National Aeronautics and Space Administration

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EVM and Schedule Management

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Abstract

- The objective of EVMS surveillance is to ensure that the management control processes that support the performance measurement baseline (PMB) are in place, compliant with the EVMS guidelines, are routinely being used, and provide timely and reliable data. The PMB is a triple constraint where the constraints are **schedule, budget and scope**.
- For Surveillance, NASA uses the DCMA EVM Compliance Metrics (DECM) Tests that are aligned with the EIA-748 EVM Standard. Guidelines 6 is Scheduling Work, and **DECM has 23 Tests for evaluating if the IMS** supports project goals in its planning, statusing and forecasting.
- This session will focus on the Test Metric that analyzes **forecast start/finish dates riding the status date of the IMS for two or more consecutive months** as an example of how surveillance works in concert with IMS health checks. It will cover how to run the test to recognize trends and how this test helps ensure that the forecast is credible in support of critical path analysis.

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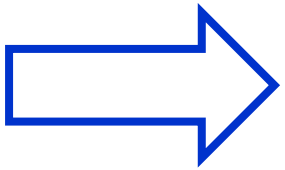
  - Review Current Execution Index (CEI) to determine percent of tasks forecasted for a given period that are finished.

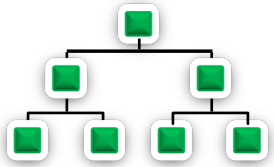
EVM depends on the Schedule.
The Schedule benefits from the EVM Surveillance.

Triple Constraint: Role of the Schedule in EVM



1. DEFINE THE WORK

Technical Baseline



What? How? Who?

- Project Plan, Statement of Work (SOW), etc.
- Work Breakdown Structure (WBS)
- Organizational Breakdown Structure (OBS)
- Responsibility Assignment Matrix (RAM)

2. SCHEDULE THE WORK

Schedule Baseline

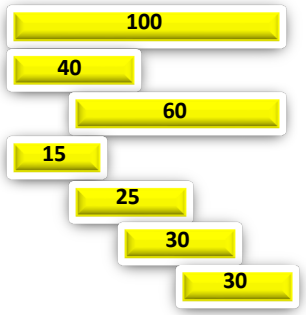
When?

Integrated Master Schedule (IMS)

- Logic network and critical path
  - Master Schedule
  - Intermediate Schedule
  - Detailed Schedules

3. ALLOCATE BUDGETS

Budget Baseline



How much?

- Work/Budget Authorization System
- Control Account Plan (CAP)
- Work Packages (WP) & Planning Packages (PP)
- Performance Measurement Techniques (PMTs)

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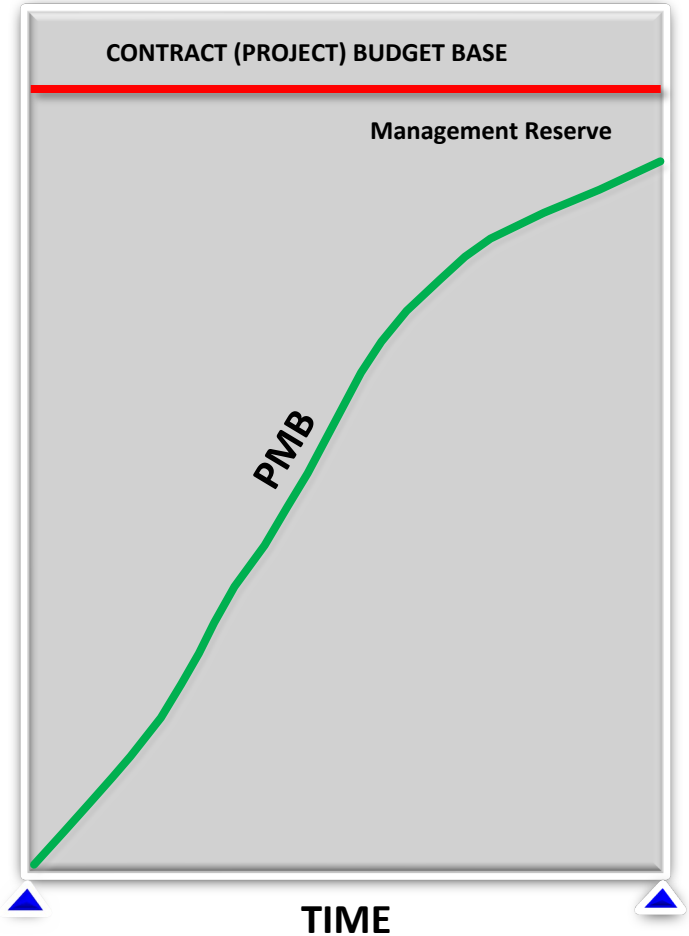


An integrated plan depends on the schedule

Defense Contract Management Agency Compliance Metrics (DECM) Aligned to EIA-748 EVM Standard – GL 06 Scheduling Work

EVM Standard Guideline (GL)	GL Description	No of DECM Test Metrics*
GL 01	Define Work Scope (WBS)	2
GL 02	Define Project Organization (OBS)	2
GL 03	Integrate Processes	10
GL 04	Identify OH Mgmt	1
GL 05	Integrate WBS/OBS to Create Control Accounts	3
GL 06	**Scheduling Work**	**23**
GL 07	Identify Products & Milestones for Progress Assessment	1
GL 08	Establish the Performance Measurement Baseline	5
GL 09	Authorize & Budget by Cost Elements	3
GL 10	Determine Discrete Work & Objective Measures	9
GL 11	Sum Detail Budgets to CA	1
GL 12	LOE Plng & Control	5
GL 13	Establish OH Budgets	1
GL 14	Identify MR & UB	4
GL 15	Reconcile to Target Cost Goal	1
GL 16	Record Direct Costs	7
GL 17	Summarize Direct Costs by WBS Elements	1
GL 18	Summarize Direct Costs by OBS Elements	1
GL 19	Record/Allocate Indirect Costs	3
GL 20	Identify Unit & Lot Costs	2
GL 21	Track & Report Mtl Costs & Quantities	8
GL 22	Calculate SV & CV	2
GL 23	Analyze Significant Variances	4
GL 24	Analyze Indirect Cost Variances	1
GL 25	Summarize Perf Data & Variances for Mgmt Reporting	2
GL 26	Implement Corrective Actions	2
GL 27	Maintain EAC	12
GL 28	Incorporate Changes in a Timely Manner	2
GL 29	Maintain Baseline & Reconcile Budgets	16
GL 30	Control Retroactive Changes	3
GL 31	Prevent Unauthorized Revisions	1
GL 32	Document PMB Changes	4
Grand Total		142

GL 06 Scheduling Work**

- **Definition:** Schedule the authorized work in a manner which describes the sequence of work and identifies significant task interdependencies required to meet the requirements of the program.
- **Management Value:** Scheduling authorized work facilitates effective planning, statusing, and forecasting, all of which provide the ability to evaluate and implement actions designed to complete the project effort within contractual parameters. The integration of the technical, schedule, and cost aspects of the project results in the:
  - Expected sequence of work.
  - Establishment of significant interdependencies between work packages and planning packages (or lower-level tasks/activities) that determine the critical and driving paths through the project.
  - Time-phasing of authorized discrete work for use as the foundation to establish a valid performance measurement baseline.
- **Contains the most DECM Test Metrics at 23 or 16%.**

* DECM Test Metrics v5.0 ** NDIA EVM EIA-748-D Intent Guide

Defense Contract Management Agency Compliance Metrics (DECM) Aligned to EIA-748 EVM Standard – GL 06 Scheduling Work

EVMS Test Metric Specification *

1. Guideline No:	2. Test Metric ID:	3. Test Type:
06	06A506c	Automated

4. Attribute/Intent Definition:
06A5: The schedule provides baseline, forecast, and actual dates.

5. Test Definition:
Are forecast start/finish dates riding the status date of the IMS for two consecutive months?

6. Test Metric:
X = Count of incomplete tasks/activities & milestones with either forecast start or forecast finish date riding the status date
Y = Total count of incomplete tasks/activities & milestones

7. Metric Threshold:
X/Y ≤ 1%

8. Data Elements Required:
11 Integrated Master Schedule (Two Consecutive Months)
- 11A Actual Finish Date
- 11C Actual Start Date
- 11V Forecast Finish Date
- 11W Forecast Start Date
- 11AF Remaining Duration
- 11AG Status Date
- 11AM Task/Activity/Milestone UIDs

45 IMS Data Dictionary

9. Assumptions:
1. A forecast date is considered "riding" the IMS status date when, from one reporting period to the next the date moves in constant proportion to the status date (e.g., early finish date equals status date plus constant remaining duration).
2. If the Status Date does not match the Period End Date, use the IMS Status Date for this metric. Note: Misalignment is addressed in metric 03A101e.
3. Incomplete tasks/activities and milestones equals no actual finish date in the IMS.
4. If Forecast Finish Dates and Forecast Start Dates are invalid (i.e., < Status Date), tasks/activities & milestones are not counted in this metric.

Examine if remaining task forecast dates exceed 1% of work to go where the dates are riding the month end status date for two periods in a row. ***Is work getting pushed to the next month, month over month?***

The results may lead to evaluating:

- Work Off Trend charts for bow wave of tasks being pushed forward
- Current Execution Index (CEI) to determine rate of forecasting from previous month

10. Instructions:
1. Identify and count all incomplete tasks/activities and milestones in the current IMS; this is the denominator (Y) of the metric.
2. Identify the status date of the IMS being examined (previous and current).
3. Forecast start date riding the status date:
   a. Using the current IMS
      i. Filter for tasks/activities and milestones without an actual start date
      ii. Find all tasks/activities and milestones with valid forecast start dates that are within 3 working days (5 calendar days) of the status date
      iii. Copy the Unique IDs and forecast start dates into MS Excel – this is the first start data set
   b. Using the previous IMS
      i. Filter for tasks/activities and milestones without an actual start date
      ii. Find all tasks/activities and milestones with valid forecast start dates that are within 3 working days (5 calendar days) of the status date
      iii. Copy the Unique IDs and forecast start dates into MS Excel – this is the second start data set
   c. Compare the Unique IDs from the two start data sets to see if any Unique IDs appear in both data sets – if any are found, the task/activity or milestone may have a forecast start date riding the status date. Count these tasks/activities and milestones.
4. Forecast finish date riding the status date:
   a. Using the current IMS
      i. Filter for incomplete tasks/activities and milestones without an actual finish date
      ii. Find all tasks/activities and milestones with actual start dates that are on or prior to the previous IMS status date
      iii. Copy the Unique IDs, remaining durations, and forecast finish dates into MS Excel – this is the first finish data set
   b. Using the previous IMS
      i. Find all tasks/activities and milestones with actual start dates
      ii. Copy the Unique IDs, remaining durations, and forecast finish dates into MS Excel – this is the second finish data set
   c. Compare the Unique IDs from the two finish data sets to see if any Unique IDs appear in both data sets – if any are found, compare the remaining duration value between the two data sets.
   d. If the remaining duration value has remained consistent within +/- 2 working days, the task/activity or milestone may have a forecast finish date riding the status date. Count these tasks/activities or milestones.
5. Add the results (forecast start date riding the status date + forecast finish date riding the status date), not counting any duplicative UIDs between the two sets. (So a task/activity or milestone is only counted once, rather than twice if it shares the same start and finish date). These tasks/activities or milestones may have a forecast start or finish date riding the status date. This is the numerator (X) of the metric.
6. Calculate the test metric (Block 7): X divided by Y.
7. Use block 7 as an indicator in the overall Risk Assessment to determine if further evaluation is warranted.
8. For a result above the threshold, determine if the CAM and/or scheduler is failing to provide valid forecast date inputs.

*https://www.dcma.mil/HQ/EVMS/

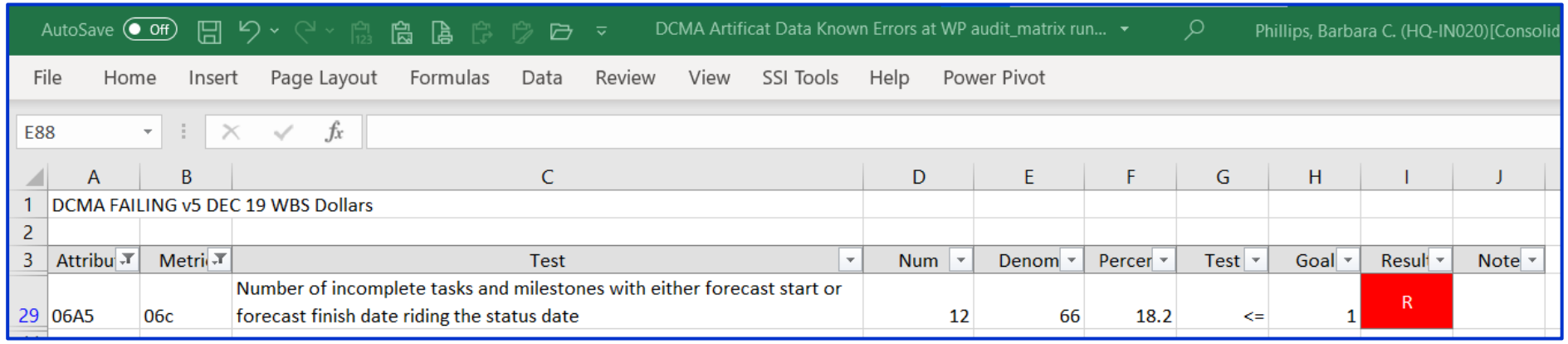
Automated Testing Capability

NASA uses analytics tools to run the Automated DECM Test Metrics

- Encore-Analytics **Empower**
  - NASA has an agency-wide license to this EVM analysis tool with schedule analysis capability
  - The Empower system administrator loads the updated DECM test metrics (currently v5.0)
  - Known for *Bull's Eye Chart* that graph that charts the CPI and SPI over time
  - Select *File* → *Export Audit Matrix* for all automated test metrics results (in Excel)
- Deltek Acumen **Fuse**
  - NASA has an agency-wide license for this schedule diagnostics tool
  - Deltek provides a configuration file for the DECM metrics that can be added by the user
  - Provides extensive set of schedule quality metrics as well as industry standards (e.g., DCMA 14 point, GAO, NASA Health Check, EVAS) metrics
  - Run metric *GL 06 Schedule* to determine the result for all Guideline DECM Test Metrics including 06A506c (can export to Excel)

The sample results in this presentation were calculated using the "Artificial Datasets – v5.0" from the DCMA Earned Value Management Systems Center (find at https://www.dcma.mil/HQ/EVMS/)

Automated Test Results for 06A506c - Empower

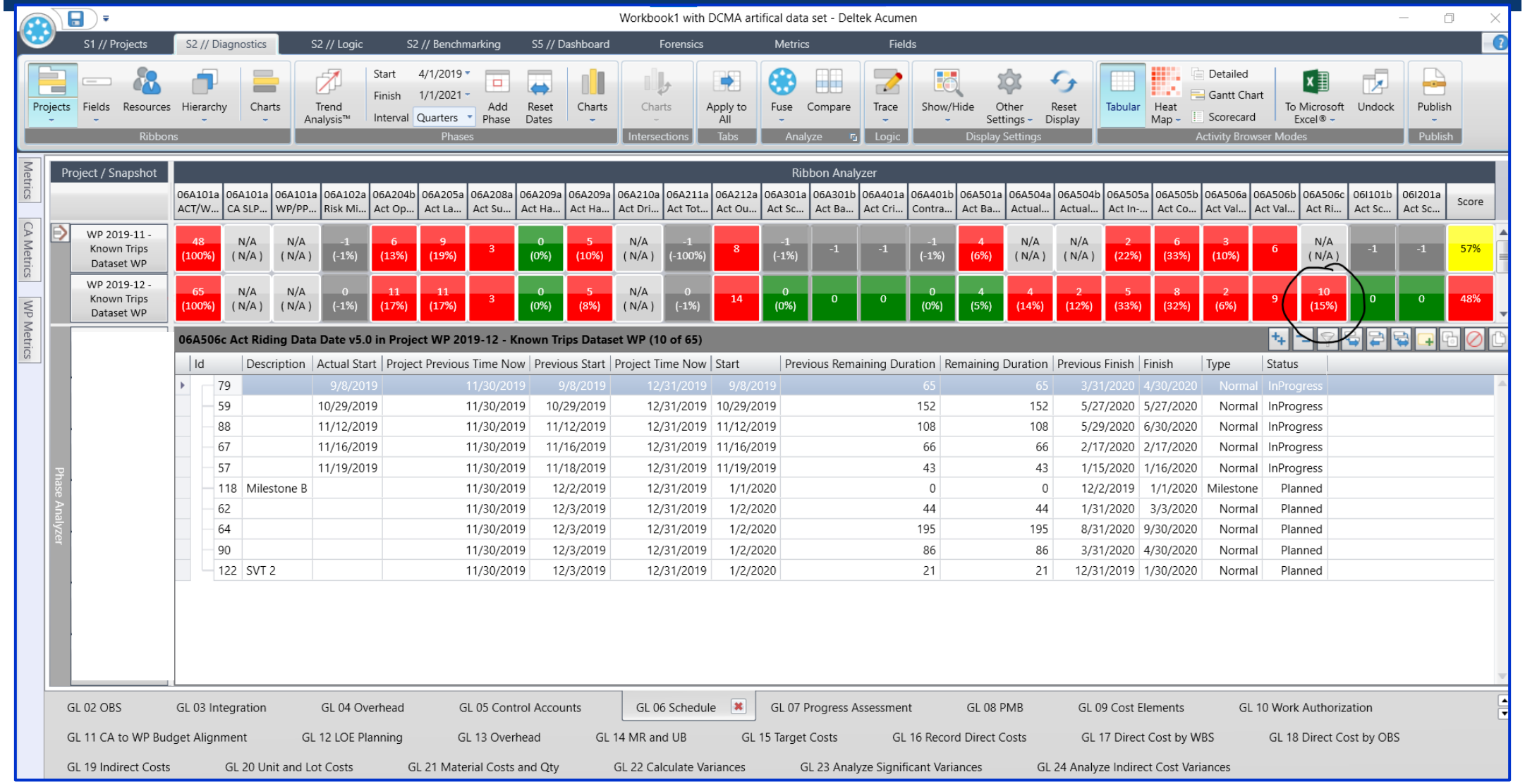


	A	B	C	D	E	F	G	H	I	J
1	DCMA FAILING v5 DEC 19 WBS Dollars									
2										
3	Attribu	Metri	Test	Num	Denom	Percer	Test	Goal	Resul	Note
29	06A5	06c	Number of incomplete tasks and milestones with either forecast start or forecast finish date riding the status date	12	66	18.2	<=	1	R	

	A	B	C	D	E	F	G	H	I
1	DCMA FAILING v5 DEC 19 WBS Dollars								
2									
3	Attribu	Metri	TestID	Failed	WBS	PROJ	UID	CAM	IMP
652	06A5	06c	06A506c	x	1A2	DCMA FAILING	57	CAM A	
653	06A5	06c	06A506c	x	1A4	DCMA FAILING	59	CAM A	
655	06A5	06c	06A506c	x	1B2	DCMA FAILING	62	CAM B	
657	06A5	06c	06A506c	x	1B4	DCMA FAILING	64	CAM B	
667	06A5	06c	06A506c	x	1C3	DCMA FAILING	67	CAM C	
684	06A5	06c	06A506c	x	2C1	DCMA FAILING	79	CAM C	
693	06A5	06c	06A506c	x	5B1	DCMA FAILING	86	CAM B	
695	06A5	06c	06A506c	x	5C1	DCMA FAILING	50	CAM C	
701	06A5	06c	06A506c	x	S1	DCMA FAILING	88		
703	06A5	06c	06A506c	x	S4	DCMA FAILING	90		
705	06A5	06c	06A506c	x	[Unlinked Tasks]	DCMA FAILING	118		
709	06A5	06c	06A506c	x	[Unlinked Tasks]	DCMA FAILING	122		
1101									

Examples provided based on DCMA's Artificial Dataset *Known Trip Dataset – WP-Level DECM v5.0* available at https://www.dcma.mil/HQ/EVMS/

Automated Test Results for 06A506c - Fuse



Fuse results excludes UIDs 50 and 86. May be due to remaining duration calculation. Currently investigating.

Examples provided based on DCMA's Artificial Dataset *Known Trip Dataset – WP-Level DECM v5.0* available at https://www.dcma.mil/HQ/EVMS/

Manual Test Results for 06A506c - Excel

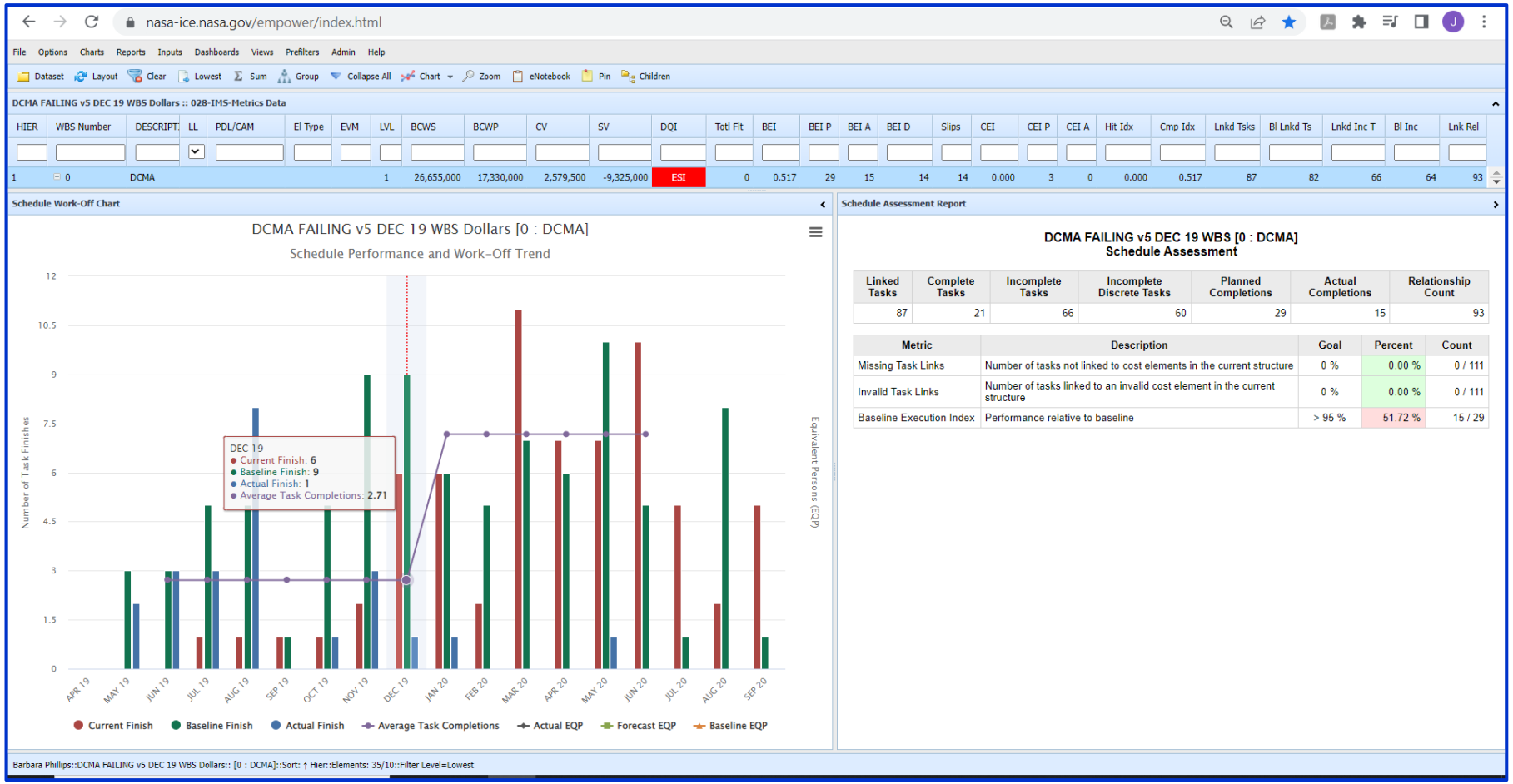
	A	B	E	F	H	I	J	K	L	M	P	Q	R	S
1	Active Metrics - pse is to show the current list of metrics that have been approved for use by the DCMA EVMS Center Configuration Control Board (CCE										METRIC RESULTS			
2	Test Metric Count	Unique Test Metric ID	Attribute ID	Current Metric Revision	Test Definition	Test Metric Numerator (X)	Test Metric Denominator (Y)	Metric Threshold	Artifacts	Test Type	Test Metric Numerator (X)	Test Metric Denominator (Y)	Result (X/Y) or (X)	OOT/NoOOT
41	1	06A506c	06A5	V5.0	Are forecast start/finish dates riding the status date of the IMS for two consecutive months?	X = Count of incomplete tasks/activities & milestones with either forecast start or forecast finish date riding the status date	Y = Total count of incomplete tasks/activities & milestones	X/Y ≤ 1%	11, 45	A	12	66	18%	**OOT**

Type	UID	Excel
Finish UID	50	**yes**
Finish UID	57	**yes**
Finish UID	59	**yes**
Start UID	62	**yes**
Start UID	64	**yes**
Finish UID	67	**yes**
Finish UID	79	**yes**
Finish UID	86	**yes**
Finish UID	88	**yes**
Start UID	90	**yes**
Start UID	118	**yes**
Start UID	122	**yes**

Examples provided based on DCMA's Artificial Dataset *Known Trip Dataset – WP-Level DECM v5.0* available at https://www.dcma.mil/HQ/EVMS/

Follow up Analysis based on Test Metric 06A506c Results:
Work Off Trend Chart (Empower)

Evaluate Work Off Trend chart to see the “Bow Wave” effect caused by tasks continually being re-forecasted.

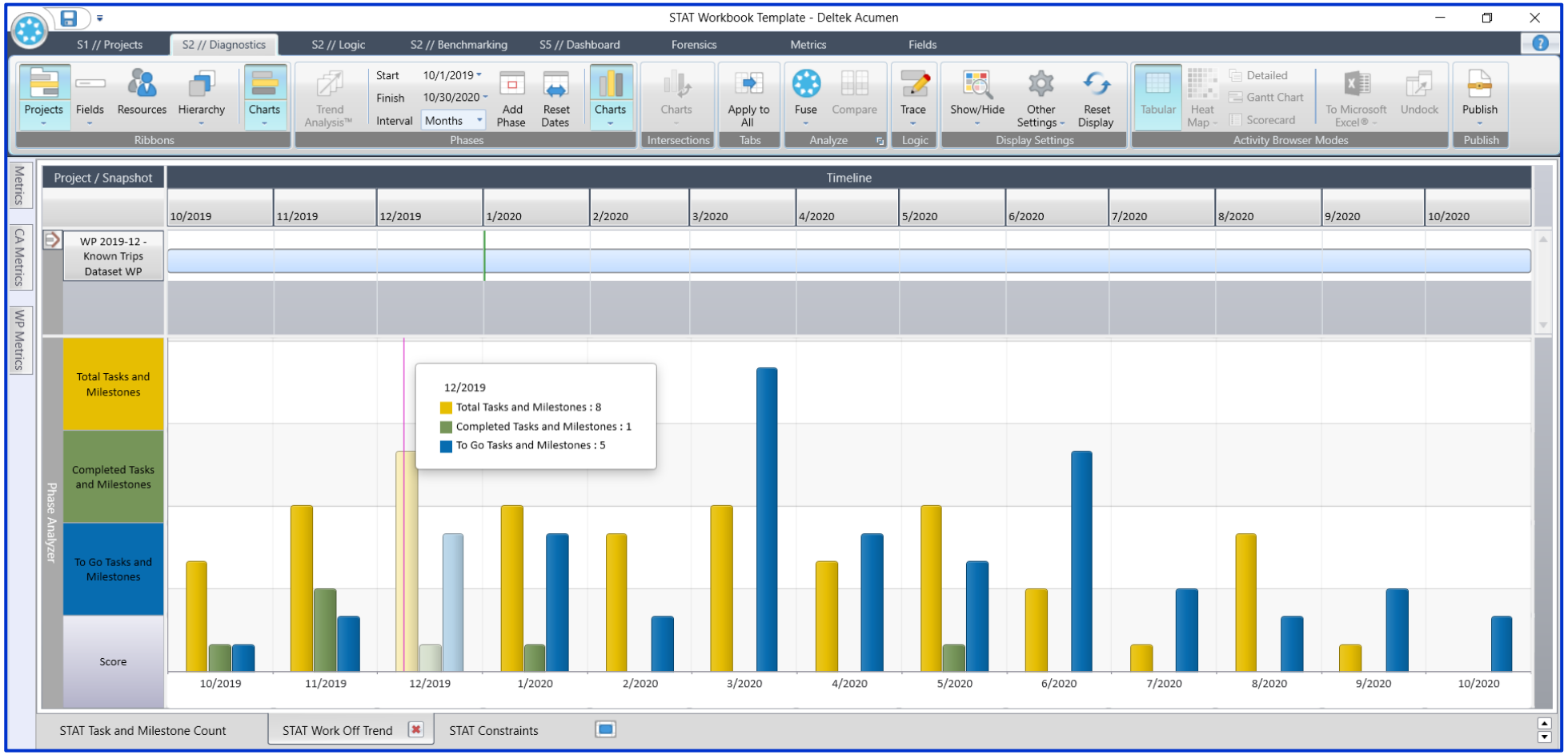


For Period 12/2019, fewer tasks had baselined dates than forecasted (e.g., 9 tasks had baseline start/finish dates and 6 tasks had forecast start/finish for a decrease of 3 tasks over baseline).

Empower includes unlinked tasks in its count

Follow up Analysis based on Test Metric 06A506c Results:
Work Off Trend Chart (Fuse)

Evaluate Work Off Trend chart to see the “Bow Wave” effect caused by tasks continually being re-forecasted.



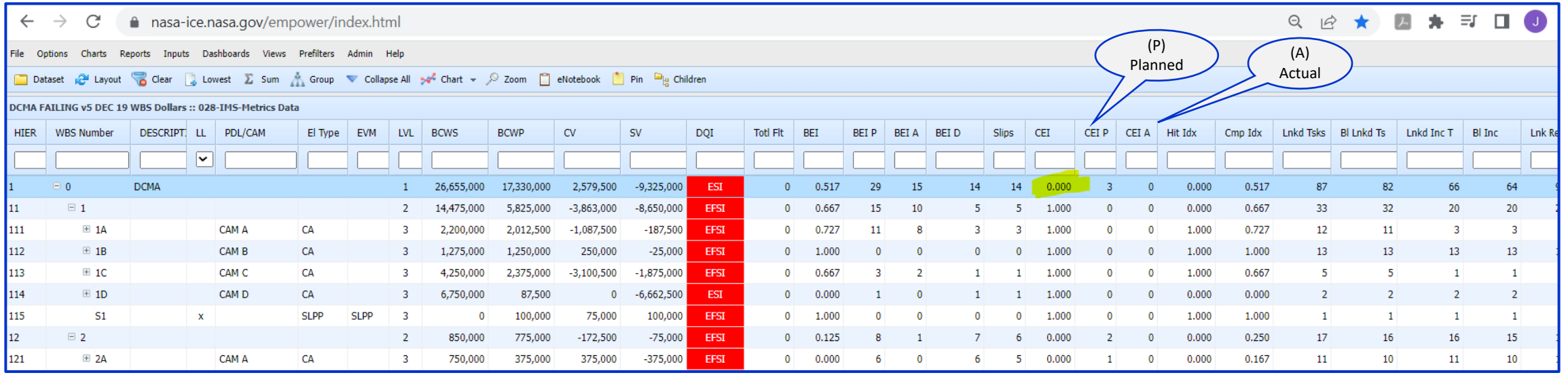
LEGEND
- Baselined tasks
- Finished tasks
- Forecasted tasks

For Period 12/2019, fewer tasks had baselined dates than forecasted (e.g., 8 tasks had baseline start/finish dates and 5 tasks had forecast start/finish for a decrease of 3 tasks over baseline).

Empower includes unlinked tasks in its count

Follow up Analysis based on Test Metric 06A506c Results:
Current Execution Index (CEI) (Empower)

CEI is a schedule execution metric that measures how accurately the program is forecasting and executing to its forecast from one period to the next. Its design is to encourage a forward-looking perspective to IMS and project management.



DCMA FAILING v5 DEC 19 WBS Dollars :: 028-IMS-Metrics Data

HIER	WBS Number	DESCRIPT	LL	PDL/CAM	El Type	EVM	LVL	BCWS	BCWP	CV	SV	DQI	Totl Flt	BEI	BEI P	BEI A	BEI D	Slips	CEI	CEI P	CEI A	Hit Idx	Cmp Idx	Lnkd Tsks	Bl Lnkd Ts	Lnkd Inc T	Bl Inc	Lnk Re
1	0	DCMA					1	26,655,000	17,330,000	2,579,500	-9,325,000	ESI	0	0.517	29	15	14	14	0.000	3	0	0.000	0.517	87	82	66	64	
11	1						2	14,475,000	5,825,000	-3,863,000	-8,650,000	EFSI	0	0.667	15	10	5	5	1.000	0	0	0.000	0.667	33	32	20	20	
111	1A			CAM A	CA		3	2,200,000	2,012,500	-1,087,500	-187,500	EFSI	0	0.727	11	8	3	3	1.000	0	0	1.000	0.727	12	11	3	3	
112	1B			CAM B	CA		3	1,275,000	1,250,000	250,000	-25,000	EFSI	0	1.000	0	0	0	0	1.000	0	0	1.000	1.000	13	13	13	13	
113	1C			CAM C	CA		3	4,250,000	2,375,000	-3,100,500	-1,875,000	EFSI	0	0.667	3	2	1	1	1.000	0	0	1.000	0.667	5	5	1	1	
114	1D			CAM D	CA		3	6,750,000	87,500	0	-6,662,500	ESI	0	0.000	1	0	1	1	1.000	0	0	0.000	0.000	2	2	2	2	
115	S1		x		SLPP	SLPP	3	0	100,000	75,000	100,000	EFSI	0	1.000	0	0	0	0	1.000	0	0	1.000	1.000	1	1	1	1	
12	2						2	850,000	775,000	-172,500	-75,000	EFSI	0	0.125	8	1	7	6	0.000	2	0	0.000	0.250	17	16	16	15	
121	2A			CAM A	CA		3	750,000	375,000	375,000	-375,000	EFSI	0	0.000	6	0	6	5	0.000	1	0	0.000	0.167	11	10	11	10	

A CEI of 0.000 translates to 0% of the three (3) tasks forecasted to finish in December as of November had an actual finish date in December. Note: fifteen (15) tasks were finished in December, but they were not forecasted to be finished December (see BEI which is cumulative to date).

Who to Contact

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