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Estimating Cost-To-Go Without Stable EVM Data

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The opinions expressed herein are solely those of the authors.

Agenda

- Introduction
- The Nominal Situation
- The Off-nominal Situation
- The Solution
- Conclusions

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Introduction

- **Disclaimer – this presentation is not about interpretation of EVM data nor is it meant to be dismissive of EVM as a field of endeavor; we attempt only to provide an approach for estimating cost-to-go when a program's EVM system has not stabilized despite significant work technical work accomplished and significant money spent**
- **Initial independent estimates for development programs typically created using parametric methods**
- **In early stages, cost-to-go estimate by simply subtracting sunk cost from the parametrically-estimated total**
- **As progress accrues, it is necessary to understand progress to-date in order to estimate cost-to-go**
- **Stable EVM data in a mature project provides measurement of work accomplished**
- **If EVM data not stable (at the total program level), an alternate approach is required**

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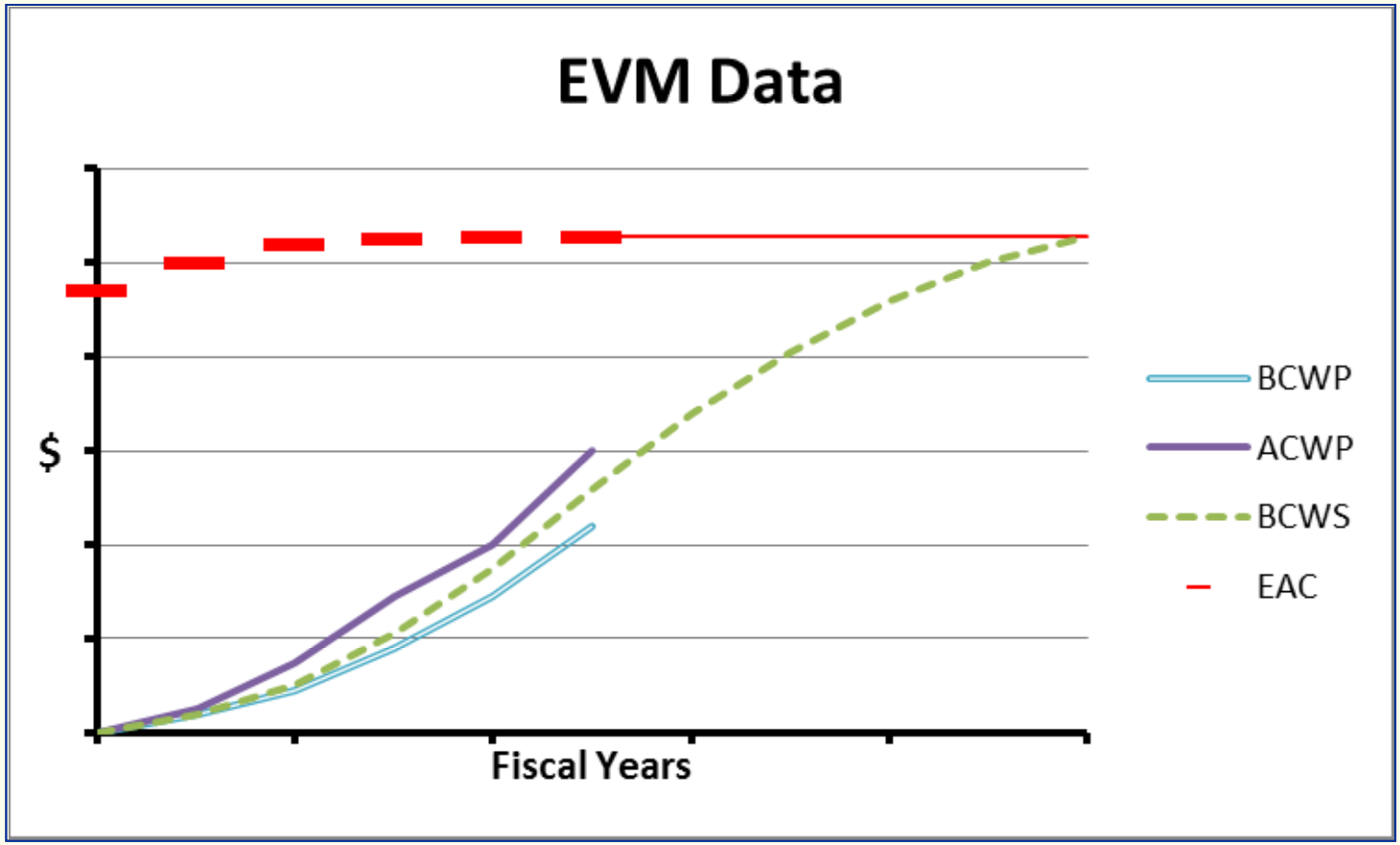
The Nominal Situation



EAC experienced early growth, but stabilized

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The Nominal Approach

$EAC = ACWP_{CUM} + (BAC - BCWP_{CUM}) / CPI$

or

$EAC = ACWP_{CUM} + (BAC - BCWP_{CUM}) / (CPI * SPI)$

Where

EAC = Estimate At Completion
$ACWP_{CUM}$ = Actual Cost of Work Performed (Cumulative)
BAC = Budget At Completion
$BCWP_{CUM}$ = Budgeted Cost of Work Performed (Cumulative)
$CPI = BCWP_p / ACWP_p$ = Cost Performance Index over some period of time "p"
$SPI = BCWP_p / BCWS_p$ = Schedule Performance Index over some period of time "p"
BCWS = Budgeted Cost of Work Scheduled

This can be applied at any WBS level for which EVM data is available

A More Independent Approach

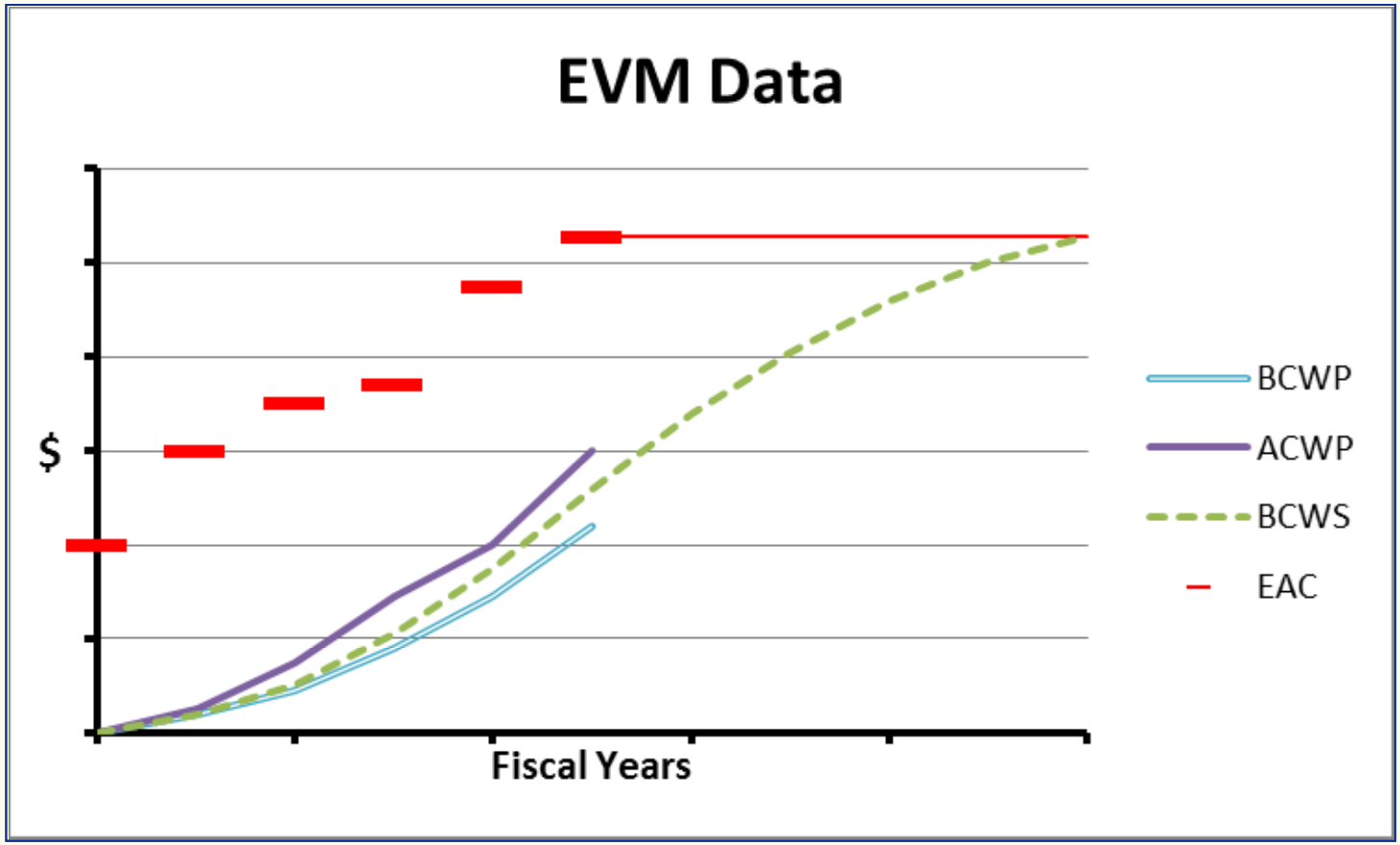
$EAC = ACWP_{CUM} + (1 - BCWP_{CUM} / BAC) * TC_I$

Where

EAC = Estimate At Completion
$ACWP_{CUM}$ = Actual Cost of Work Performed (Cumulative)
$BCWP_{CUM}$ = Budgeted Cost of Work Performed (Cumulative)
BAC = Budget At Completion
TC_I = Independently estimated Total Cost

This can be applied at any WBS level for which EVM data is available

The Off-Nominal Situation



- EAC has grown as fast as work has been accomplished!
- Estimated portion of EVM data (BAC, EAC) clearly unreliable
  - Must use independent estimate of total, not EVM EAC
  - Need to account for progress achieved without EVM BAC

Possible Causes

- **Performance requirements growth**
  - Should be reflected in changes in cost-driving performance parameters
- **Design requirements growth**
  - Should be reflected in changes in cost-driving design parameters
- **Execution requirements growth**
  - Unforeseen additional tasks required to complete the development
  - May not be captured in typical cost-driving parameters
- **Poor understanding or/or definition of the effort required, resulting in really bad early cost estimating**
- **Requirements growth results in ECPs and contract modifications and is incorporated in performance measurement baseline**
- **Regardless of cause of cost growth, BAC and EAC can't be trusted if growth has not stabilized**

The Solution

- **Key facts**
  - Sunk costs are auditable… they are what they are… however, they may not represent actual work accomplished
  - The purpose of schedule milestones is to measure progress
  - If definitions of key milestones are consistent with historical projects, then key milestones can be assumed to represent a consistent portion of overall work
- **Three step process**
  1. Look at historical data for similar projects and determine typical portion of work represented by key milestones
  2. Look at schedule for current project and calculate completion factors based on when current milestones were or will be accomplished
  3. Apply ***in***completion factors to independently estimated totals to estimate cost-to-go

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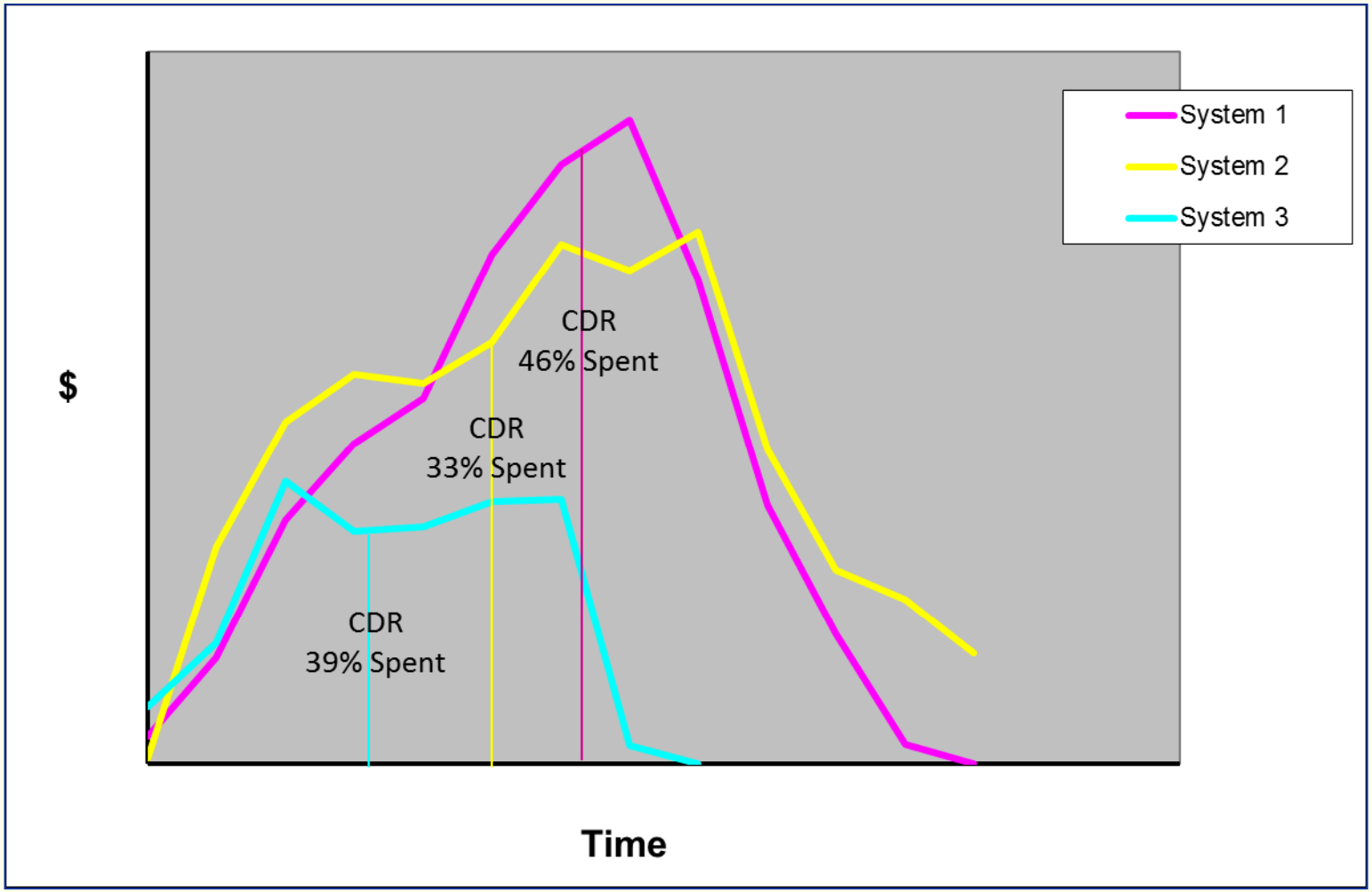
Historical Data For Similar Projects



Average percent spent at CDR: 39.3%

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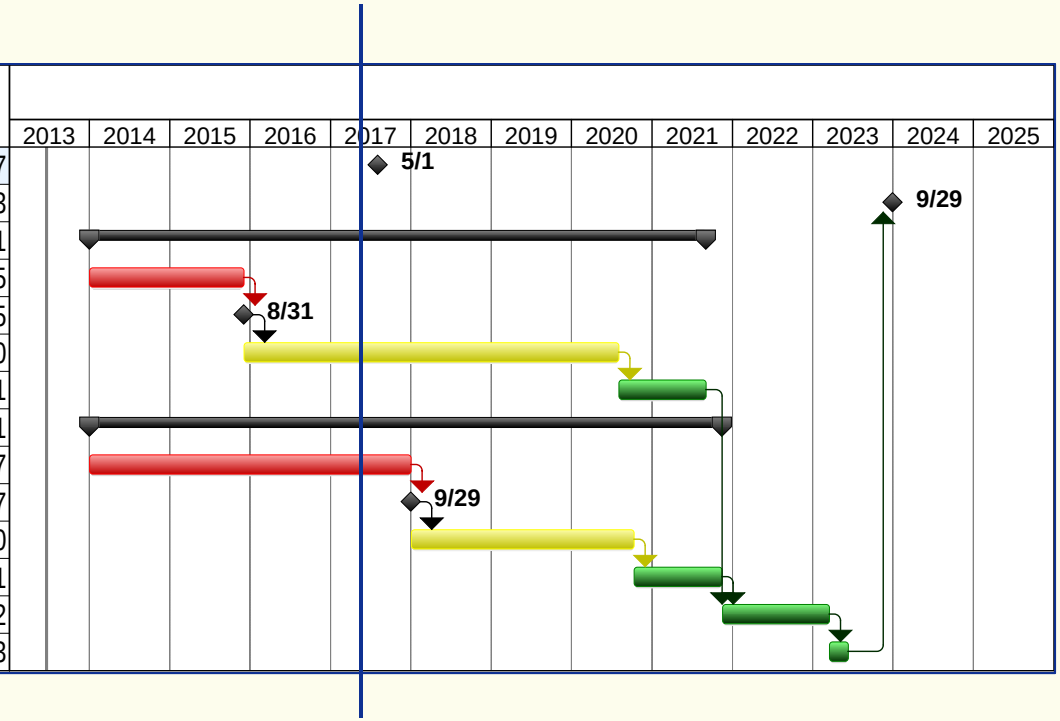
Sample Project Status

Name	Start	Finish
System CDR	5/1/17	5/1/17
Launch Date	9/29/23	9/29/23
Instrument	10/1/13	6/1/21
Design	10/1/13	8/31/15
Instrument CDR	8/31/15	8/31/15
Fabrication and Assembly	9/1/15	4/30/20
Integration and Test	5/1/20	6/1/21
Spacecraft	10/1/13	8/13/21
Design	10/1/13	9/29/17
Spacecraft CDR	9/29/17	9/29/17
Fabrication and Assembly	10/2/17	7/9/20
Integration and Test	7/10/20	8/13/21
Space Vehicle Integration and Test	8/16/21	12/13/22
Ship and Launch Prep	12/14/22	3/9/23



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Sample Actual and Estimated Costs by WBS

WBS	CDR Date	Spent Before CDR	ACWP	EAC	TCi
Instrument	8/31/2015	155.0	178.0	203.0	237.0
Spacecraft	9/29/2017	122.0	112.0	170.0	184.0
Space Vehicle Integration and Test	N/A	N/A	10.0	65.0	70.0
Launch	N/A	N/A	0.0	90.0	100.0
Total			300.0	528.0	591.0

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Application of Incompletion Factors

WBS	CDR Date	Spent Before CDR	Percent Complete Based on CPR Date	ACWP	TCi	Independent Cost To-Go	Value of Work Performed
Instrument	8/31/2015	155.0	45.1%	178.0	237.0	130.0	107.0
Spacecraft	9/29/2017	122.0	36.1%	112.0	184.0	117.6	66.4
Space Vehicle Integration and Test	N/A	N/A	N/A	10.0	70.0	60.0	10.0
Launch	N/A	N/A	N/A	0.0	100.0	100.0	0.0
Total		c		a 300.0	b 591.0	407.7	183.3
			d = 39.3% * a / c			b * (100% - d)	b * d

- Calculate completion factors based on when current milestones were or will be accomplished
  - "a/c" represents effort completed relative to CDR, e.g. a/c = 112.0 / 122.0 = 91.8%
  - Historical effort represented by CDR is 39.3% of total effort, so overall Percent Complete is 91.8% * 39.3% = 36.1%.
- Apply ***in***completion factors to independently estimated totals to estimate cost-to-go
  - multiply inverse of Percent Complete times the independent total cost: (100% - 36.1%) * 184.0 = 117.6

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Conclusions

- **It is possible to make sound estimates of costs to-go without stable EVM data**
- **Higher fidelity historical schedule data allows for higher fidelity estimating of progress based on milestone dates**

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