follows:

$$BEI = \frac{\sum \# \, Tasks \, Actually \, completed}{\sum \# \, Baseline \, Tasks \, Planned \, to \, be \, completed}$$

Empower has a chart comparing the SPI, BEI, CEI, and the Completion Index (CI) over time for the selected element (Figure 13). It can be found in PARS by first selecting a project, Empower, Charts, Schedule Analysis, Execution Indexes. This chart shows the SPI, Baseline Execution Index (BEI), Current Execution Index, and Completion Index.

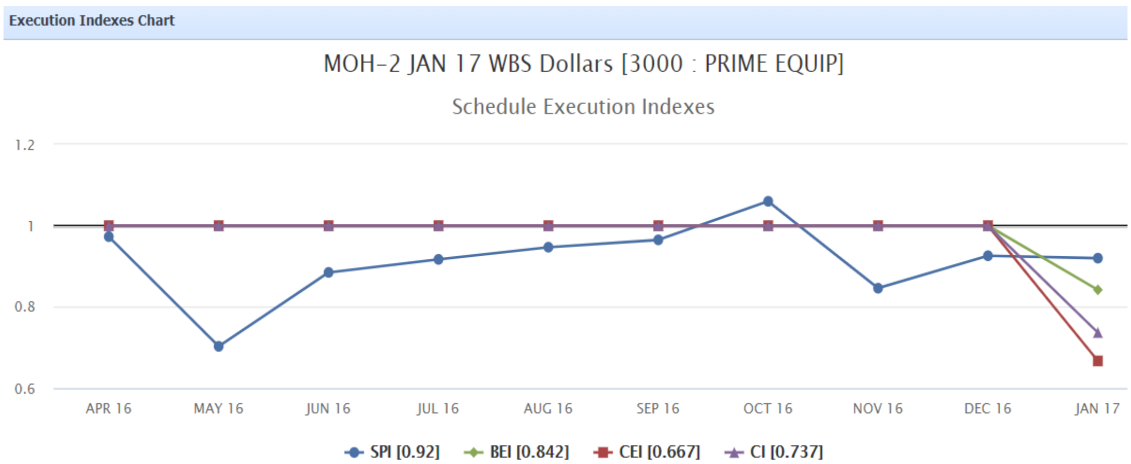


Figure 13. Schedule Execution Indexes

2.4.9 CURRENT EXECUTION INDEX (CEI)

The CEI compares forecast dates from one status period to the next to determine how well the near-term schedule represents what happens; it represents the fidelity of the forecast schedule and the project's or contractor's ability to execute tasks as projected each month. While the BEI is a baseline comparison, the CEI is an actual to forecast comparison. It serves as an indicator of the quality of schedule forecasts ("did we do what we said we would do"?). Refer to Figure 12 in Section 2.4.8.

$$CEI = \frac{\sum \# \, Tasks \, Actually \, Completed \, in \, Month \, \text{“}A\text{”} \, (from \, Month \, \text{"}B\text{"} \, Schedule)}{\sum \# \, Tasks \, planned \, in \, Month \, \text{"}A\text{"}}$$

The Completion Index shown on Figure 13 is the On-Target Completion Index of linked tasks. The equation is: Completion Index = 1 – (Slipped Completions to Date for Linked Tasks / Planned Completions to Date for Link Tasks).

2.4.10 BCWS VOLATILITY TRENDS

BCWS Volatility, also referred to baseline churn, indicates that the project's time-phasing and control of budget is unstable and that a significant departure from the original plan has occurred.

- Substantial changes to the baseline time phasing indicate the contractor has inadequate plans in place and the performance metrics may be unreliable.
- Change is inevitable but the near-term plan should be firm.

Rolling wave planning is when the BCWS is detail planned for the near term (say the next six months) as opposed to detail planning the entire project. Since EV best practices encourage rolling wave planning in six-month increments, one would expect to see little flux in the near term except for unpredictable government-caused events or real-time realized risks. In other words, the contractor should always be looking ahead at least six months to ensure the plan is current or valid. ***Concerns in this area not only apply to Project performance but also to systemic concerns with the contractor's EVMS.***

The PARS Empower BCWS Volatility Report in Figure 14 shows past 6 months and 6 months in the future with current period in the middle. The significance of this report is that it shows 1) if the baseline is constantly churning within the near term and/or 2) if BCWS is being pushed to future periods in order to achieve seemingly favorable current period metrics. This practice can cause misleading results and potentially mask future schedule issues.

BCWS Volatility

ITEM	JAN 18	FEB 18	MAR 18	APR 18	MAY 18	JUN 18	JUL 18	AUG 18	SEP 18	OCT 18	NOV 18	DEC 18	JAN 19
Future BCWS JAN 18		1,538,160	2,003,959	1,736,284	1,738,103	2,125,371	2,600,739	1,838,967	1,555,607	1,817,875	1,004,505	774,401	884,022
FEB 18			1,997,417	1,825,089	1,728,222	2,114,221	2,589,299	1,828,644	1,544,971	1,820,939	1,006,067	775,315	885,051
MAR 18				1,804,941	1,735,248	2,228,246	2,582,313	1,820,522	1,537,205	1,807,020	965,146	741,214	844,130
APR 18					8,679,466	2,207,291	2,572,142	1,896,126	1,503,900	1,728,196	794,156	645,216	743,617
MAY 18						9,443,008	2,933,354	1,900,858	1,503,900	1,728,196	794,156	645,216	743,617
JUN 18							9,182,741	1,871,818	1,590,948	2,177,456	766,517	607,679	693,479
JUL 18								6,764,011	1,582,523	2,164,072	725,827	538,569	610,547
Current BCWS	1,835,489	1,521,216	1,990,943	2,106,242	1,580,880	2,640,393	2,934,461						
Maximum	1,835,489	1,538,160	2,003,959	2,106,242	8,679,466	9,443,008	9,182,741	6,764,011	1,590,948	2,177,456	1,006,067	775,315	885,051
Minimum	1,835,489	1,521,216	1,990,943	1,736,284	1,580,880	2,114,221	2,572,142	1,820,522	1,503,900	1,728,196	725,827	538,569	610,547
Difference	0	16,944	13,016	369,958	7,098,586	7,328,786	6,610,599	4,943,489	87,048	449,261	280,239	236,746	274,505
Percentage	0.00	1.11	0.65	21.31	449.03	346.64	257.01	271.54	5.79	26.00	38.61	43.96	44.96
Average							115.89%						
Prior Average							136.46%						
Future Average							71.81%						
Delta to Prior								4,892,193	-8,425	-13,385	-40,690	-69,110	-82,932
% Delta to Prior								261.36%	-0.53%	-0.61%	-5.31%	-11.37%	-11.96%

Figure 14. PARS Empower BCWS Volatility Report

In Figure 14, the 'current period' (July 2018) is outlined in red. The current period BCWS of $2,934,461 has a blue background. The figures above it represent, for each of the 6 months prior, as shown in the first column as Future BCWS, the BCWS planned for July 2018. From that information, the following calculations are useful.

There are four calculations listed in the current period. A result of five or more percent is used as an early warning indicator that the project's time-phasing and control of budget is volatile in the near term and that a significant departure from the original plan has occurred. The first, entitled Percentage, compares the Minimum and Maximum BCWS values for the report period within the past six months.

In this example, the maximum value that was planned over the six months was in June 2018 where the planned BCWS for July 2018 was $9,182,741. The minimum value that was planned for July 2018 was from the April 2018 report at $2,572,142. Using the following formula,

$$\text{Percentage} = \frac{\text{Maximum} - \text{Minimum}}{\text{Minimum}} \times 100$$

this represents a 257% change. The report shows most of the churn was just 2 to 4 months prior.

The individual calculations for the past six months are then used to determine the Average percent of change over the past six months. If the absolute values for the six-month average exceeds 5%, there is high volatility in the near-term plan. If the re-plan is not government-directed, it should be investigated and potentially documented in the monthly assessment as an indicator of baseline churn.

The Prior Average reflects the 6-month average as reported in the prior reporting period, i.e. June 2018. The Future Average is the 6-month average based on the next six months of data, i.e. August 2018-January 2019. Note that the calculations of 6 period averages in this report are calculated by summing the monthly percentages and dividing by 6.

The third calculation identifies changes made during the current reporting period. Changes made to the BCWS during the current period are considered retroactive changes once the period begins and should not happen. The current period should be a freeze period for baseline changes and changes within a current period can be an indicator of problems with the cycle time of the contractor's revisions processes or baseline discipline issues. This report is designed not to display zero (0) values in the % Change cells. Therefore, blank cells indicate a true zero (0) percent (no change in values), while 0% indicates there is insignificant difference (< 0.5%) between compared values. Anything greater than 0% is of concern for the current period changes calculation.

In summary, substantial changes to the baseline time phasing may indicate the contractor has inadequate plans in place and the performance metrics may be unreliable. Change is inevitable, but the near-term plan should be firm and change control should be exercised.

2.4.11 MANAGEMENT RESERVE (MR) AND UNDISTRIBUTED BUDGET TRENDS

Another important chart to monitor is the MR/UB Trends. Of interest to the Analysis is MR usage (downward change) that coincides with improvement in the Cost Variance curve (upward change). The Analyst should investigate to determine if the MR was used to offset a cost variance, an action that is not compliant with EIA-748.

In Figure 15, the MR slightly increased from January to February, and decreased in March. Also shown is a decrease in the positive Cost Variance overrun in March. The Analyst should determine why the MR was used, and if it was partially used to offset the cost variance.

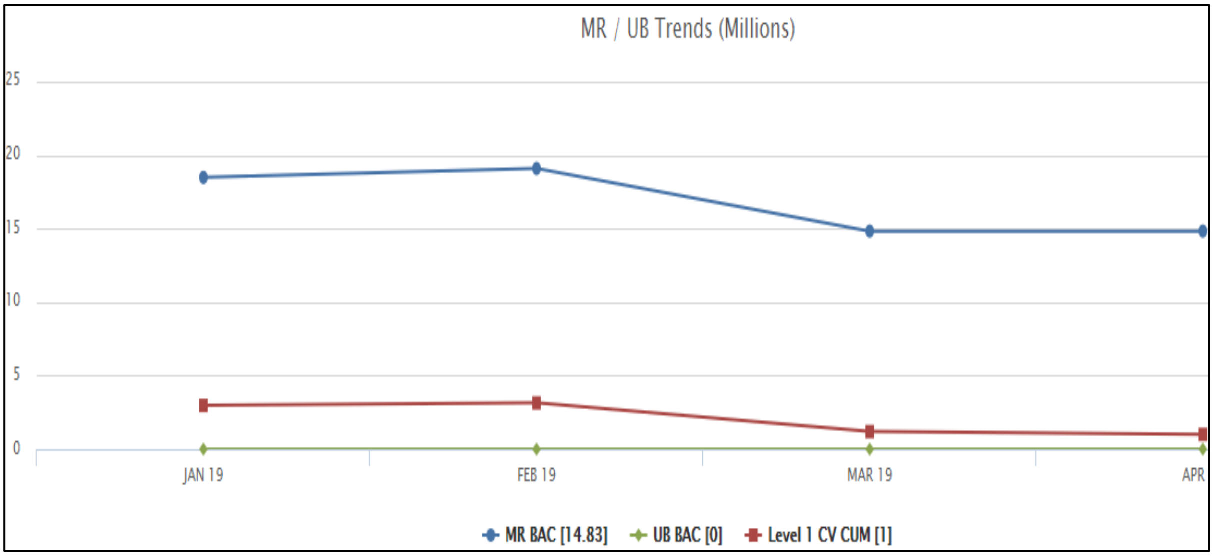


Figure 15. PARS Empower MR / UB Trends Chart

2.5 ANALYSIS PLAN STEP 5: ASSESS REALISM OF CONTRACTOR'S EAC

The contractor is required to provide an Estimate at Completion (EAC). The formula is based on actual cost of work performed to date plus the estimate of the costs to complete. An accurate EAC is vital to DOE as it provides a dynamic estimate of the projected funding required to cover the contractor's costs to perform the work in the PMB. ***Concerns in this area not only apply to Project performance but also to systemic concerns with the contractor's EVMS.***

The PARS DOE Forecast Dashboard in Figure 16 shows the data for evaluating the EAC. The key elements will be discussed in this section.

19 WBS Dollars :: DOE Forecast :: DOE Forecast

WBS	DESCRIPTION	LL	Level	Element Type	EVM	CAM	DQI Flag	VAR Required	Number of Tasks	Percent Complete	SPI Cum	CPI Cum	CPI Cum3	CPI Cum6	CPI Cum To TCPI (EAC) Trend	DQI EAC High	DQI EAC Low	TCPI (EAC)	TCPI (BAC)	DQI CV<VAC	CV Cum	VAC	BAC	EAC	IEAC CPI	IEAC Composite	IEAC CPI3	IEAC CPI6
1	Project		1				EF	sc	13465	99.42	0.998	1.040	0.785	0.802	↑	1	0	0.352	0.132	6	77,072,515	55,394,843	2,014,893,356	1,959,498,513	1,937,368,647	1,937,388,997	1,941,043,062	1,940,715,007

Figure 16. PARS Empower Forecast Dashboard

The Forecast Dashboard compares the CPI_{CUM} to both the $TCPI_{BAC}$ and to the $TCPI_{EAC}$. The CPI_{CUM} and the $TCPI_{BAC}$ are compared to assess whether the contractor is on track to achieving completion within the BAC. The CPI_{CUM} and the $TCPI_{EAC}$ are compared to evaluate the realism of the contractor's EAC and to evaluate the reasonableness of using past efficiencies to predict future efficiencies. ***Concerns in this area not only apply to Project performance but also to systemic concerns with the contractor's EVMS.***

The Cost and To-Complete Performance Indexes Chart (Figure 17) shows these indices over time.

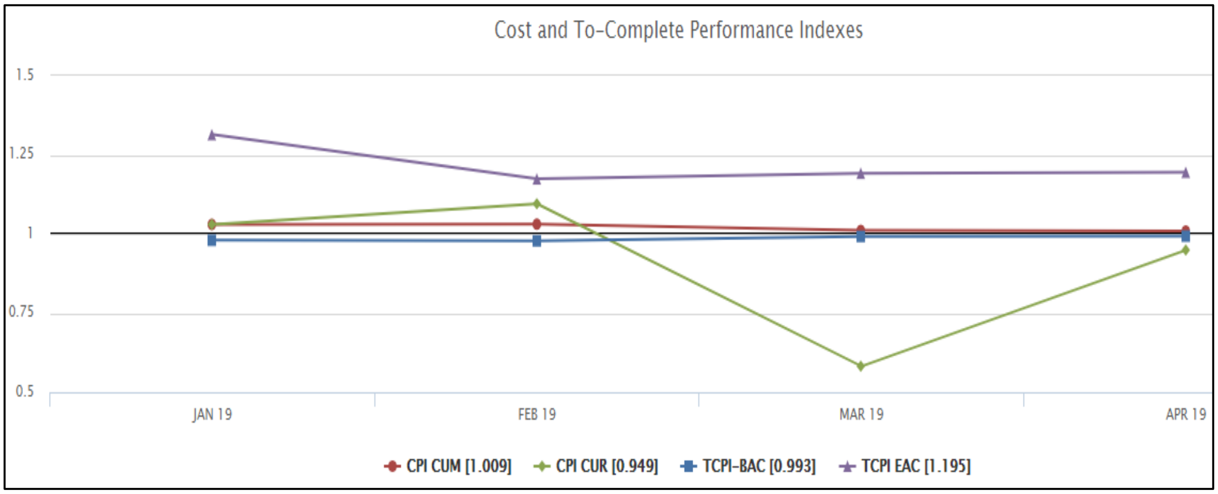


Figure 17. PARS Empower Cost and To-Complete Performance Indexes

A mathematical difference of 0.05 or greater is used as an early warning indication that the contractor's forecasted completion cost could possibly be unrealistic, stale, or not updated recently. If the 0.05 threshold has been breached, the Forecast Dashboard indicates this under the CPI < > TCPI ±0.05 column. It is merely a metric to flag any concerns, but it is not considered an error because it is possible that the nature of the work has changed, thus making predictions of the future based on past performance unjustified.

When the TCPI is greater than the CPI by more than 5%, it may indicate an overly optimistic EAC. In other words, the ETC is based on an increase in cost efficiency by more than 5% for the remainder of the project. A TCPI less than the CPI by 5% or more may indicate an overly pessimistic EAC. In this case, the ETC is based on an expected drop in cost performance by 5% or more for the remainder of the project. By using the Forecast Dashboard, the Analyst can scroll to see the impact at the project level, and zero in on which WBS element(s) is influencing this behavior.

A CPI_{CUM} – $TCPI_{EAC}$ difference greater than or equal to 0.05 (using the absolute value of the difference) should be considered a flag. $TCPI_{EAC}$ reflects the work remaining divided by the cost remaining as follows:

$$\text{To Complete Performance Index } (TCPI_{EAC}) = \frac{BAC - BCWP_{CUM}}{EAC - ACWP_{CUM}}$$

While the report flags information +/-.05; it also provides the total calculated answers. A larger difference of greater than or equal to +/- .1, i.e. 10%, indicates the EAC is not achievable based on current performance. Studies of major acquisition programs at DOD validated that 10% was the reasonable threshold at which the EAC should be updated.

2.6 ANALYSIS PLAN STEP 6: PREDICT FUTURE PERFORMANCE AND AN IEAC

The last step in the Analysis Plan is to provide the insights gained by the analysis in the form of an Independent Estimate at Completion (IEAC) and a narrative assessment.

2.6.1 INDEPENDENT ESTIMATE AT COMPLETION (IEAC)

An IEAC is the Government's forecast of the final total cost of the project. The Forecast Dashboard in Figure 15 above has IEACs to the far right. These IEACs allow the Analyst to compare the contractor's EAC to industry standard calculations of cost estimate based on contractor-reported data and variety of performance factors to establish reasonableness range for at-complete cost of the project. These IEACs formulas are:

$IEAC_{CPI}$ = BAC / CPI_{cum} = $ACWP_{cum}$ + [BCWR / CPI_{cum}]= Estimate at Completion (CPI)

$IEAC_{COMPOSITE}$ = $ACWP_{cum}$ + [BCWR / (CPI_{cum} * SPI_{cum})] = Estimate at Completion (composite)

$IEAC_{CPI3cum}$ = ACWP + (BCWR/CPI_3) = ACWP + [(BAC – $BCWP_{cum}$) / (($BCWP_4$ – $BCWP_1$) / ($ACWP_4$ – $ACWP_1$))] = Estimate at Completion (CPI 3 Period Cum)

The IEAC formula can also be based on the last six months of data. The $IEAC_{CPI6}$ is calculated as:

$IEAC_{CPI6}$ = ACWP + (BCWR/CPI_6) = ACWP + [(BAC – $BCWP_{cum}$) / (($BCWP_7$ – $BCWP_1$) / ($ACWP_7$ – $ACWP_1$))] = Estimate at Completion (CPI 6 Period Cum)

Below the Forecast Dashboard to the left, the Forecast Chart is shown as Figure 18. It graphically displays how the four formulas (shown as lines) explained above relate to the contractor's BAC and EAC (shown as columns).

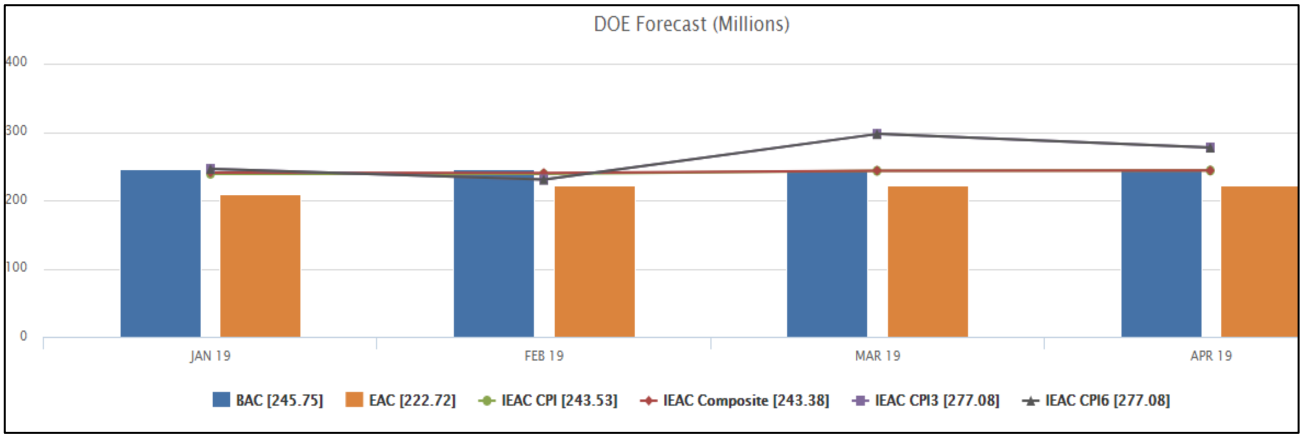


Figure 18. PARS Empower Forecast Chart

Often the EAC_{CPI} formula provides the most optimistic result, the $EAC_{COMPOSITE}$ provides the most pessimistic, and the EAC_{CPI3} provides the most likely based on studies of hundreds of completed projects. This assumption is based on CPI_{CUM} and SPI_{CUM} being less than 1. If both metrics are greater than 1, then the reverse will be true; meaning EAC_{CPI} will become the most pessimistic IEAC. **These formulas are most accurate when the project is between 15% complete and 95% complete. Outside of these ranges the formulas may not provide accurate bounds.**

The next step performs a detailed analysis of the contractor's EAC by Work Breakdown Structure (WBS) element at the lowest level available. This analysis is used as:

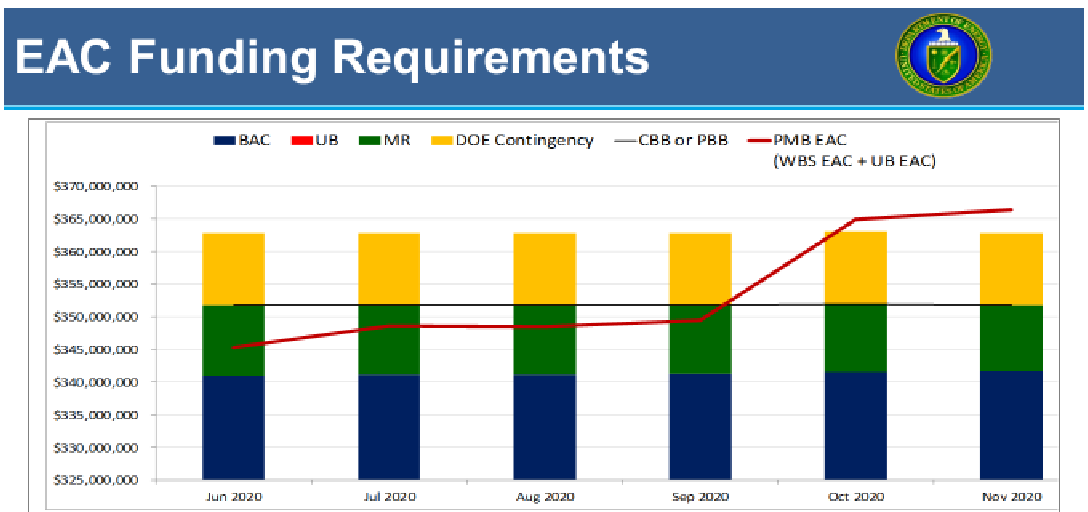
- Verification of the reasonableness of the Comprehensive EAC
- Adjustments to the IEAC based on known issues with one or more WBS elements

It involves determining the reasonableness of the WBS level estimates with information gained from project surveillance, reviews, and/or site-level input. This is the perfect place to adjust if the contractor's value does not appear reasonable. Conduct a comparison of contractor-reported EAC to independent EAC calculated based on of the high risk WBS elements to determine if contractor-reported EAC is current, accurate, and complete.

Roll up any adjustments made to individual WBS element EACs and any changes made to risks determining the value of the IEAC. Check the rolled-up value against the two formula values that are most pessimistic and most optimistic. The rolled-up value may fall outside of the statistical formula bounds, but this should be considered a flag. If this occurs, double check your adjustments and ensure they are properly documented.

2.6.2 EAC FUNDING REQUIREMENTS

The EAC Funding Requirements are provided in Project Reports, Project Summary Excel Workbook, EAC Funding Requirements worksheet. See Figure 19.



	Jun 2020	Jul 2020	Aug 2020	Sep 2020	Oct 2020	Nov 2020
DOE Cost Contingency	$11,000,321	$11,000,321	$11,000,321	$11,000,321	$11,000,321	$11,000,321
Management Reserve (MR)	$10,904,847	$10,681,393	$10,644,886	$10,585,353	$10,365,538	$10,117,404
Undistributed Budget (UB)	$0	$0	$0	$0	$0	$0
Budget At Complete (BAC)	$340,901,465	$341,124,919	$341,161,425	$341,220,958	$341,611,498	$341,688,907
CBB or PBB	$351,806,312	$351,806,312	$351,806,311	$351,806,311	$351,977,036	$351,806,312
Estimate At Complete (PMB EAC)	$345,311,276	$348,569,622	$348,440,509	$349,447,145	$364,830,378	$366,403,597

Figure 19. PARS EAC Funding Requirements

The primary purpose of the EAC Funding Requirements report is to show if sufficient funding is available to complete the project based on EAC projections. Any significant fluctuations in project cost components and identified anomalies should be investigated as discussed in Steps 3, 4, 5, and 6. Major components of Total Project Cost (TPC) are plotted in a stack column which allows the Analyst to identify current balances of each major TPC component focusing primarily on the DOE Contingency and Contract Budget Base (CBB)/Project Budget Base (PBB).

While the CBB/PBB, MR, UB, and BAC consist of budget, changes in budget may also be an indicator of cost concerns. For example, MR is shown on this report to track usage over time. Repeated applications of MR (indicated by MR depletion shown in green and BAC increases shown in blue) may suggest the contractor is realizing risks at a faster rate than anticipated which then leads to increases in the EAC as shown by the red line.

Recall that DOE Contingency is used either to 'buy' additional scope or to 'pay' for project overruns. An increase in the CBB/PBB line should have corresponding decrease in the DOE Contingency indicating new project scope was added to the CBB/PBB. An EAC or IEAC greater than the CBB/PBB indicates a forecasted cost overrun which would require DOE Contingency overrun funding. The Analyst should monitor the EAC and the Analyst's IEAC to ensure enough DOE Contingency is available.

Focus areas for analysis include:

- A comparison of the contractor's reported forecast (EAC) against the Total Project Cost to determine if additional funding may be required to complete the project.
- Verification that all components of Total Project Cost are being accurately reported, the height of each column for each period is the same or very close, and any indications that the risk reserves and contractor baseline have not been reported accurately or are being used improperly.

The indicators include:

- Fluctuations in the CBB or PBB line without corresponding reverse changes in the DOE Contingency, a significant change in Contingency balance that is not reflected in the CBB or PBB line, and a decrease in Contingency with an associated increase in MR without any change to the Budget at Completion.

2.7 <u>MONTHLY ASSESSMENT REPORT</u>

The Project Analysis objective is to provide an independent assessment of each project assigned. The primary reference in completing the Monthly Assessment Report is in the Project Analyst Desk Guide in PM-MAX. As stated in the Desk Guide "The narrative should be concise while also imparting a sense of whether the project is performing well or experiencing challenges, and the nature of the challenges." The 6-step monthly analysis provides support for making the determination of project performance and high-level details of any challenges by focusing on broad trends or major issues that require attention related to cost, schedule, or Estimated at Completion (EAC) growth.

When describing an issue, consider the following:

- Problem(s)
- Cause(s)
- Impact to overall project
- Effectiveness of implemented corrective actions and if further corrective actions are needed
- Predictions based on special knowledge gained through analysis and project oversight

Do not repeat metrics that are easily visible on the Monthly Report; rather, provide insight behind the metrics such as the top cost and schedule drivers.

The EAC is an important number used by project stakeholders. A project office depends on the EAC for securing enough funding for the project. PM's IEAC is an independent second opinion of the final cost of the project. This provides the project office with important information to aid in funding decisions. Make predictions based on the analysis such as IEAC and any funding concerns.

3.0 RESOURCES

DOE PM, *Earned Value Management System Compliance Review Standard Operating Instruction* (ECRSOP). Washington, DC: November 28, 2018

DOE PM, Earned Value Management website.
External: https://www.energy.gov/projectmanagement/services-0/earned-value-management
Internal: https://community.max.gov/display/DOEExternal/PM+EVM+Guidance

DOE PM, Project Analyst Desk Guide.
https://community.max.gov/display/DOE/3f.+Completing+a+Monthly+PARS+Project+Assessment

DOE, *Program and Project Management for the Acquisition of Capital Assets*, DOE O 413.3B, Washington, DC: 11-29-2010 (Chg 5, 04-12-2018)

GAO. *GAO Cost Estimating and Assessment Guide*, GAO-09-3SP. Washington, DC: March 2009

GAO. *GAO Schedule Assessment Guide*, *Best Practices for Project Schedules*, GAO-16-89G. Washington, DC: December 2015.

Humphreys, Gary C. *Project Management Using Earned Value.* Irvine, CA: Humphreys & Associates, Inc., 4th Ed. 2018

National Defense Industry Association (NDIA) Integrated Program Management Division. *Planning and Scheduling Excellence Guide* (PASEG), 09-12-2019, V4.0.

4.0 ACRONYM GLOSSARY

ACWP	Actual Cost of Work Performed
ASAP	As Soon As Possible
BAC	Budget at Completion
BCWP	Budgeted Cost of Work Performed
BCWR	Budgeted Cost of Work Remaining
BCWS	Budgeted cost of Work Scheduled
BEI	Baseline Execution Index
CA	Control Account
CAM	Control Account Manager
CBB	Contract Budget Base
CEI	Current Execution Index
CPI	Cost Performance Index
CPP	Contractor Project Performance (refers to PARS Contractor data uploads)
CUM	Cumulative; as in from start to current reporting period
CUR	Current; as in current EVMS reporting period
CV	Cost Variance
DQI	Data Quality Indicator
EAC	Estimate at Completion
EV	Earned Value
EVM	Earned Value Management
EVMS	Earned Value Management System
EPASOP	EVMS Project Analysis SOP
FF	Finish-to-Finish
FNET	Finish-No-Earlier-Than
FNLT	Finish-No-Later-Than
FPD	Federal Project Director
FS	Finish-to-Start
IEAC	Independent Estimate at Completion
IPMR	Integrated Program Management Report
LOE	Level of Effort
MFO	Must-Finish-On
MR	Management Reserve

MSO	Must-Start-On
OTB	Over Target Baseline
PARS	Project Assessment and Reporting System
PASEG	Planning and Scheduling Excellence Guide
PB	Performance Baseline
PBB	Project Budget Base
%comp	Percent Complete
PM	Office of Project Management
PMB	Performance Measurement Baseline
SF	Start-to-Finish
SNET	Start-No-Earlier-Than
SNLT	Start-No-Later-Than
SPI	Schedule Performance Index
SS	Start-to-Start
SV	Schedule Variance
TAB	Total Allocated Budget
TCPI	To Complete Performance Index
TF	Total Float
TPC	Total Project Cost
VAC	Variance at Completion
WBS	Work Breakdown Structure
WP	Work Package