

# Quantified Benefits of Earned Value Management ...and their Benefits

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Matthew Jones  
JHU/APL Space Exploration Sector  
[matthew.jones@jhuapl.edu](mailto:matthew.jones@jhuapl.edu)

# Summary of NASA's Slow Adoption of EVM

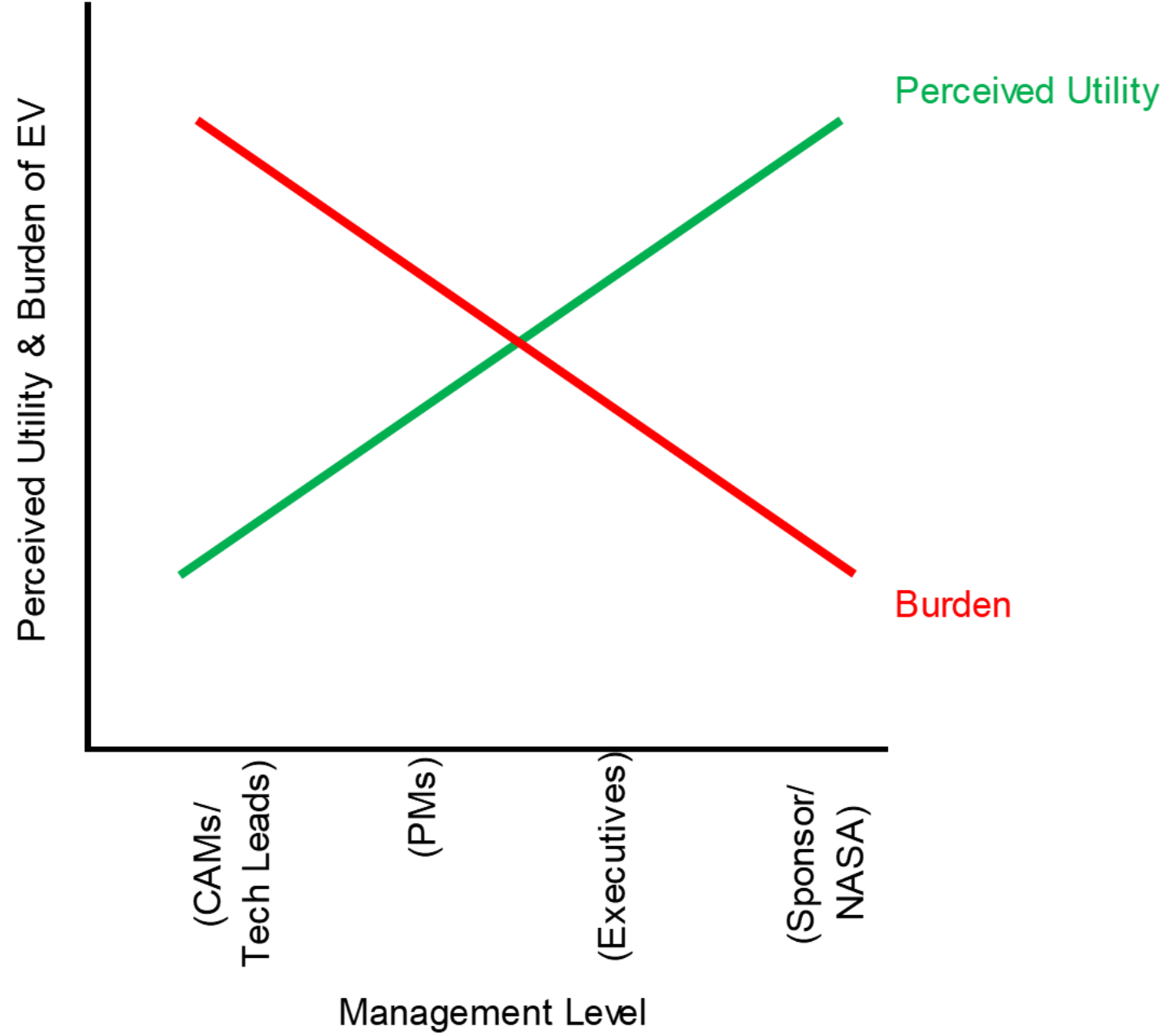


- 1967** EVM Concept introduced by DOD [Cost/Schedule Control System Criteria (C/SCSC)]
- 1972** First EVM Joint Implementation Guide issued to ensure consistency among military departments.
- 1991** Defense Acquisition P&Ps issued reaffirming use of EVM (DOD Instruction 5000.2)
- 1996** Mandatory Procedures for Major Defense Acquisition Programs and Major Automated Information System Acquisition Programs issued (DODR 5000.2-R Under Secretary of Defense)
- 1997** NASA Policy Directive – “Each Project Manager is responsible for implementing EVM effectively on all applicable contracts.” (NPD 9501.3)
- 2004** GAO notes NASA Slow Adoption (GAO report number GAO-04-642)  
*“NASA has yet to implement a well-defined process for estimating the cost of its programs--a weakness we and NASA's Inspector General have repeatedly reported...Despite this effort, the programs we reviewed failed to follow key cost-estimating processes, including...earned value management (EVM) to assess progress.”*
- 2012** GAO notes NASA Slow Adoption (GAO report number GAO-13-22)  
*“NASA’ 10 major spaceflight projects discussed in this report have not yet fully implemented earned value management (EVM). As a result, NASA is not taking full advantage of opportunities to use an important tool that could help reduce acquisition risk.”*

# Innovators, Disruptors, Mohawks...EVM Skeptics?



# The EVM Perception Problem



# EVM Business Case

Benefits

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Cost

Benefits of Cum. to Date EVM Data + Benefits of iEAC EVM Data

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Cost of EVMS Implementation + Cost of EVMS Surveillance

# EVM Business Case

Benefits

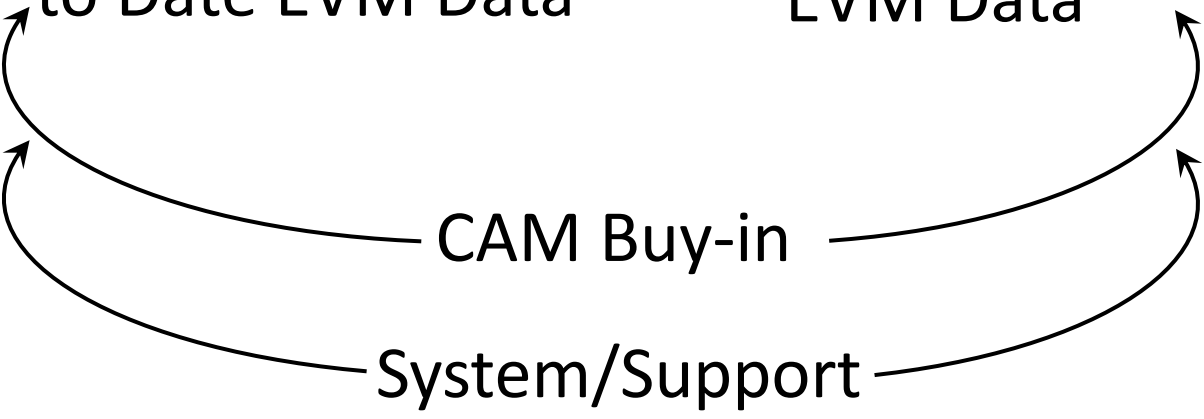
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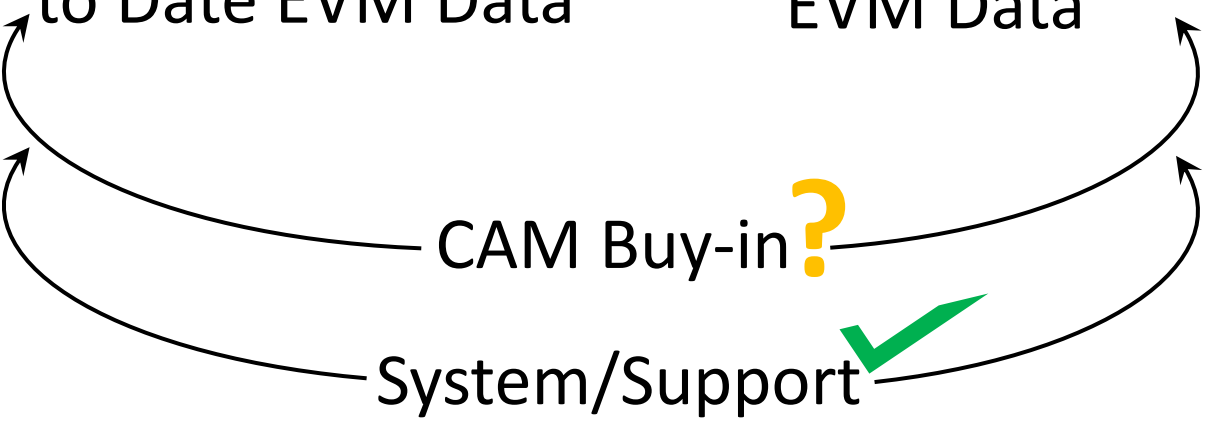
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Cost of EVMS Implementation ✓

Cost of EVMS Surveillance ?

CAM Buy-in ?

System/Support ✓



# EVM Business Case

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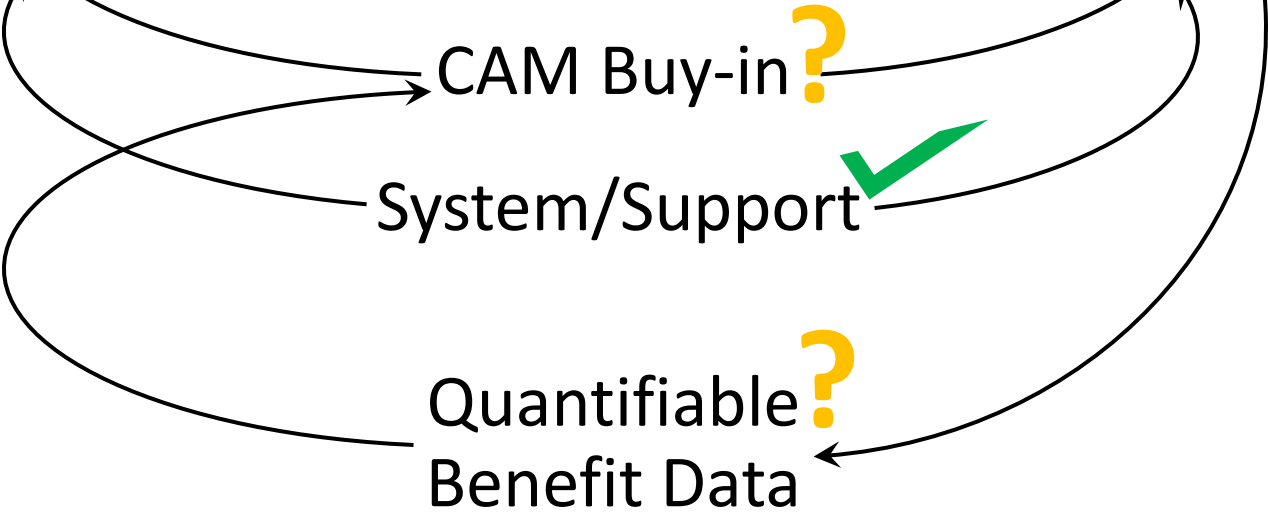
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Cost of EVMS Implementation ✓ + Cost of EVMS Surveillance ?



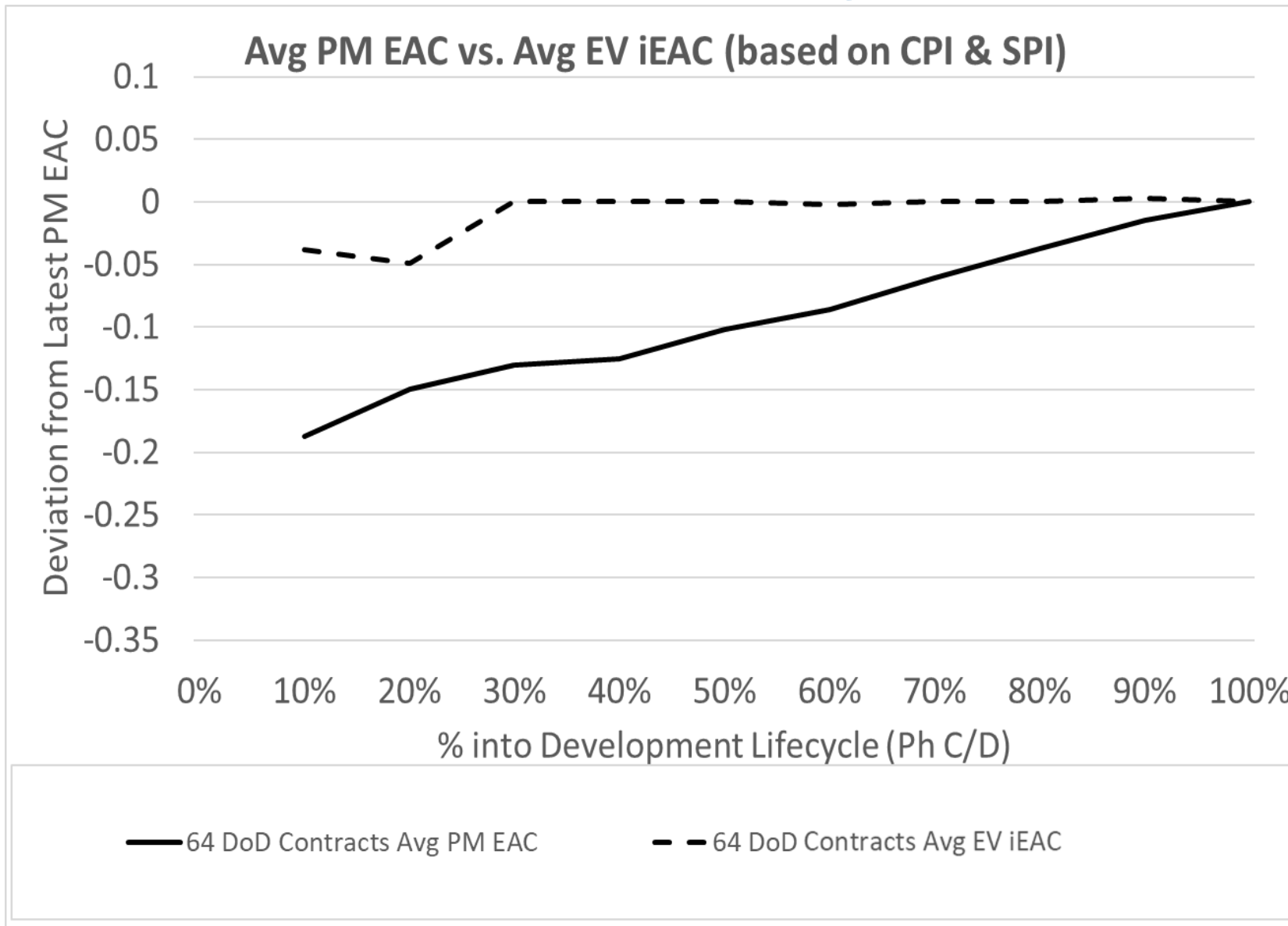


# Why isn't the existing Quantified Benefits of EVM data compelling enough?



- One study (1996) is widely cited as evidence of quantified benefits of EVM.
  - Christensen, David. (1996). Project Advocacy and the Estimate at Completion Problem. *Journal of Cost Analysis and Management*.
- More recent studies have offered mixed findings, and several have claimed that “research shows that data integrity has suffered since Christensen’s research in 1996.”
  - Kim, Deborah B. (2018). *An Analysis of the Estimate at Complete for Department of Defense Contracts*.

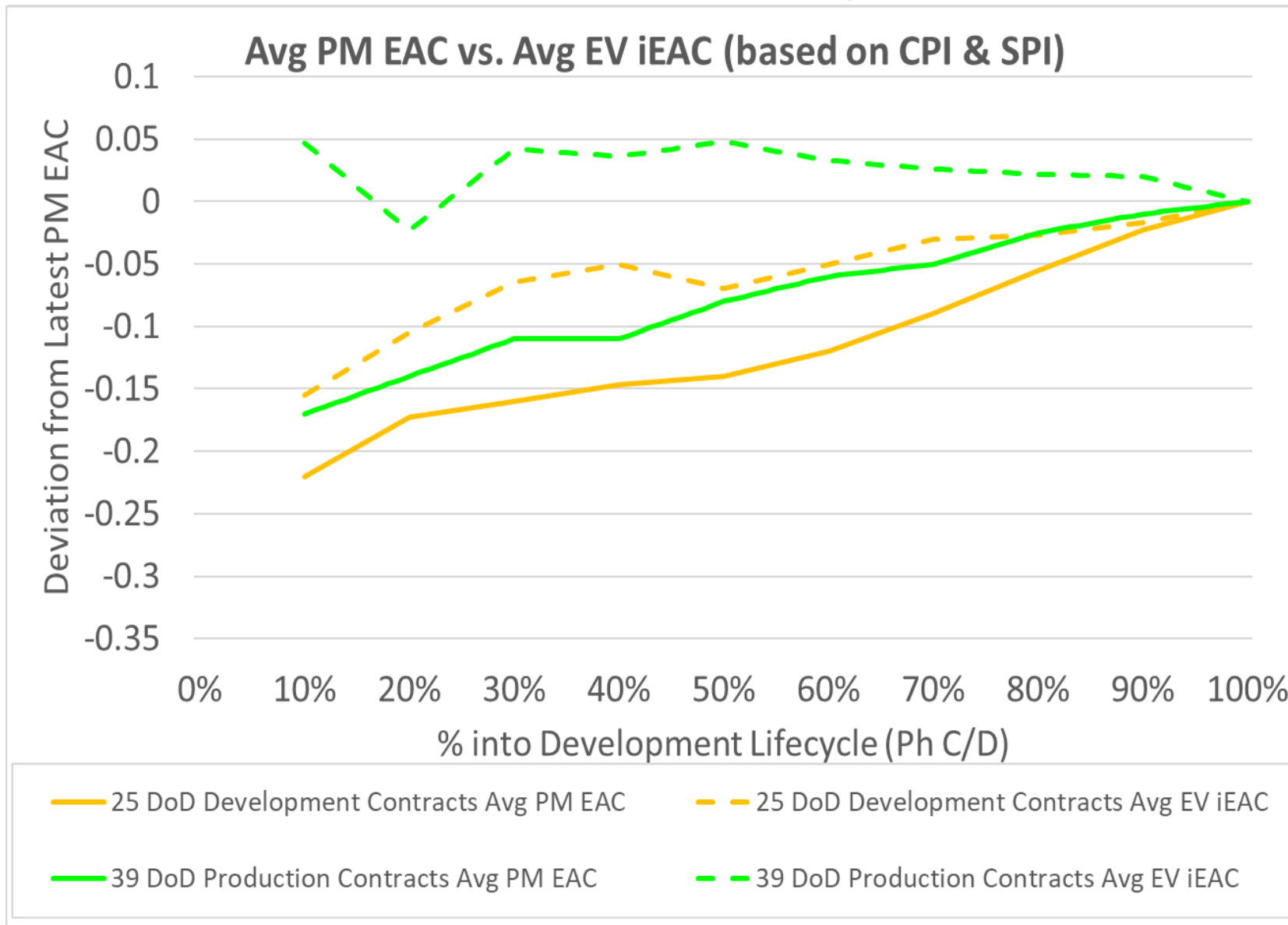
# Quantifiable Benefits identified by Previous DoD Study



DoD Sample of 64 Contracts

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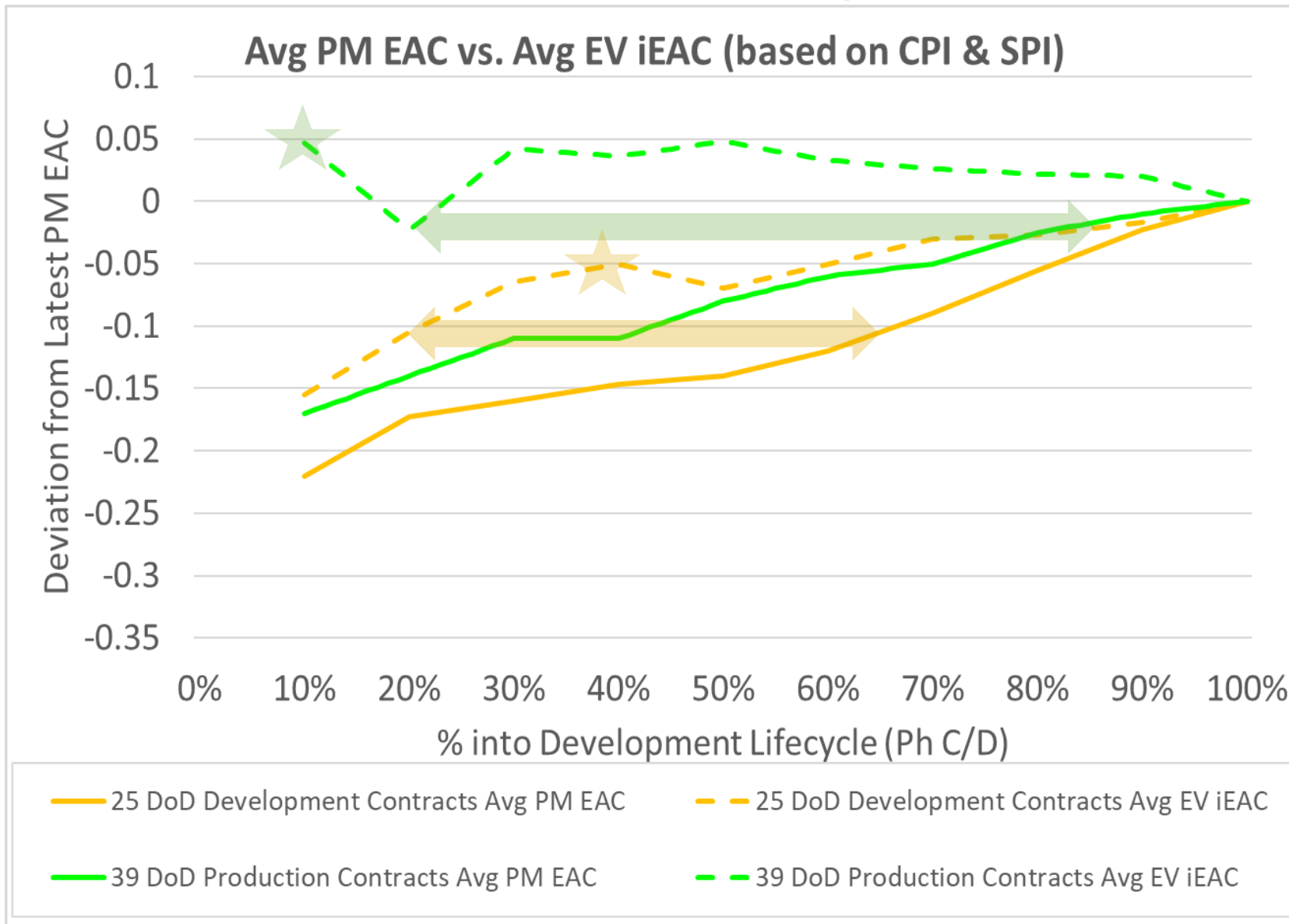
# Quantifiable Benefits identified by Previous DoD Study



DoD Sample of 64 Contracts (2 subsets of 25 & 39 Contracts)

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# Quantifiable Benefits identified by Previous DoD Study

Data Set	Point in POP where iEAC predicts final EAC at ~5% accuracy	Advanced Warning 20% into Lifecycle
64 DoD Contracts (Christensen 1996)	~10% into POP	~55% of POP Advanced Warning
Subset of 25 DoD Production Contracts	~10% into POP	~60% of POP Advanced Warning
Subset of 39 DoD Development Contracts	~40% into POP	~45% of POP Advance Warning

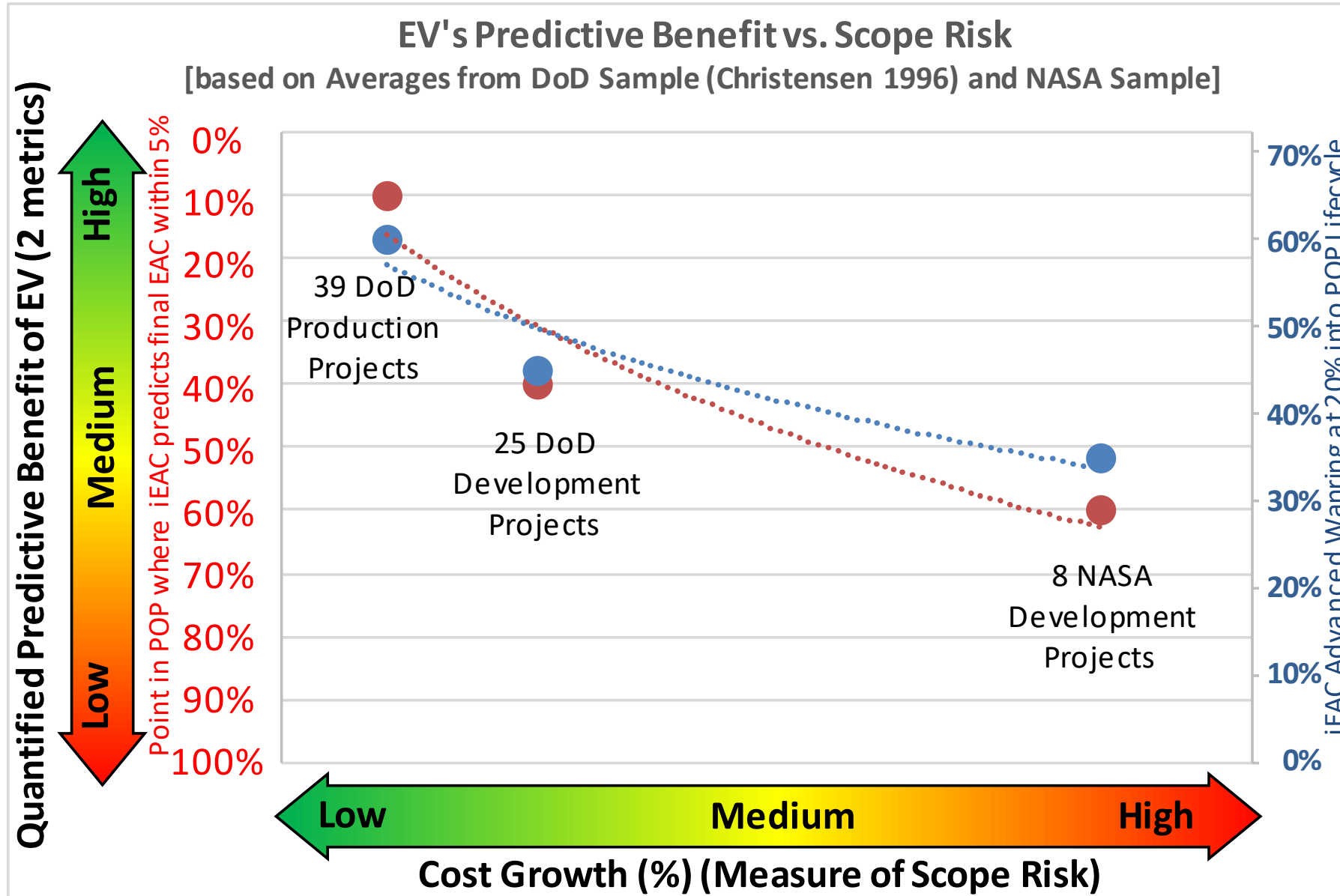
# Quantifiable Benefits identified by Previous DoD Study

## Compared to NASA Data

Data Set	Point in POP where iEAC predicts final EAC at ~5% accuracy	Advanced Warning 20% into Lifecycle
64 DoD Contracts (Christensen 1996)	~10% into POP	~55% of POP Advanced Warning
Subset of 25 DoD Production Contracts	~10% into POP	~60% of POP Advanced Warning
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8 APL SES NASA Contracts	~60% into POP	~25% of POP Advanced Warning

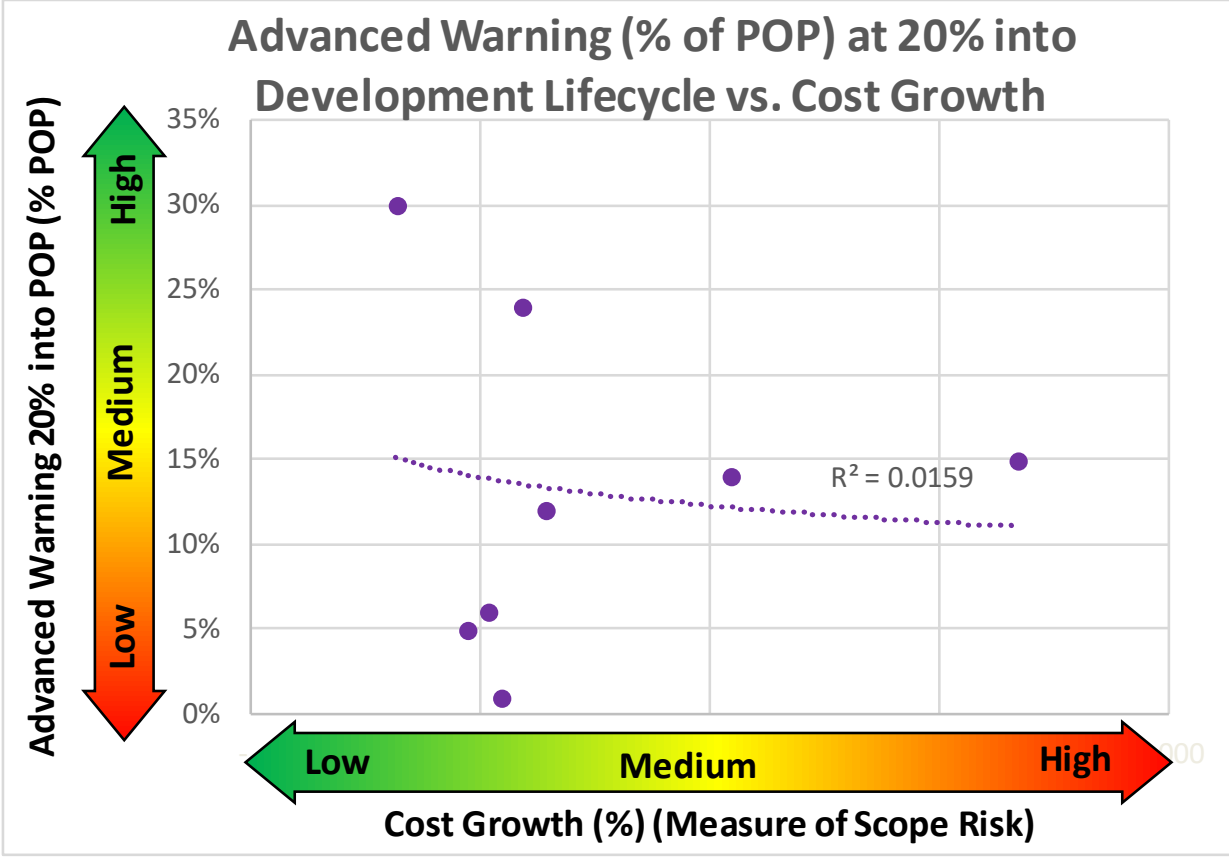
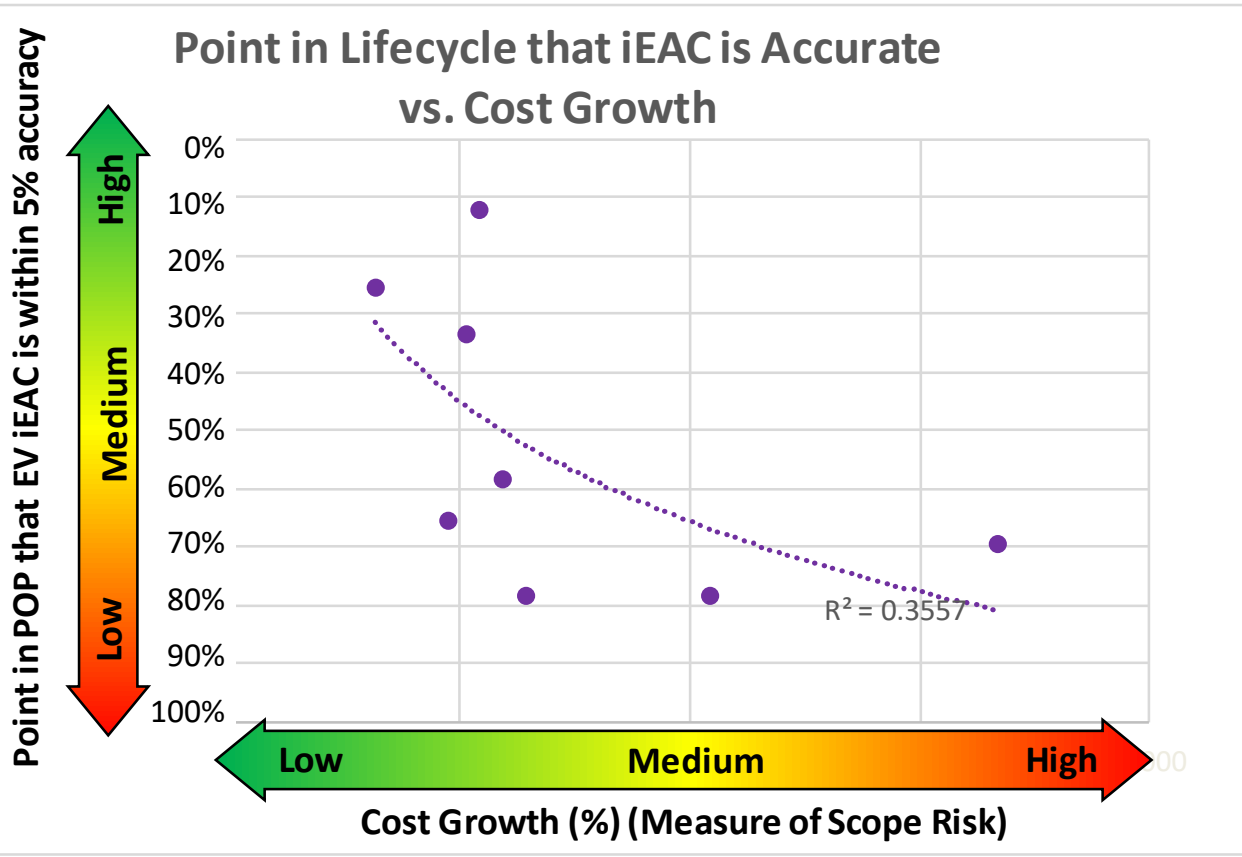
# Quantifiable Benefits vs. Cost Growth

– Using NASA Project Sample Avg. and DoD Sample Avg. from Previous Study



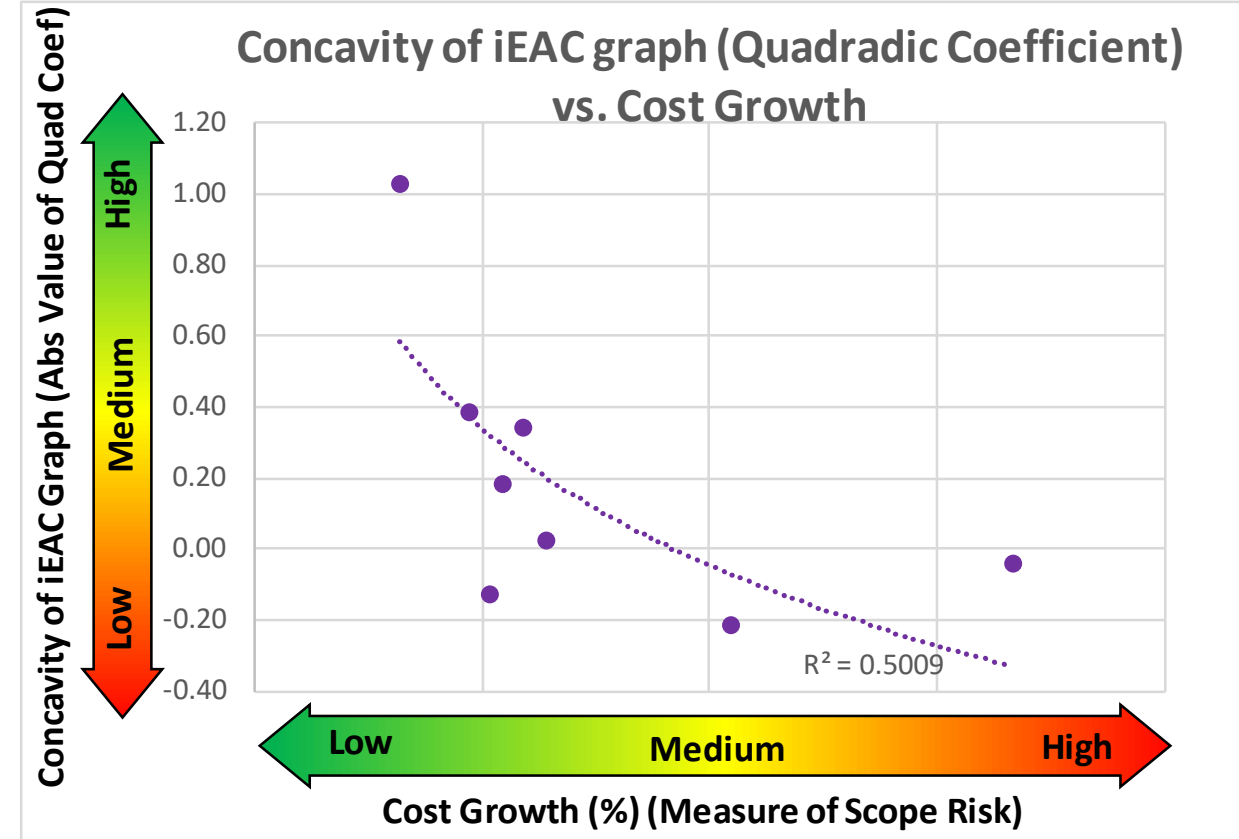
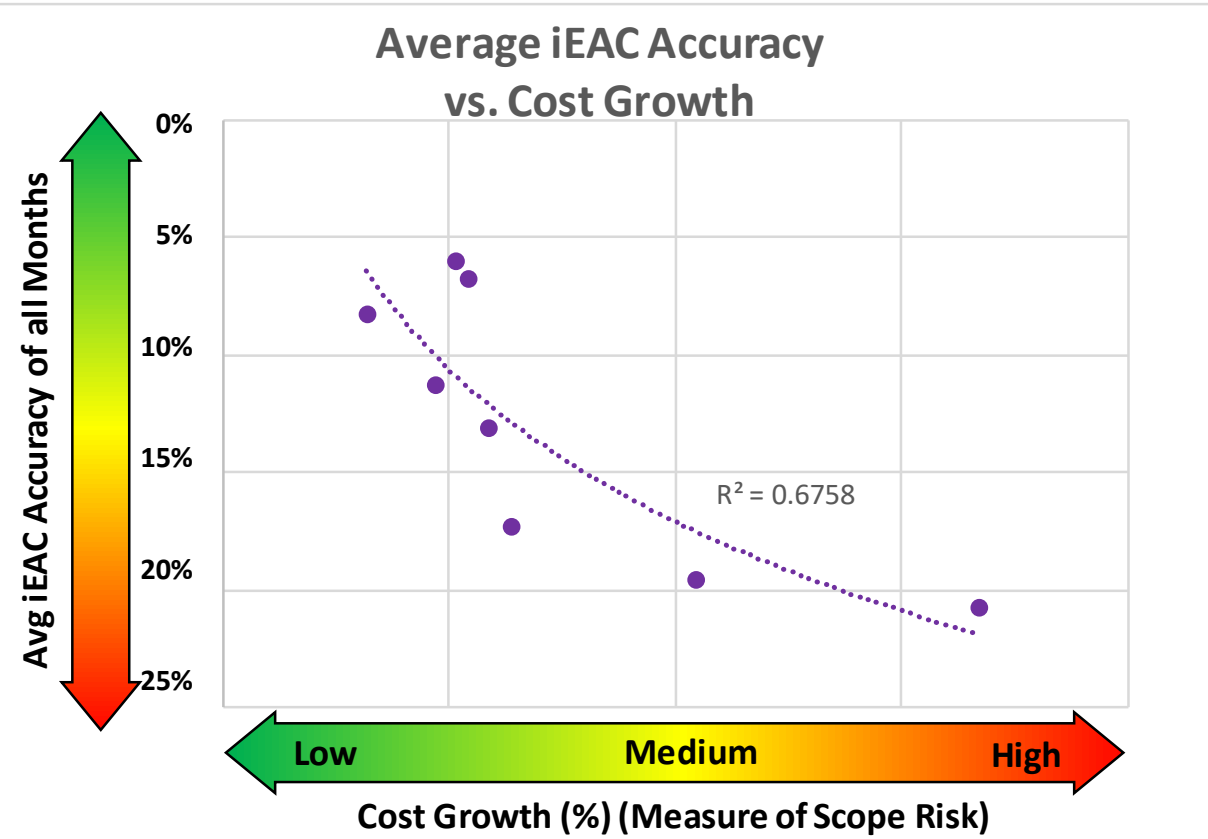
# Quantifiable Benefits vs. Cost Growth

## – Using Individual NASA Project Data (8 projects)

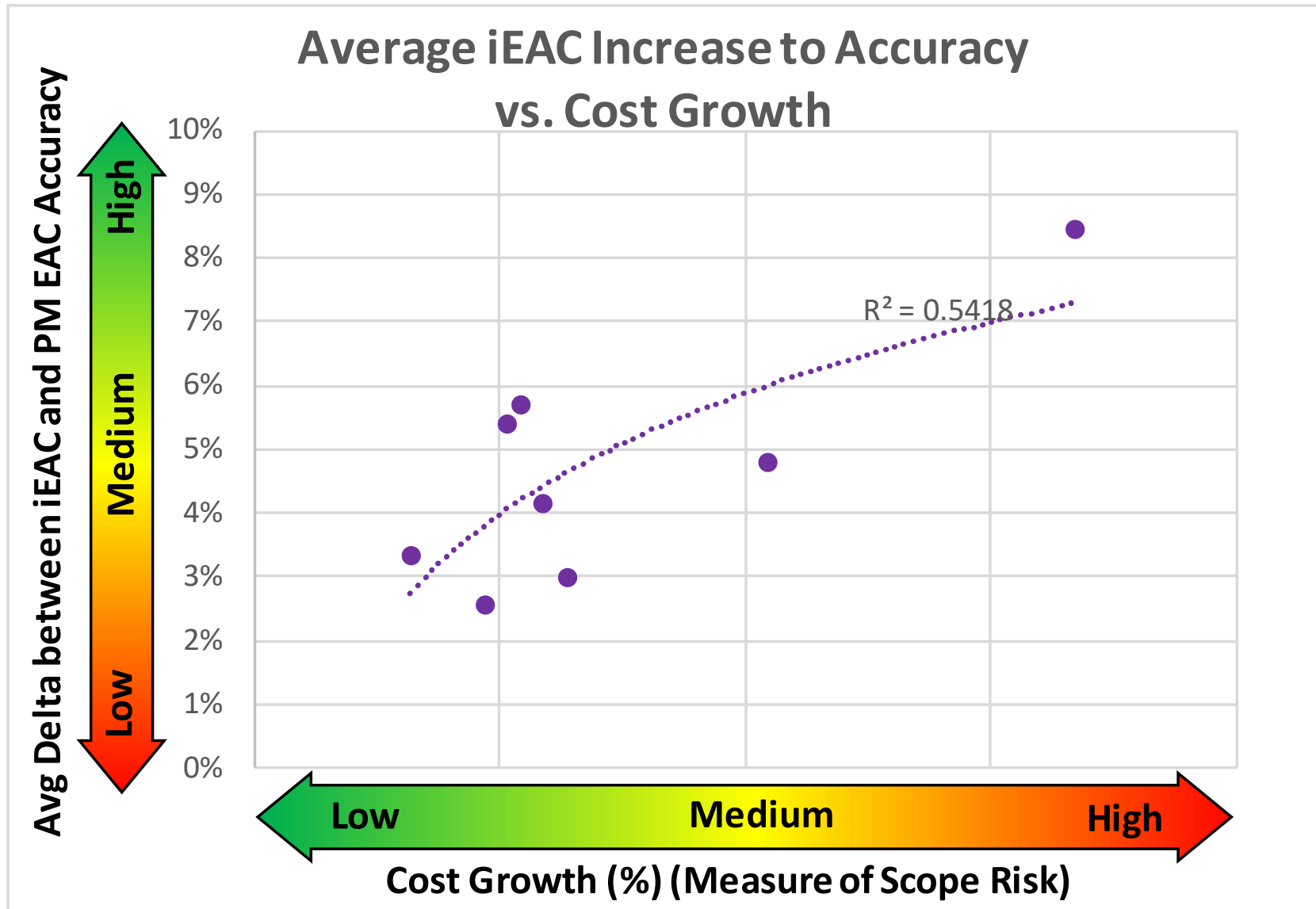




# Alternative Quantifiable Benefits Measurements vs. Cost Growth – Using Individual NASA Project Data



# Increase in Quantifiable Benefits (compared to EAC) vs. Cost Growth – Using Individual NASA Project Data



# Summary: EVM Quantified Benefits are Compelling



## ...but not perfect (or straight forward)

- **iEAC provides advanced warning of cost growth across industries (DoD & NASA).**
- Advanced warning of future cost growth is less accurate and more delayed on projects with higher scope risk.
  - But the incremental improvement to PM EAC accuracy that the iEAC provides actually grows as a project's scope risk increases.  
**(Access to EVM's advanced warning benefit is likely just as important, if not more important, for projects with high scope risk.)**

# Key Take-Aways for EVM Practitioners

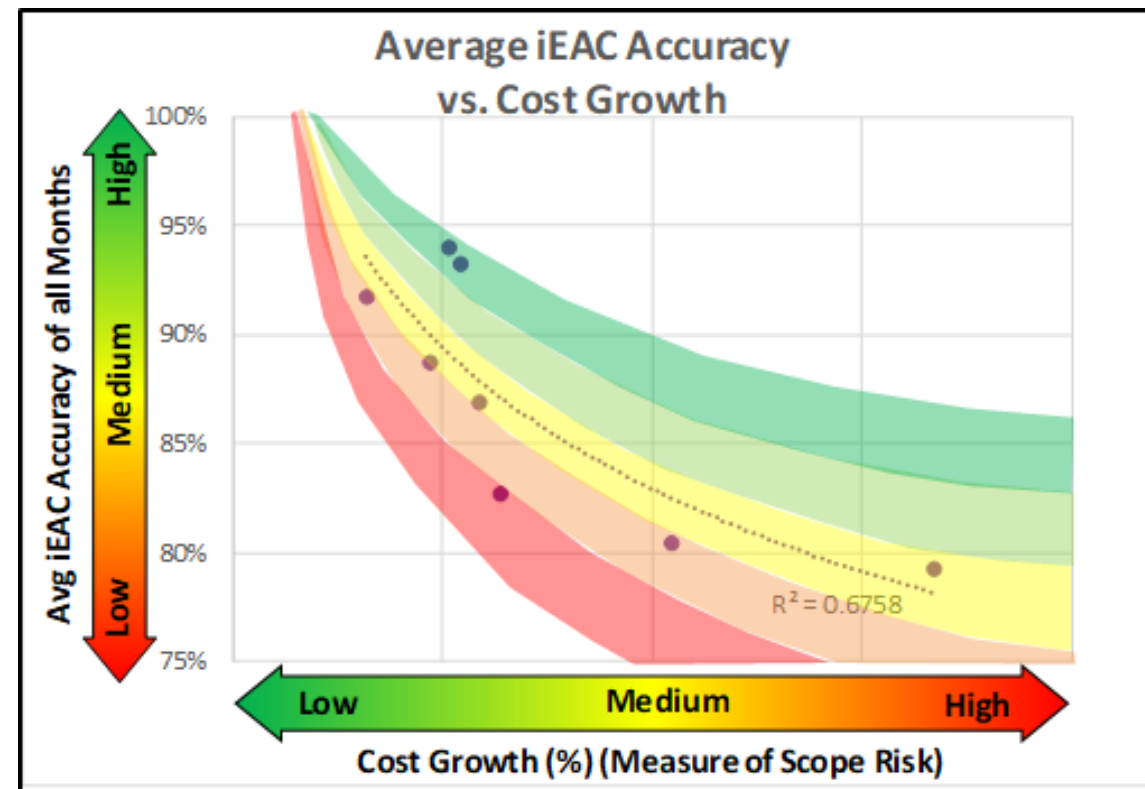
**In addition to focusing on optimizing quality and efficiency of system and support... focus on improving CAM buy-in...**

- 1)**
  - Don't get trapped arguing about the benefits that a CAM experiences
    - Instead point to data supporting quantified benefits of the iEAC that may benefit the CAM's superiors (more so than the CAM directly).
  
- 2)**
  - Admit that the iEAC data is not perfect...just vastly better than the alternative (bottom-up EACs).
    - Although EV on projects with high scope risk have less accurate and more delayed predictive powers than on lower scope risk projects... The increase in predictivity when compared to bottom-up EAC is higher on high scope risk projects.

# Future Applications / Research

## 1) Collect more data to develop industry standard for iEAC accuracy.

- Banded ranges (High, Medium, Low) for quality of EVM in notional example.
- Notional example grades project EVM on average iEAC accuracy normalized for cost growth/scope risk.



## 2) Explore use of iEAC accuracy industry standard as surveillance metric.

- Quality of a given EVMS could be measured based on the calculation of quantifiable benefits metric instead of labor-intensive surveillance of specific processes.
  - Decreases the cost of surveillance on a project and therefor strengthens the business case for EV.
  - Metric would be more equitable as it takes into account the impact of differing levels of scope risk.
  - Quantifiable metrics could even be incorporated into a Cost Plus Incentive Fee (or Award Fee) structure to directly incentivize a high quality EVMS.

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CAM Buy-in

System/Support

Quantifiable Benefit Data

Take Away – Larger study of iEAC data (normalized for cost growth) could increase CAM buy-in thereby increasing quality of EVM; decrease surveillance costs....all optimizing EVM Business Case.

**Questions?**

# Is Cost Growth a Good Proxy for Scope Risk?

## Indications are the answer is yes, based on:

- Previous 1996 DoD study data which is implicitly segregated by scope risk
- A formal survey of JHU/APL CAMs which showed wide agreement that scope risk is the leading driver of cost growth (~75%)
- JHU/APL data shows no statistical correlation between PM experience and cost growth
- Multi-variable regression analysis of JHU/APL data that indicates scope risk is the primary driver of cost growth
- The fact that NASA dataset comes from a single organization (JHU/APL) thus decreasing the likelihood that cost growth is driven by project management quality since:
  - Projects all use same standardized processes
  - Projects use the same compliant EVMS
  - Staff receive the same standardized training
  - Projects often use the same EVM/scheduling support staff