EVM Data Analysis

TOPIC LEARNING OBJECTIVES

Upon successful completion of this topic, the student will be able to:

1. Define the 5 Earned Value Management (EVM) independent variables (BCWS, BCWP, ACWP, BAC, EAC) and use them to compute appropriate performance status indicators.
2. Identify the limitations in analyzing cost and schedule variance.
3. Identify the four EVM data analysis steps.
4. Recognize five EVM signs of significant problem areas or risk.
5. Match the type of work with the most appropriate performance measurement technique.
6. Given a Gantt chart and performance (e.g., cost, risk and schedule) data, detect and analyze the impact of significant problem areas, based on the status indicators.
7. Analyze and interpret Contractor performance indicators (cost variance, schedule variance, SPI & CPI) to explain the program's cost and schedule status and identify trends and problem.
8. Given performance data, calculate an estimate of cost at completion.
    a. Understand difference between Government and Contractor estimates at completion
9. Analyze the Contractor's status by applying earned value analysis techniques (e.g., calculate cost variance, schedule variance, cost performance index and schedule performance index).
10. Given a segment of contract work and associated tasks, plan and schedule the tasks and resources necessary to complete contract work within cost and schedule constraints.

STUDENT PREPARATION

Student Support Material

1. DAU EVM Gold Card
2. Basic EVM Parts 1, 2 and 3
   https://media.dau.edu/media/t/0_ohsk5llw
   https://media.dau.edu/media/t/0_quugon3w
   https://media.dau.edu/media/t/0_xi9enlj5

Primary References

1. Integrated Program Management Policy and Guidance: DoD Earned Value Management Implementation Guide https://www.acq.osd.mil/asda/ae/ada/ipm/policy-guidance.html#guides-references
2. ANSI/EIA-748-C Standard for Earned Value Management Systems

Additional References

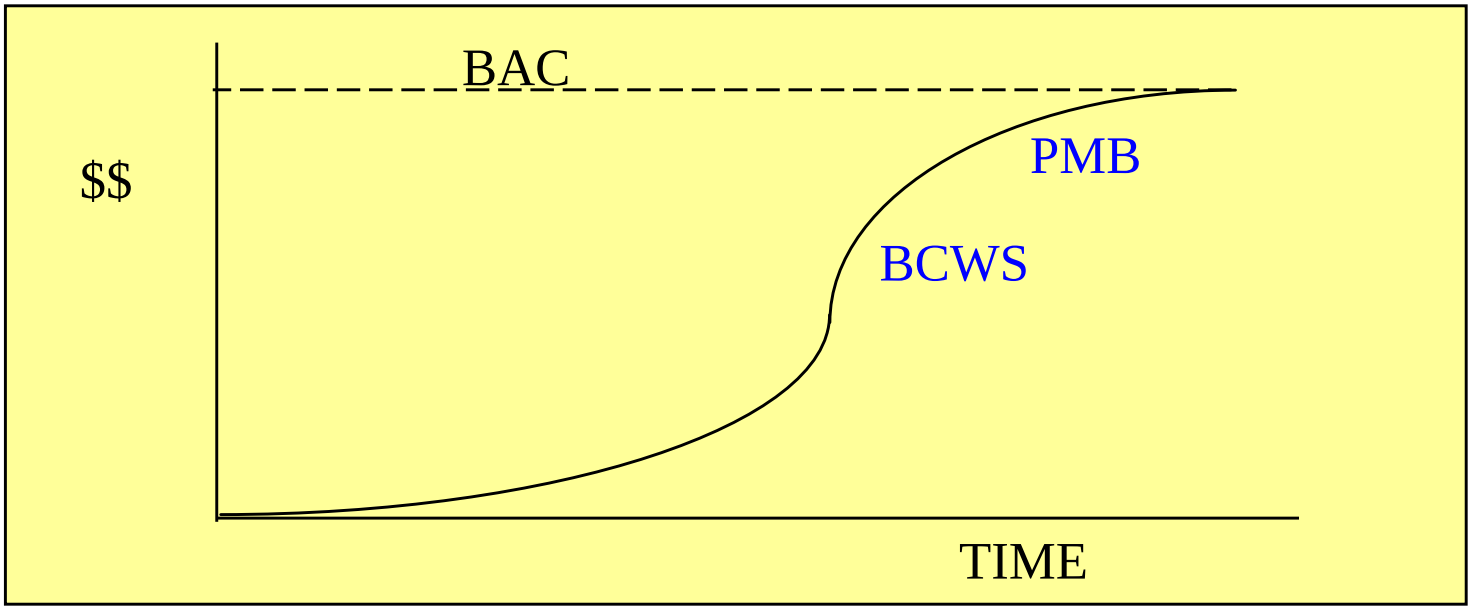
1. NDIA IPMD Earned Value Management Systems ANSI/EIA-748-C Intent Guide
2. DAU EVM 101 Fundamentals of Earned Value Management

Overview

- EVM definitions
- Measurement techniques
- Data analysis steps
- Problem areas and risk indicators
- Practical exercise

Review of EVM Concepts

- Budgeted Cost of Work Scheduled (BCWS)
  - a.k.a. Planned Value (PV)
- Budget At Completion (BAC)
- Performance Measurement Baseline (PMB)



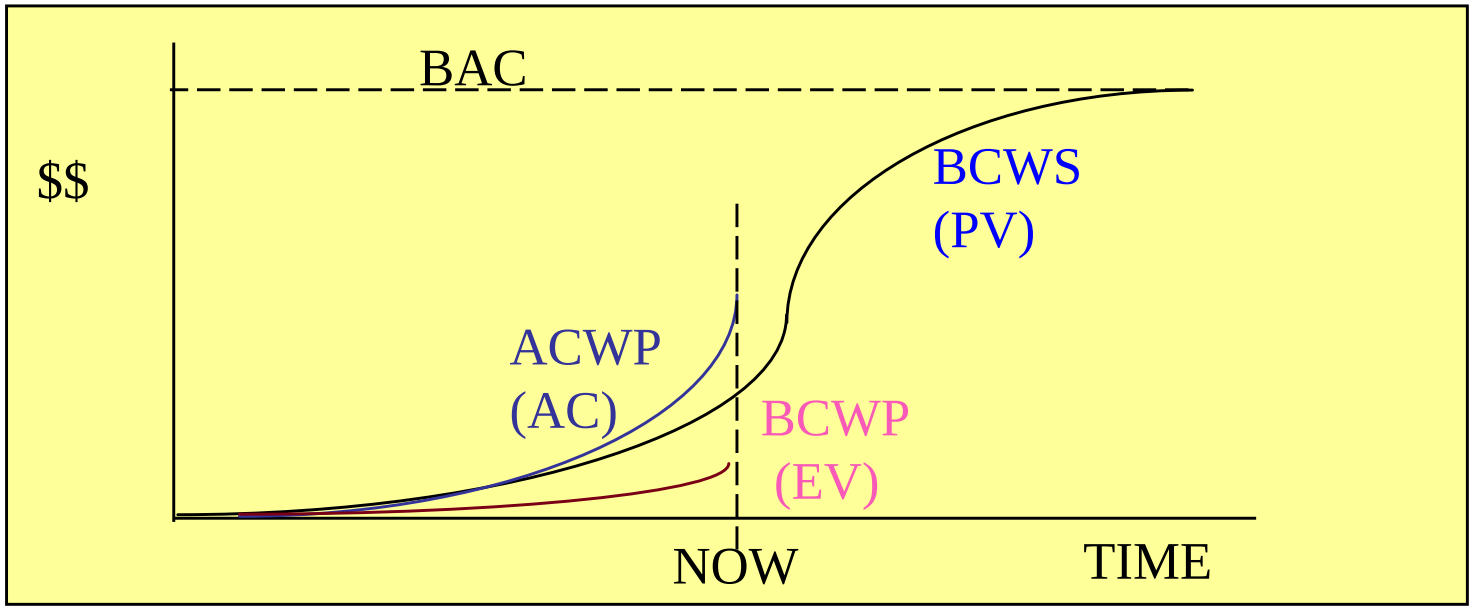
EVM Independent Variables

- Budgeted Cost of Work Scheduled (BCWS)
  - The ***sum of the budgets for all work packages scheduled*** to be accomplished within a specified timeframe
  - The Plan a.k.a. Planned Value (PV)
  - The value of the work scheduled
- Budgeted Cost of Work Performed (BCWP)
  - The ***sum of all budgets for completed*** work packages
  - a.k.a. Earned Value (EV)
  - The value of the work performed
- Actual Cost of Work Performed (ACWP)
  - The ***costs actually incurred to accomplish the work*** earned within a specified timeframe
  - a.k.a. Actual Cost (AC)

These variables form the basis of almost all EVM calculations

EVM Independent Variables

- PV, AC, and EV are often plotted together on progress reports



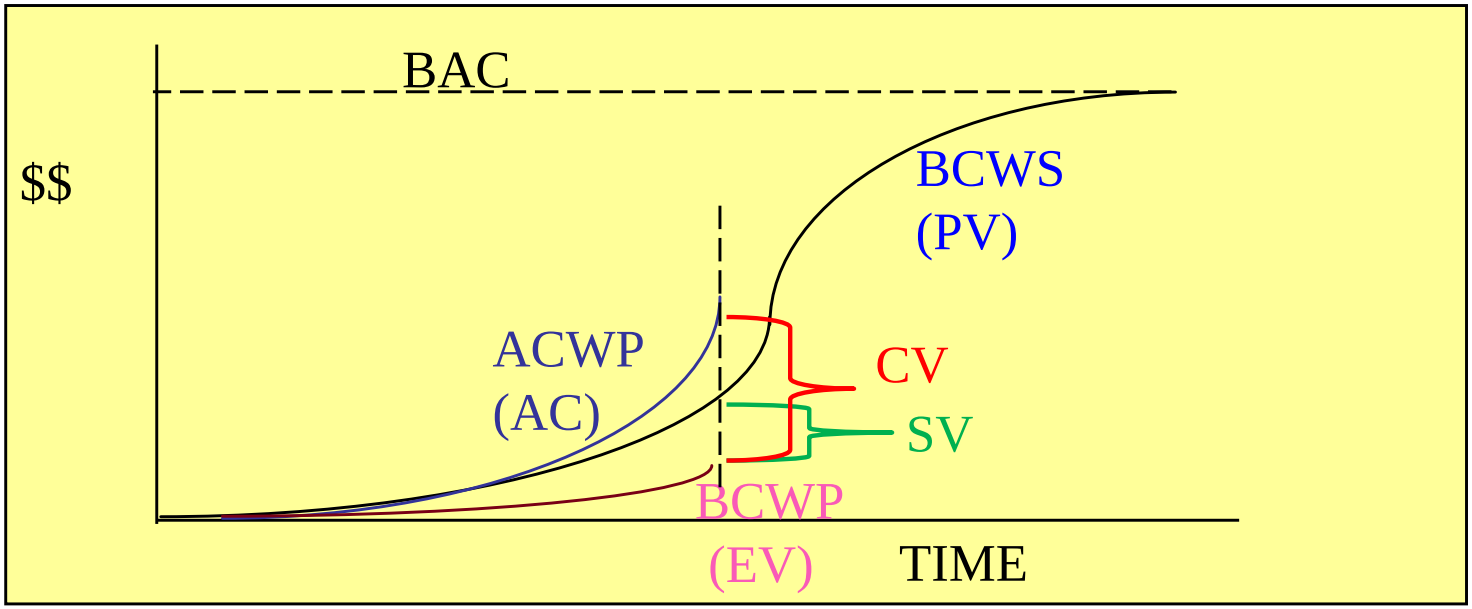
EVM Variances

- Variance reports are critical to earned value analysis
- Schedule Variance (SV)
  - The difference between the "value" of the work that has been performed and the work that has been scheduled
  - Indicates how much ahead or behind schedule the project is
  - SV = BCWP – BCWS = EV – PV
- Cost Variance (CV)
  - The difference between the value and cost of the work that has been performed
  - Indicates how much over or under budget the project is
  - CV = BCWP – ACWP = EV – AC
- Schedule and Cost Variance can also be scaled to a percentage of the work
  - SV% = (SV / BCWS)*100
    - Scaled to the total amount of work scheduled
  - CV% = (CV / BCWP)*100
    - Scaled to the total amount of work that has been performed

SV and CV: + is favorable, - is unfavorable

EVM Variances

- Variances can be visualized as the vertical distance between the curves of the independent variables



Can you tell how this project is doing in terms of cost and schedule?

Variance Limitations

- Schedule Variance
  - Must be analyzed in conjunction with other schedule information
  - ***By itself, reveals no critical path information***
  - May be misleading as unfavorable accomplishments in some areas may be offset by favorable accomplishments in other areas

- Cost Variance
  - ***Further analysis required to determine causes of cost variance and overall effect on contract cost***
  - Trend indicator
  - Used in top level reporting to assess whether overall program budget is reasonable
  - May be misleading when comparing dollars vs labor hours

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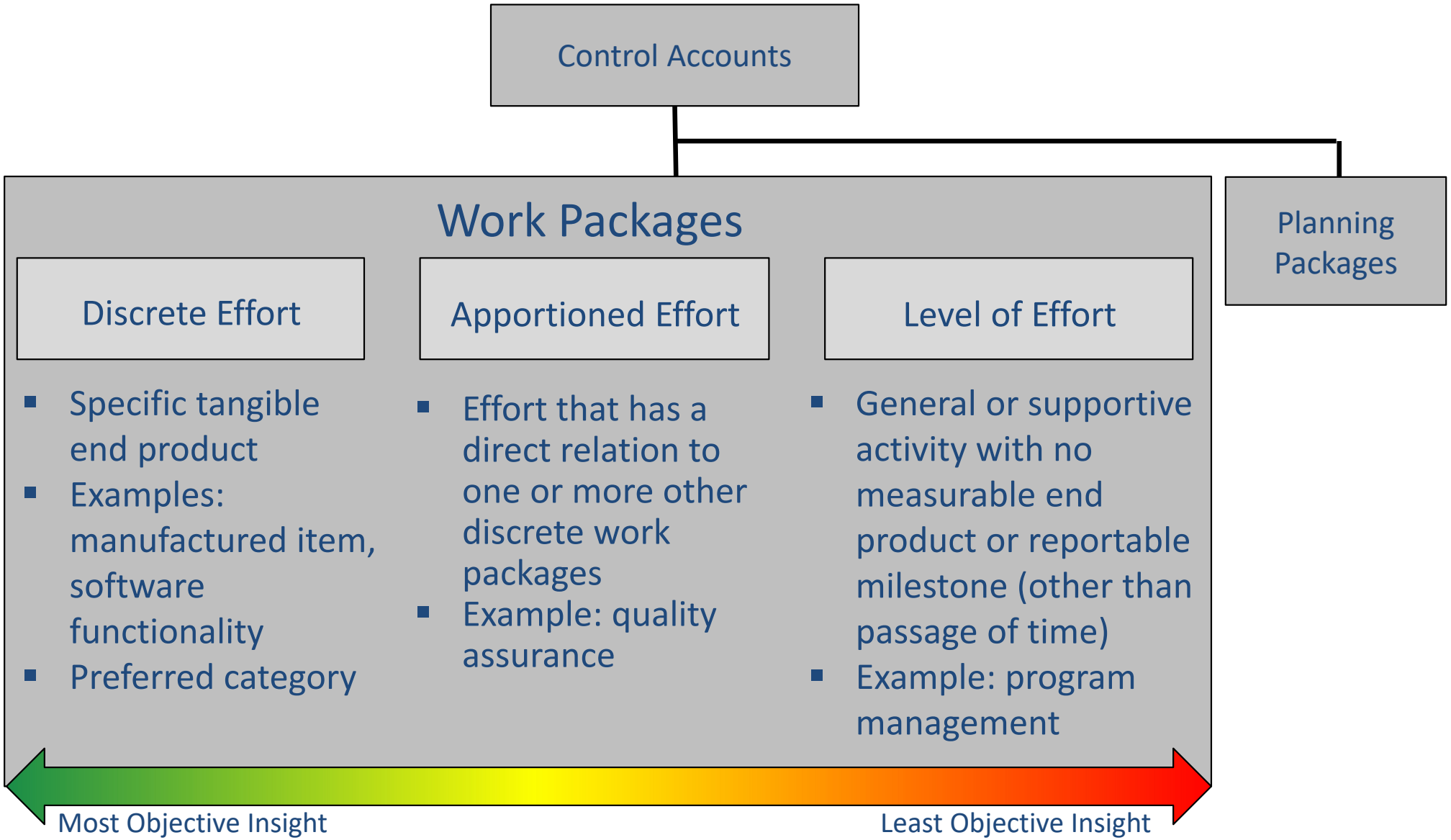
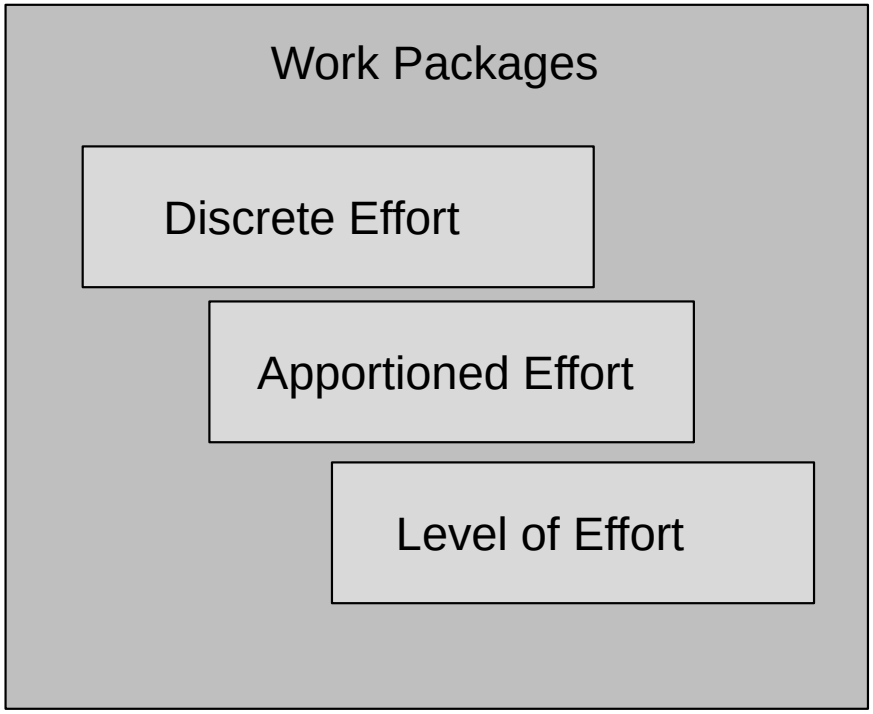
Work Package Categories



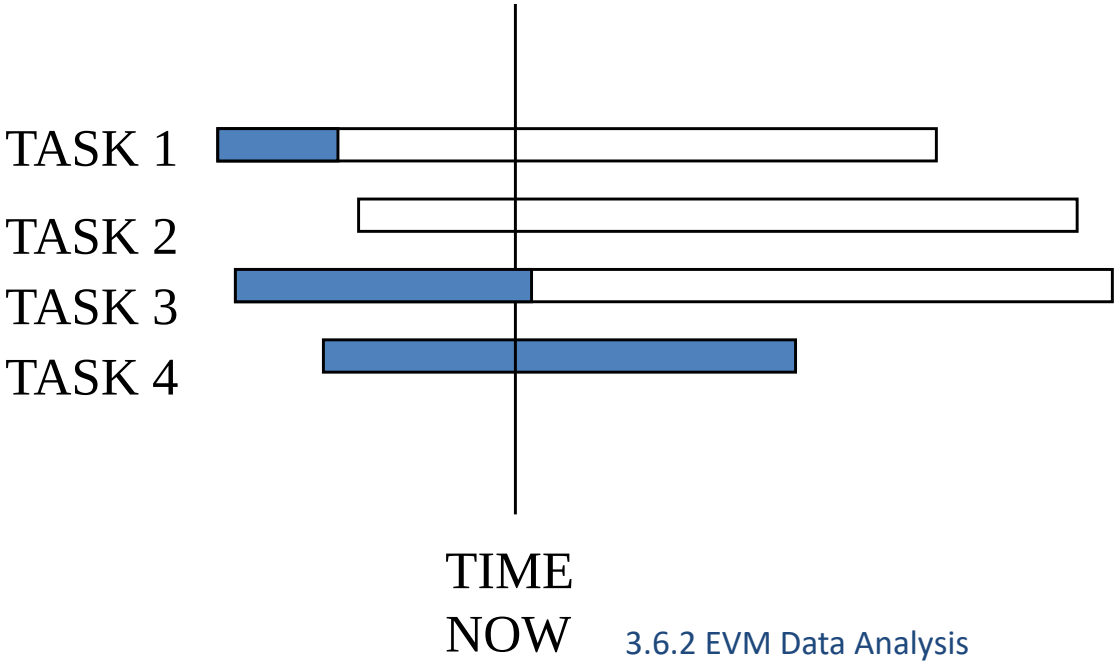
Techniques for Measuring Earned Value

- Techniques for Discrete Effort:
  - Percent Complete
  - Weighted Milestones
  - Percent Start/Percent Finish
  - 0/100
- Apportioned Effort technique
- Level of Effort technique



Measuring Earned Value (Percent Complete Technique)

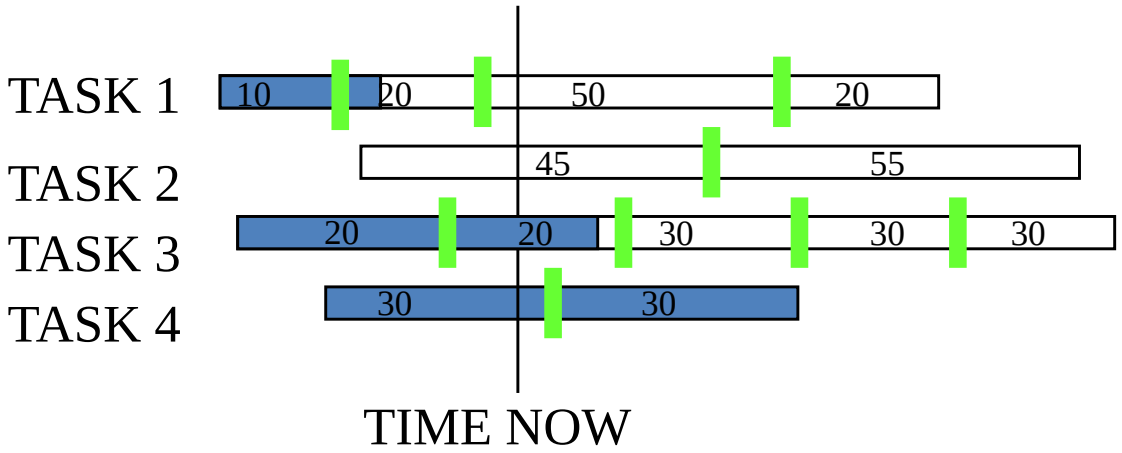
- EV is taken based on percent of task completed
- Used for ***long duration tasks with no interim milestones***
- Should have quantifiable data to back up estimate
- Advantages: Flexible, easy to implement
- Disadvantages: Encourages subjective assessments, estimates only as good as estimator



BAC	%	EV
100	15	15
100	0	0
130	30	39
60	100	60
390		114

Measuring Earned Value (Weighted Milestone Technique)

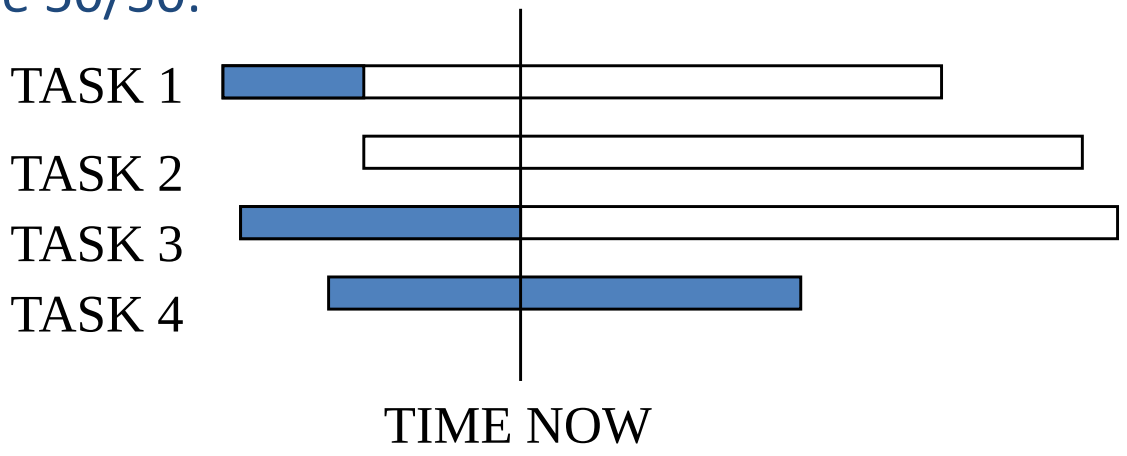
- Work is planned with interim milestones - logical divisions of the task
  - Allocates BCWS to each milestone according to required resources
- EV realized when milestone is completed
- Used for ***long duration tasks where milestones can be identified***
- Advantage: Milestones can be placed in each reporting period for accurate schedule status
- Disadvantage: Experience required for accurate/meaningful milestones



BAC	EV
100	10
100	0
130	20
60	60
390	90

Measuring Earned Value (Percent Start/Percent Finish Technique)

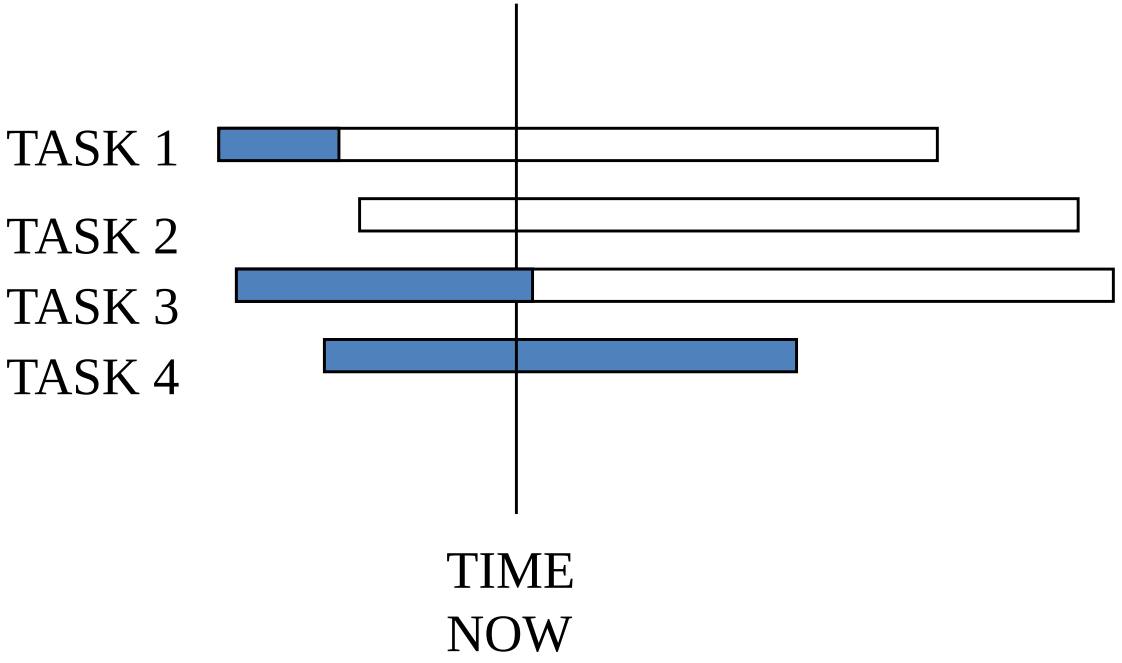
- X% performance taken when task starts, Y% performance taken when task is complete
  - A predetermined percentage of BAC is awarded as EV when a task starts, and the remainder is awarded when task is completed
  - i.e., in the 50/50 method, 50% EV is realized when the activity starts and the remaining 50% when it is complete
- Ideal for tasks that ***start and complete within 2 consecutive reporting periods***, otherwise the EV does not increase during the entire duration
- Example 50/50:



BAC	EV
100	50
100	0
130	65
60	60
390	175

Measuring Earned Value (0/100 Technique)

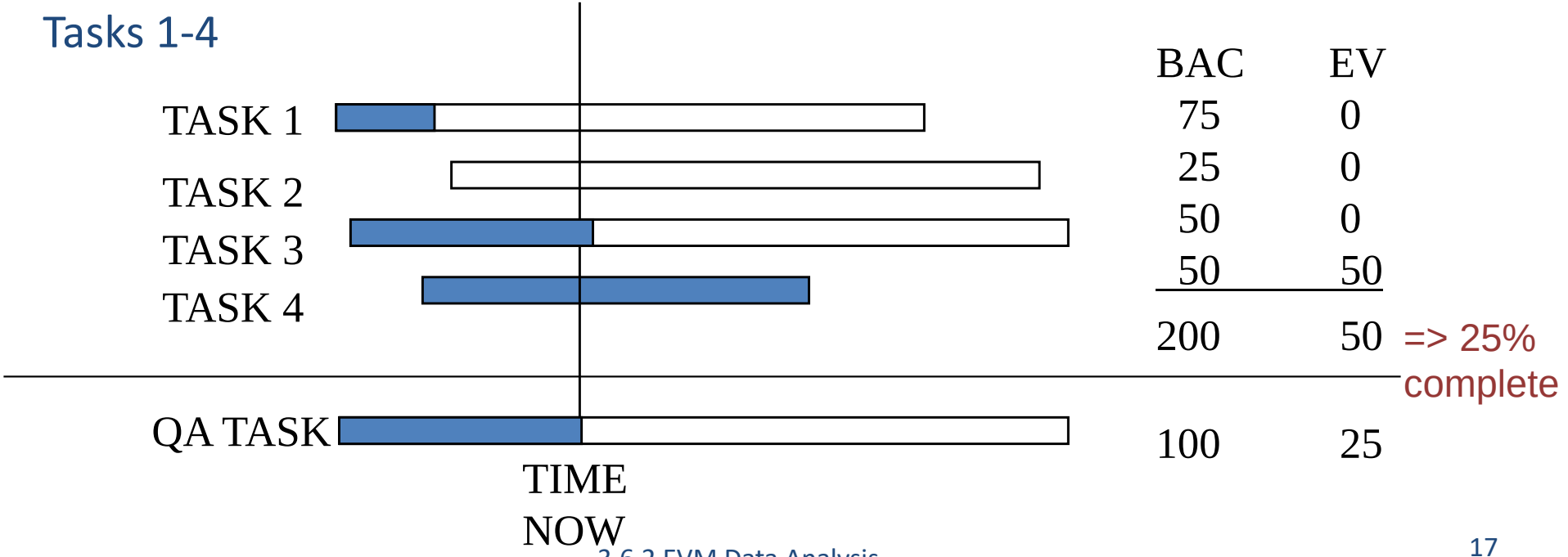
- EV is achieved when the task is complete
- Used for ***short duration tasks or work packages that start and finish in a single accounting period***
- Advantage: Lends itself to automation



BAC	EV
100	0
100	0
130	0
60	60
390	60

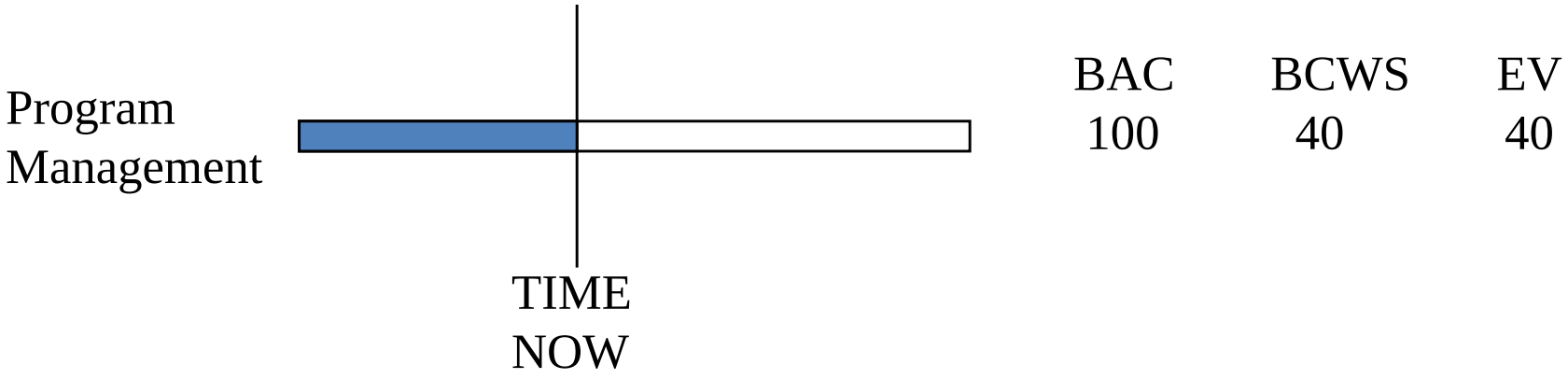
Measuring Earned Value (Apportioned Effort Technique)

- Used for all apportioned effort work packages, such as general or supportive activities associated with a discrete effort
- PV is based on a percent of the discrete effort's budget and schedule
- EV is dependent on the performance of discrete work
- Example: Tasks 1-4 are discrete work packages measured using 0/100 technique. QA Task is an apportioned effort Quality Assurance task for Tasks 1-4



Measuring Earned Value (Level of Effort Technique)

- EV measured solely by passage of time
- Has no specific product
- ***EV always equals BCWS***
- Used only for Level of Effort Work Packages



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- Data analysis steps
- Problem areas and risk indicators
- Practical exercise

Data Analysis Steps

- Data analysis steps:
  1. Get current performance status
  2. Identify performance trends
  3. Predict performance completion
  4. Determine management actions

Number crunching is not analysis – analysis informs the decision making process

Data Analysis Steps
1. Get current performance status

- Given: BCWS, BCWP, ACWP, determine variances:
  - Schedule Variance (SV)
  - Cost Variance (CV)
- Variance reports written at the summary level can make it difficult to pinpoint performance to individual cost element(s)
  - Therefore, variances should be drilled down to smaller cost elements:
    - Labor
    - Material
    - Subcontract
    - Overhead

Warning: Good performance in one area can mask poor performance in another (e.g., good performance in material, can mask poor labor performance)

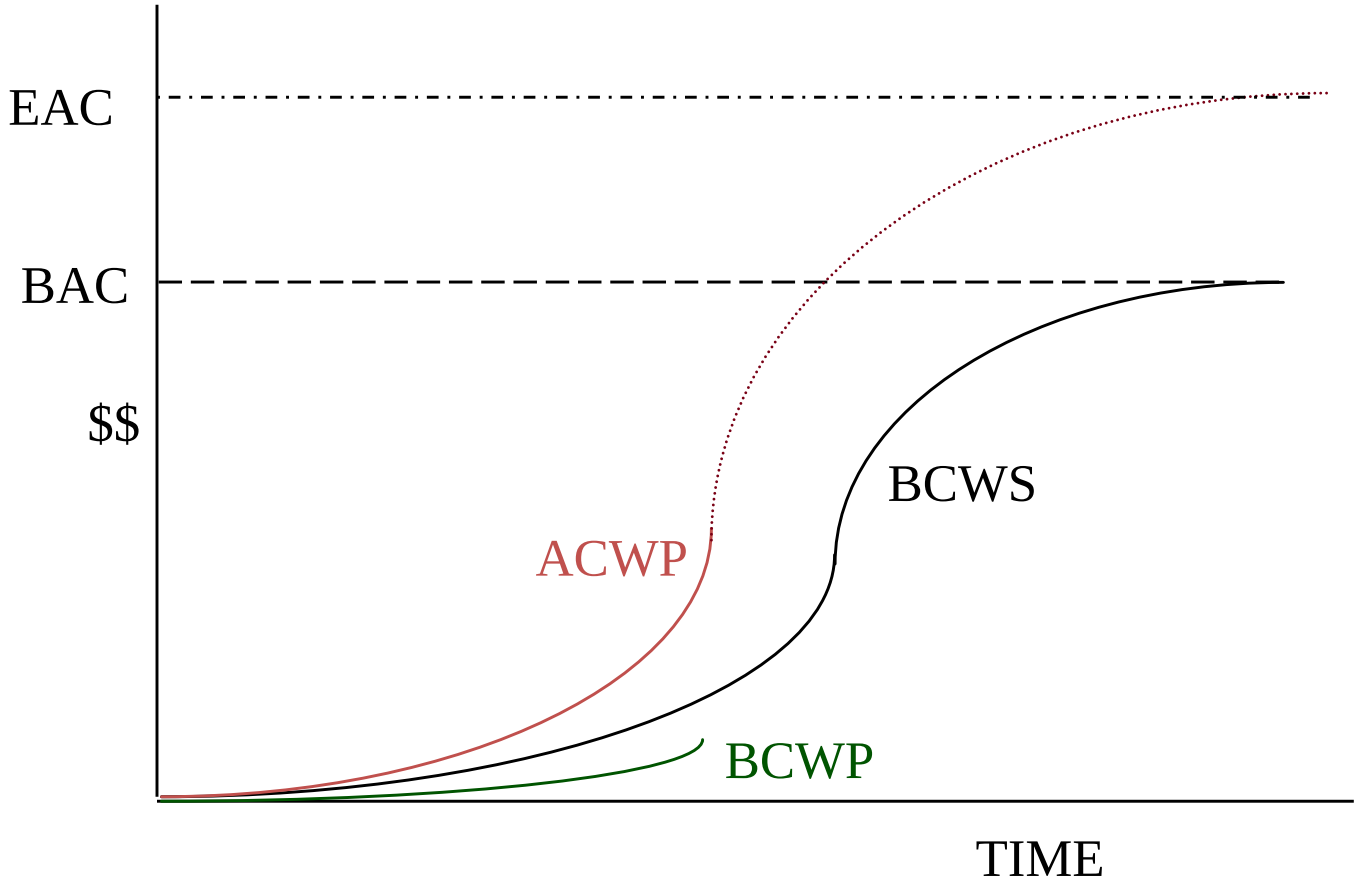
Data Analysis Steps
2. Identify performance trends

- Cumulative performance data measures the magnitude of the rate of change from previous period to current period
- Graphical data
- Analyze if performance is getting better or worse
- Analyze the rate of improvement or erosion
- Other performance metrics that could be calculated:
  - Schedule Performance Index (SPI) = BCWP / BCWS
    - Ratio of work done to work scheduled
  - Cost Performance Index (CPI) = BCWP / ACWP
    - Ratio of value of work done to actual cost of work done
  - Percent Complete = (BCWP / BAC) * 100
    - Ratio of the value of work done to the value of all work scheduled
  - Percent Spent = (ACWP / BAC) * 100
    - Ratio of the cost of work done to the total budget

SPI and CPI >1 is favorable, <1 is unfavorable

Data Analysis Steps
3. Predict performance completion

- Calculate Estimate At Completion (EAC)
  - What do we expect the ***entire*** job to cost at a given time, based on current and historical performance?



Data Analysis Steps
3. Predict performance completion

- Government PMs and Contractors each compute EACs
  - Contractors may compute EAC by rolling up estimates from the control accounts or by using performance factors
  - Government PMs generally use performance factors to compute EAC
    - The Government only gets data at the reporting level specified in the contract, generally not at the control account level

Cumulative CPI Method

$$EAC = BAC/CPI$$

3 Month Average Method

$$EAC = ACWP + \frac{BAC - BCWP}{(BCWP/ACWP)_{\text{3 MONTHS}}}$$

Cost / Schedule Method

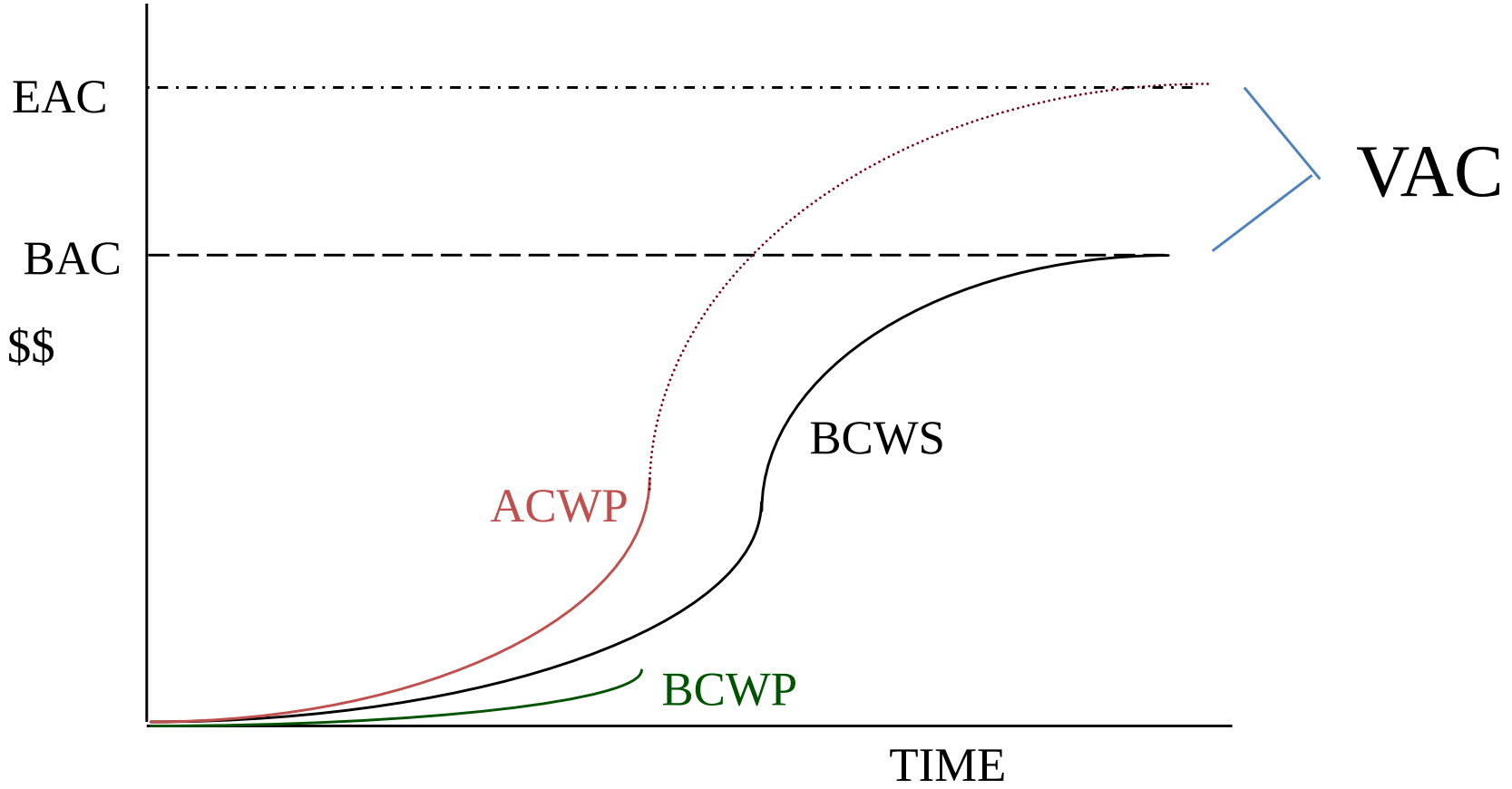
$$EAC = ACWP + \frac{BAC - BCWP}{CPI \times SPI}$$

Cost / Schedule Weighted Factor Method

$$EAC = ACWP + \frac{BAC - BCWP}{(.8)(CPI)+(.2)(SPI)}$$

Data Analysis Steps
3. Predict performance completion

- Variance At Completion (VAC)
  - Difference between original BAC and the current EAC
  - VAC = BAC - EAC



Data Analysis Steps
3. Predict performance completion

- TCPI = To Complete Performance Index is the efficiency necessary to complete
  - Either on Budget (BAC) or on the Estimate at Completion (EAC)
  - TCPI is a comparative metric used primarily to determine if an independent EAC is reasonable
  - TCPI is considered reasonable if it is within 0.5 of current CPI
  - Answers the basic question:

"How efficient must we use our remaining funds?"

$$TCPI = \frac{\text{Work remaining}}{\text{Cost remaining}}$$

$$TCPI_{EAC} = \frac{BAC - BCWP}{EAC - ACWP}$$

$$TCPI_{BAC} = \frac{BAC - BCWP}{BAC - ACWP}$$

Data Analysis Steps
4. Determine management actions

- If behind schedule
  - Why is work behind?
  - What tasks are involved?
    - Are they in the critical path?
  - Are there resources to recover?

- If over budget
  - What tasks are involved?
  - Why are costs high?
    - Will they be controlled in the future?

- Use data elements to get SPI or CPI, apply to remaining work to get new EAC
  - At each WBS element
  - At each functional organization
  - At contract total

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Problem Areas and Risk Indicators

- Common indicators of problem areas or risks
  - Application of management reserves
  - Significant revisions of PMB
  - Zero variance
  - Sudden change in monthly performance trends
  - Linear downward cost variance
  - Unreasonable TCPI

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Exercise: Building a Fence

- You have a project to build a new fence to go around the perimeter of your property that consists of 4 equal sides
  - Each side will take 2 days to build and cost $5,000 per side
  - Labor is limited, and work can only be done on one side at a time

- Create a schedule to complete the fence:
  - PS = Planned Start , PF = Planned Finish

Task Day:	1	2	3	4	5	6	7	8	9
Side 1									
Side 2									
Side 3									
Side 4									

Exercise: Building a Fence

- It is now the end of day 5 and here is our progress:

Task Day:	1	2	3	4	5	6	7	$ Spent	Status
Side 1	S-----	--F						$3500	100%
Side 2		S----		--F				$5000	100%
Side 3				S----	--------			$3750	75%
Side 4								0	0%

- PV =
- EV =
- AC =
- BAC =
- CV =
- CPI =
- SV =
- SPI =
- EAC = BAC/CPI=
- VAC =

Review

Questions	Answer	Acronym
How much work should be done?	Budget Cost of Work Scheduled The Plan	BCWS
How much work is done?	Budgeted Cost of Work Performed Earned Value	BCWP
How much work did the completed work cost?	Actual Cost of Work Performed	ACWP
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

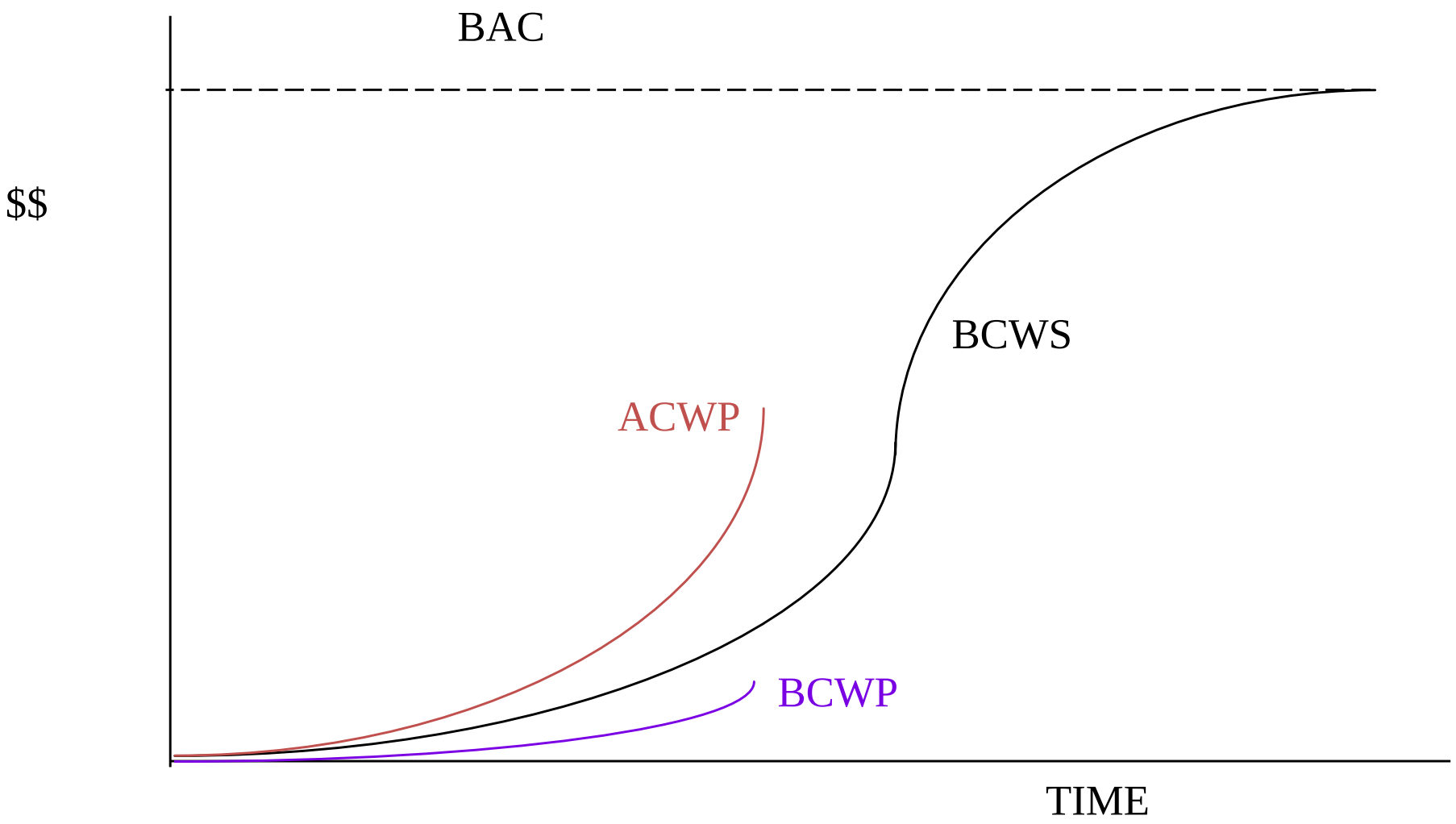
Summary

- What are the 4 Data Analysis Steps?

- What are the 4 Discrete Effort Performance Measurement Techniques and when are they used?

- (True/False) A major limitation of cost variance is that it does not take critical path into account

EVM Interpretation Quiz
How is schedule and cost performance?



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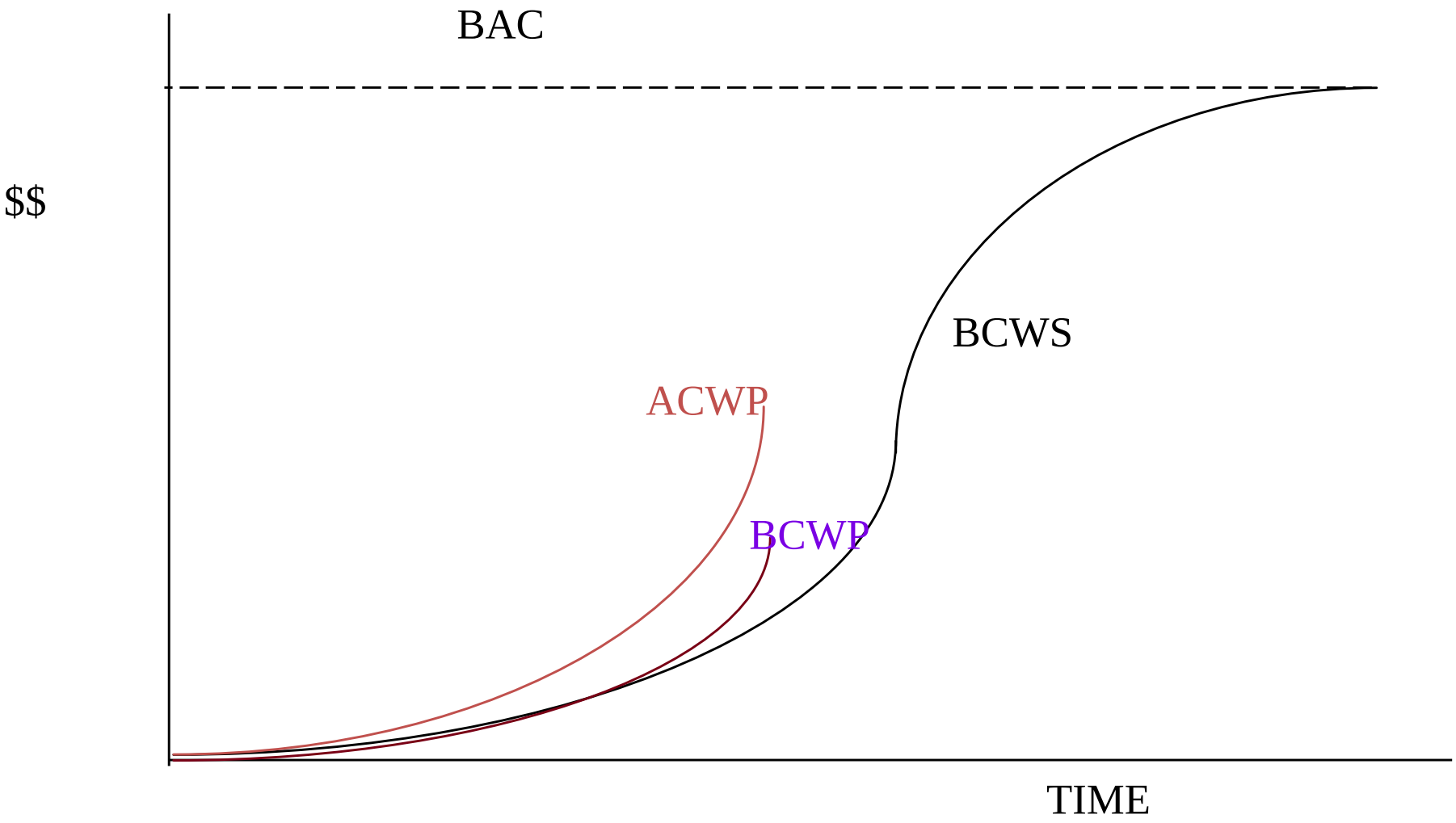

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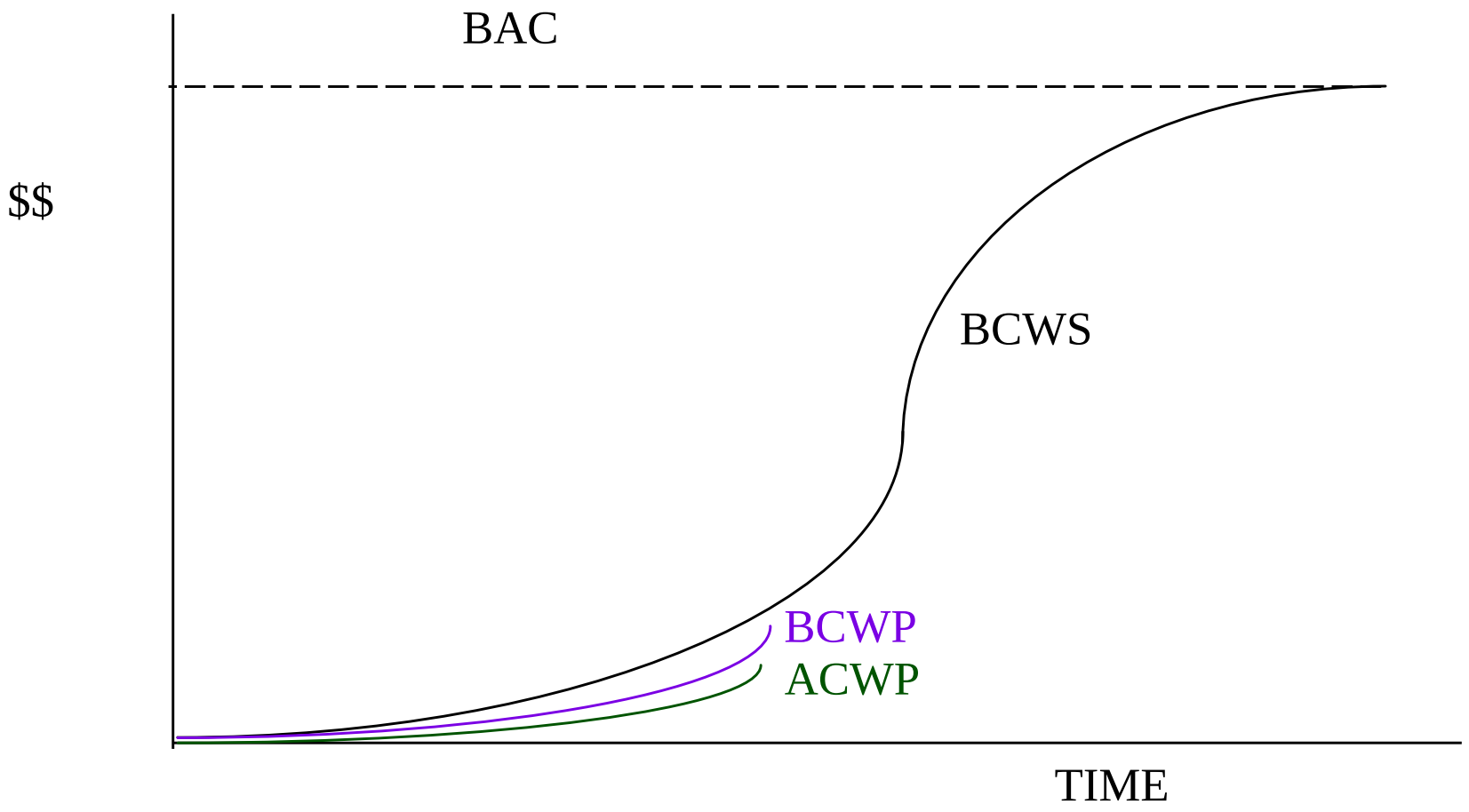

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