



Earned Value Management Practitioners Forum 2019

Variance Analysis Process and Metrics

Helping CAMs with Analysis and Writing VARs

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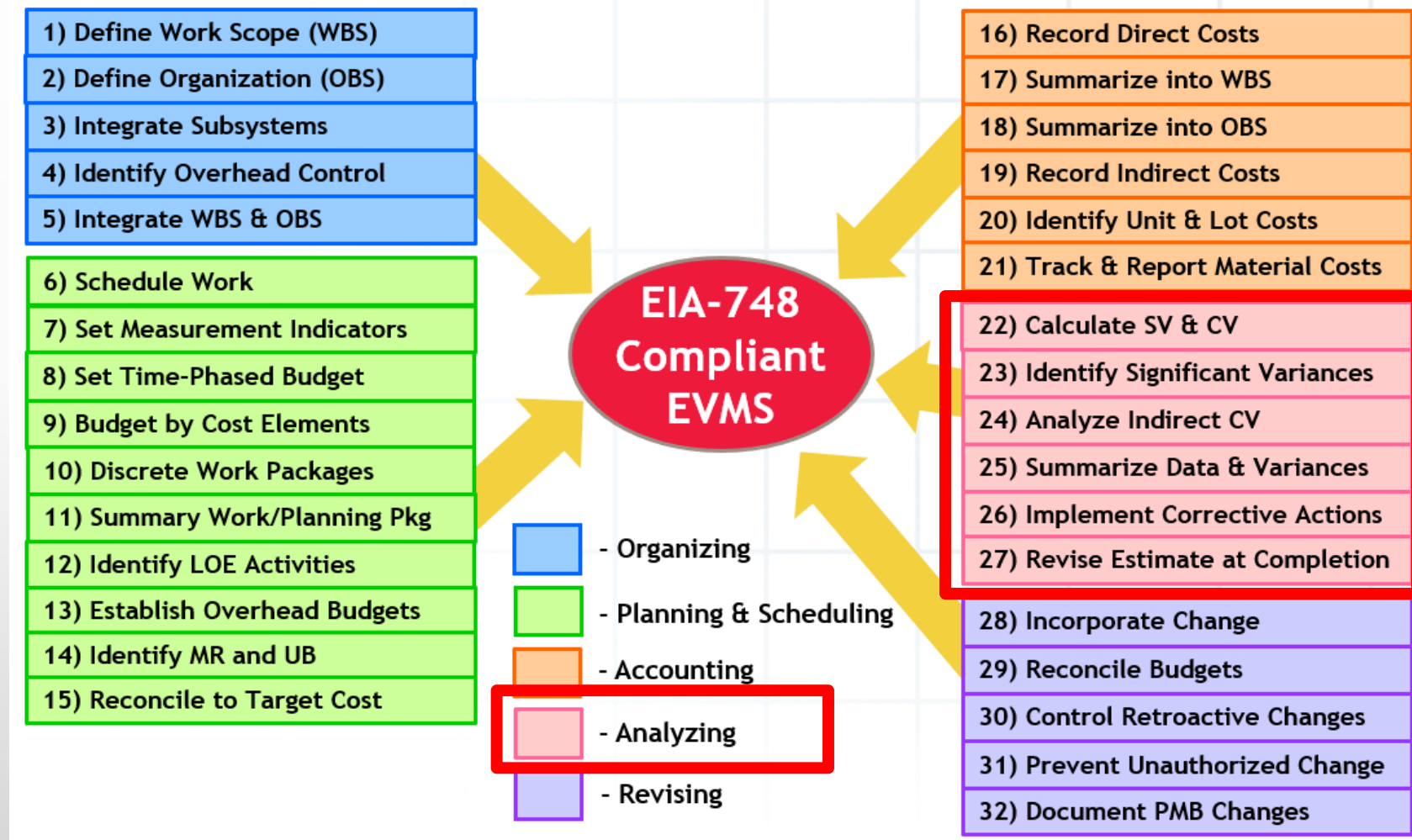
Learning Objectives

- Introduction to VARs and their purpose
- Data Flow, Functions, and Responsibilities
- Benefits associated with a well-written VAR

- Review of formulas and performance metrics
- Interpreting the data to improve program performance

- VAR sub-components and best practices
 - Root Cause Analysis
 - Impact Analysis
 - Corrective Actions

Presentation Focus



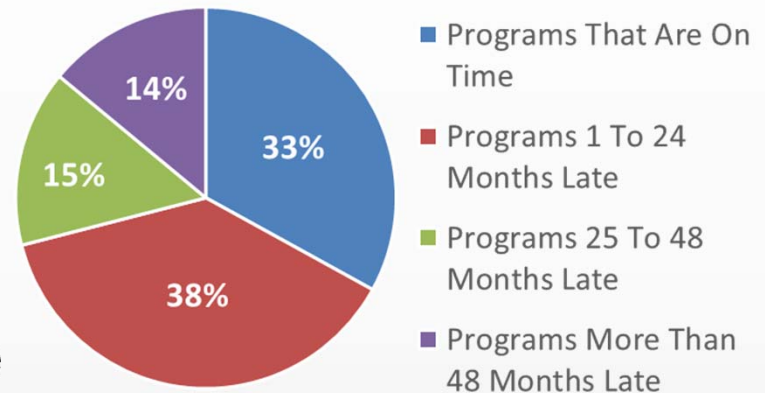
VAR - Purpose

- Monthly narrative supporting formal customer reporting
- Primary communication vehicle and consolidated formal interpretation of program status (Format 5)
- Summarizes and provides an audit trail of problem analysis along with their impacts to corrective actions
- Decision making trigger for the program managers
- Detects variances that could otherwise go unnoticed
- Induces preventative/corrective actions when pre-assigned thresholds are breached
- Opportunity for CAMs to demonstrate they understand scope, cost, and schedule dependencies

Why is Variance Analysis Important

- The GAO issued a study of weapons systems programs:
 - Average schedule delay of 21 months and average budget overrun of 26%
 - Combined cost overrun was \$295 billion
 - Overruns on major programs were found to be increasing by 2% per year

Schedule Delays

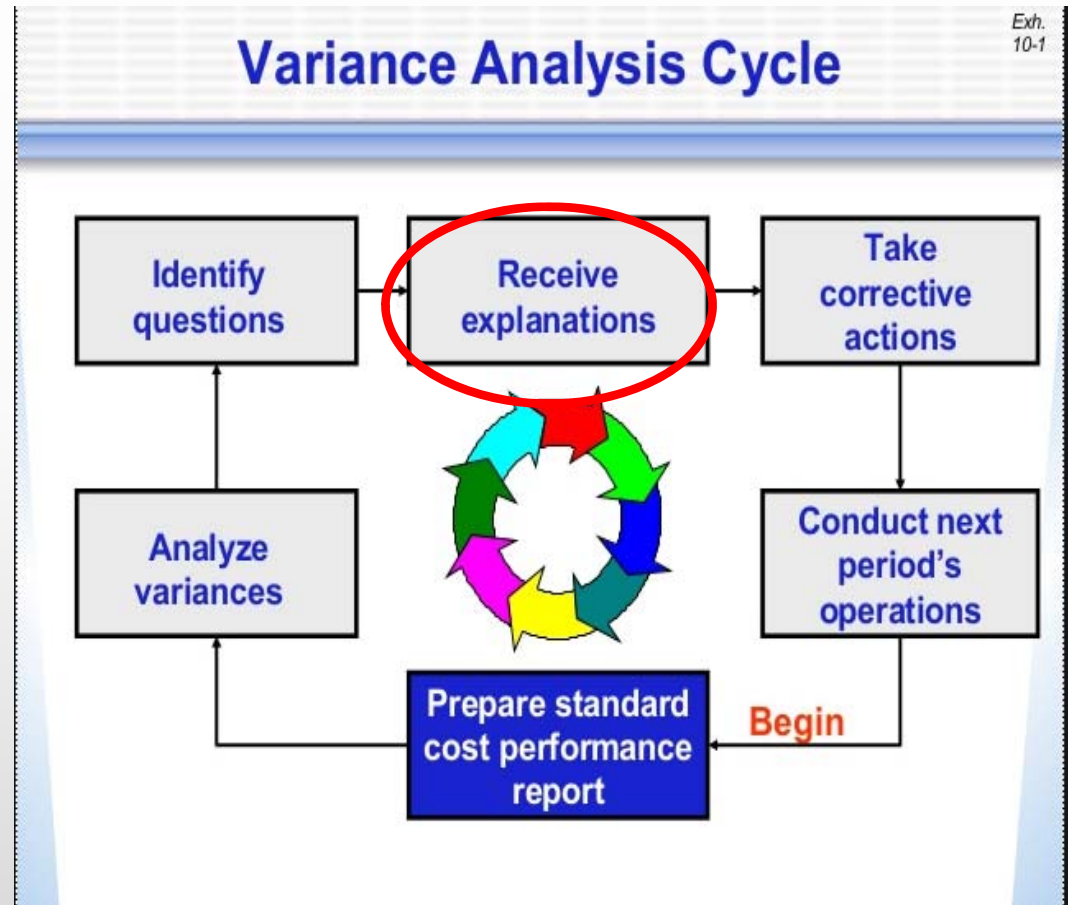


Defense Projects ⁶⁰	Per-Unit Cost Estimate and Date of Estimate	
	Original	Recent or Final
Program names redacted	\$360m (2004)	\$667m (2014)
	\$102m (1998)	\$376m (2013)
	\$79m (2001)	\$138m (2013)
	\$29m (2008)	\$77m (2014)
	\$24m (2005)	\$61m (2014)

Note: Per-unit costs in constant 2015 dollars. m=million.

Data Flow, Functions, & Responsibilities

- Responsibility of the Control Account Manager (CAM)
 - One CAM per Control Account, but multiple Control Accounts can be assigned to a single CAM
 - If an EAC impact is included, it is often reviewed and approved by the Program Manager
- Based on month-end data that is typically provided to the CAMs by finance/accounting teams for completion and return
- Reviewed and approved by Program & Business management (can be iterative in a single cycle)
- Consolidated per IPMR (Integrated Program Management Report) Format 5
- Submitted to customers



Benefits of a Well-Written VAR

Project Benefits: All done during monthly review cycle and planning phase

Cost:

- Provides better projections for forecasting and EACs
- Helps provide clarity on staffing requirements

Schedule:

- Aligns predecessor and successor tasks
- Facilitates the Understanding and communication of mitigation plans

Scope:

- Provides actionable mitigation plans designed to stop cost, schedule, and scope creep
- Ensures program team understands upcoming tasking
- Tracks mitigation plans to completion

Consequences of a Deficient VAR

Project Risks: One or more of the following can result in Corrective Action Requests (CARs) leveraged by the DCMA depending on severity

Cost:

- Reduced MR, reduced profit
- Overall increase to program cost

Schedule:

- Missed deadlines and deliverables
- Added tasking to correct issues not identified

Scope:

- Increased risk to the project
- Out of scope tasking added to correct issues

DCMA Corrective Action Request

The DoD has four (4) levels of CARs. The level depends on the severity of the nonconformity and the level of supplier management visibility required to adequately address corrective actions. The levels are:

- **Level I:** Issued for nonconformity that can be corrected on the spot and where no further corrective action response is necessary. Level I CARs shall be documented and issued to the supplier management level responsible for taking corrective actions.
 - **Level II:** Issued when contractual nonconformity cannot be corrected on the spot. As a minimum, nonconformity associated with Critical Safety Item (CSI) critical characteristics and Safety of Flight (SOF) characteristics shall be issued at this level. Level II CARs should be directed to the supplier management level responsible for initiating corrective actions
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- **Level III:** Issued to the supplier's top management to call attention to serious contractual nonconformity. Repeat nonconformities found within one year for the same single point failure SOF characteristics shall be issued as a Level III CAR. A Level III CAR may be coupled with contractual remedies such as reductions of progress payments, cost disallowances, or business management systems disapprovals, etc. A Level I or II CAR need not be issued before a Level III CAR is generated. All Level III CARs shall be coordinated with the Contracting Officer.
 - **Level IV:** Issued to the supplier's top management when a Level III has been ineffective or the contractual nonconformity is of such a serious nature to warrant contractual remedies such as suspension of progress payments or product acceptance activities, in accordance with applicable [Federal Acquisition Regulations \(FAR\)/Defense Federal Acquisition Regulations Supplement \(DFARS\)](#) policies and procedures. Level IV CARs should be addressed to the supplier's top-level management.

Thresholds and Implications

- WBS elements that trip the customer defined thresholds require explanations
 - Different types of thresholds
- Internal CA level thresholds < Customer CA Reporting thresholds – *good practice*
- Even if your reporting level is at the CA level, it is worth looking into Work Package or even Resource level variances
 - No variance at the reporting level can be a result of offsetting but significant variances at lower levels
- Schedule variances generally indicate cost variances will follow
- Manage critical path items

Questions & Answers in EVM

Question	Answer	Acronym
How much work did we plan to do?	Budgeted Cost for Work Scheduled	BCWS = PV
How much work got done?	Budgeted Cost for Work Performed	BCWP = EV
How much did the completed work cost?	Actual Cost of Work Performed	ACWP = AC
What was the total job supposed to cost?	Budget at Completion	BAC
What do we now expect the total job to cost?	Estimate At Completion	EAC
What is the difference between the BAC and the EAC?	Variance at Completion	VAC

Formulas

- Variances

- Cost Variance..... $CV = BCWP - ACWP$
- Schedule Variance..... $SV = BCWP - BCWS$
- Cost Variance %..... $CV\% = (CV / BCWP) * 100$
- Schedule Variance %..... $SV\% = (SV / BCWS) * 100$

- Efficiency Factors

- $CPI = BCWP / ACWP$
- $SPI = BCWP / BCWS$

*** > 1 is favorable; <1 is unfavorable

- Metrics at Complete

- Estimate at Complete..... $EAC = ACWP + ETC$
- Variance at Complete..... $VAC = BAC - EAC$

Interpreting and Deducing

Cost Variance

- Since $(CPI = BCWP / ACWP)$ & $(CV = BCWP - ACWP)$
 - If $(BCWP > ACWP)$ then $(CPI > 1)$ then $(CV > 0)$
 - **Favorable Cost Variance** – Informal term “Cost Underrun”
 - If $(BCWP < ACWP)$ then $(CPI < 1)$ then $(CV < 0)$
 - **Unfavorable Cost Variance** – Informal term “Cost Overrun”

Schedule Variance

- Since $(SPI = BCWP / BCWS)$ & $(SV = BCWP - BCWS)$
 - If $(BCWP > BCWS)$ then $(SPI > 1)$ then $(SV > 0)$
 - **Favorable Schedule Variance** – Informal term “Ahead of Schedule”
 - If $(BCWP < BCWS)$ then $(SPI < 1)$ then $(SV < 0)$
 - **Unfavorable Schedule Variance** – Informal term “Behind Schedule”

Data Anomalies

- Data anomalies do not necessarily equate an error; sometimes they simply require an explanation
- Different types of data anomalies may present themselves more frequently based on your specific project
- Common data anomalies:
 - Zero variances are not necessarily ideal
 - Negative data elements, especially Actuals or Earned Value
 - Actuals but no EV or EV but no Actuals

Key Elements of a VAR

Root-Cause Analysis

- Identify the underlying cause of the problem
- Give reasons for the variance
 - Address last month, cumulative, and/or at completion
 - Address cost variances and schedule variances separately
 - For cost variances, determine if the cause is rate or volume
 - Address important drivers with as much quantification as possible

Impact Analysis

- Identify the impact on tasks and for the program as a whole
 - For schedule variance, indicate weeks of impact and effect on other areas
 - Address EAC implications and risks

Corrective Action Plan

- Identify specific corrective actions
- Implement a corrective action plan
 - Specifically identify who is going to do what by when
- Is the variance recoverable?

Root-Cause Analysis

- Looks into what happened and why
- Clearly and concisely identifies reasons for the variance
 - Defines each underlying root cause/drier of the problem separately
 - Highlights significant problems (not all problems)
 - Accounts for majority of reasons behind the variance (85-95%)
- Focuses on Quantitative Analysis rather than qualitative
 - Emphasis should be on what is significant and should refer to specific data elements
 - Apportions total variance to each problem/cause
- Addresses CV and SV separately

Root-Cause Analysis Considerations

Detailed questions to ask during Root Cause Analysis:

- **Schedule**
 - What tasks are not being started, completed, or are slipping?
 - Is an “upstream” or predecessor task the root cause?
 - Why is the internal plan not being met?
 - Is the cause internal or external?
 - Are the tasks on the critical path?

- **Cost**
 - What tasks have the cost variance?
 - What is causing the tasks to cost more or less than the plan?
 - Is the cost variance driven by volume?
 - Is the cost variance driven by direct labor rates (skill mix or adequate proficiency)?
 - Is the cost variance driven by indirect rates (burden performance)?
 - Is the cost variance driven predominately by technical issues?
 - Is the cost variance driven by non-labor?

Root-Cause Analysis Checklist

Report Period of VAR

	Evaluation	
	Yes	No

General Checklist to Review the VAR

1- Does the VAR address Current month, Cumulative-to-Date and At-Complete Variances for each cost/schedule variance separately?	1		
2- Does the narrative address all issues with a clear technical explanation?	2		
3- Is the focus on specific issues, not general problems?	3		
4- Can reader not previously familiar with the problem fully understand it?	4		
5- Is the explanation logical, thorough, and consistent with statements in past VARs?	5		
6- Does the VAR have correct spelling, grammar, and expanded acronyms?	6		

Problem and Root Cause

1- Does the narrative fully explain root causes for each problem?	1		
2- Are important drivers addressed with qualifications, references, dollar value, and metrics to support the narratives?	2		
3- Were the following things taken into consideration:	3		
a. Labor rate and volume issues	a		
b. Direct costs vs. burden issues	b		
c. Material - price, usage, and timing issues	c		
d. Subcontract - timing issues	d		

Impact Analysis

- Describe specific cost, schedule, and technical impacts to the program ,other functional areas, or other tasks in the WBS for each of the variance drivers and root causes
- Schedule impacts
 - Critical path
 - Identify key IMS line items and dependencies that are impacted
 - Identify changes to float
- Include approximate dollar value of the cost/schedule impact and include duration changes and date impacts
- Assess the impact to the EAC based on these variances and quantify risks and opportunities
- If there is no task impact or program impact, explain why not

Impact Analysis Considerations

Cost Impact

- What is your current/cumulative cost variance?
- Do you expect the cost trend to continue?
 - Is a revision to the EAC necessary?
 - Are there newly realized Risks/Opportunities?

Schedule Impact

- How many days/weeks/months is the slip and does it impact major milestones or the critical path?
- Is there adequate slack to absorb the schedule impact?
- Are risks currently being tracked in the IMS?

Technical Impact

- Is the variance resulting in a change in solution or approach?
- Are there adequate resources available to mitigate technical impact?
- Which “downstream” or successor tasks are impacted by your schedule variance?

Impact Analysis Checklist

Report Period of Var:

	Evaluation	
	Yes	No

Impact Analysis Checklist

- 1- Does the narrative address both short and long-term impacts to the control account, other control accounts, and the total program?
- 2- Is the relationship between technical tasks, cost, and schedule addressed?
- 3- For schedule variances, is the impact to the critical path, float, schedule margin, contractual milestones, and/or delivery dates addressed?
- 4- Are resources to complete work effort (labor, material, subcontract, travel, ODC) quantified? (Evaluate skill mix, availability of resources)
- 5- Are risks and opportunities in achieving cost/schedule objectives identified?
- 6- Are impacts to the EAC addressed?
- 7- If there is no impact, is a justification provided?
- 8- Have you coordinated with all groups affected by this control account's variance?

1		
2		
3		
4		
5		
6		
7		
8		

Corrective Action Plan

- The Corrective Action Plan seeks to answer:
 - Who?
 - What?
 - When?
 - How much?
- Describe specific actions to alleviate or minimize negative impacts
- Include the individual, resources, or organization responsible for the required action
- Include schedules for the corrective action including completion dates and recovery dates
 - If recovery is not possible, explain why
- Include corrective action follow-ups to review the results of earlier corrective actions
- Identify plans to mitigate any Risks and take advantage of Opportunities
- Describe workaround plans incorporated into the IMS

Corrective Action Plan Checklist

Report Period of VAR

	Evaluation	
	Yes	No

Corrective Action Plan Checklist

1- Are results of the corrective action plans from previous VARs included?	1		
2- Is the individual or organization responsible for each required action included?	2		
3- Are any dependencies and assumptions documented?	3		
4- Does the Corrective Action Plan have a logical flow from the impact section?	4		
5- Does the Corrective Action narrative contain past results, current plan, expected outcome & alternatives?	5		
6- Did you re-evaluate and update the EAC and Risk & Opportunity Plan?	6		
7- If no corrective action is possible, is a justification provided?	7		
8- Was the corrective action transferred to the "corrective action log" for assignment of owner and due date?	8		
9- Is the corrective action measurable, realistic, and achievable	9		

Pitfalls and Potential Solutions

Pitfalls	Potential Solutions
Lack of Technical expertise	Ensure proper CAMs assigned
Inadequate turnaround time for reports	Streamlined internal reporting process
No EVM training	Ensure EVM training to all members
Lack of process	Follow EVM process from day 1
Errors in data	Continual check throughout the month for data anomalies
Incorrect level of data capture	Validate reporting level adequate for both internal and external analysis and reporting

Key Takeaways

- A VAR that is detailed and provides specific information about the problem will allow the program team and management to make informed decisions to reduce any potential risk to the program and financials. And ensure no CARs are assigned.
- Overall items to remember with VARs:
 - Focus on quantitative not qualitative data
 - Ensure you are specific and not the general in problem areas
 - The Control Account Manager (CAM) is the most knowledgeable person to write the variance analysis, utilize the program team for support vs writing the VAR
- For those writing a VAR and approving them it is best to ensure you ask these 5 questions and if not answered, rewrite until they are clearly defined:
 - “**why**” the problem occurred, are there specifics examples
 - “**what**” is impacted now or in the future, detail out any cost/schedule impact
 - “**how**” the corrective action is being taken, define any return to green plan
 - “**when**” the corrective actions will occur, identify specific dates/impacts
 - “**who**” is responsible for implementing the corrections?

Questions???