



2022 ICEAA Professional Development & Training Workshop

# Alternate EAC Methodologies: Calculating EACs without Standard EVM Data

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# Abstract

An Estimate at Complete (EAC) is an independent forecast of what it will cost to complete a project at any given point in the schedule. It allows estimators to use given actual costs as well as an estimate of remaining costs to provide insight on whether sufficient funds are available to cover the cost of the contract at completion.

There are many guidance documents, studies, and assessments on developing EACs within the Earned Value Management (EVM) system. Developing an EAC typically involves establishing a performance-based estimate founded in the best practices of Earned Value Management (EVM) Gold Card analysis.

This presentation explores three alternative approaches to develop an EAC by leveraging burn rate profiles, different from those prescribed in the EVM Gold Card. By leveraging burn rate profiles, estimates can be developed by applying regression analysis and/or interpolation techniques. Each methodology contains pros and cons based on the data available for analysis, which provides a unique perspective of the projects' cost at complete.

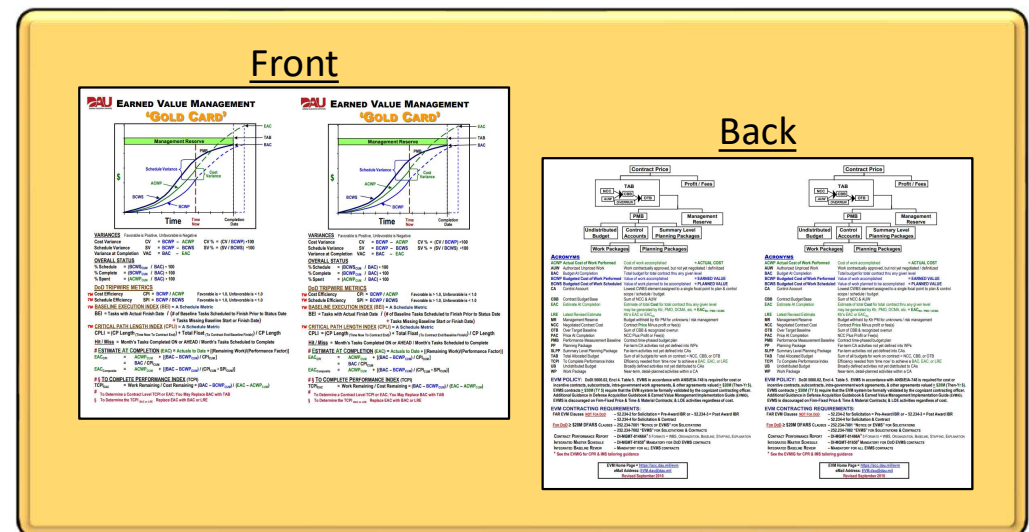
# Agenda

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- Background
- Overview
- Alternative EAC Approaches
- Application Examples
- Comparison of Results
- Conclusion & Future Work

## What is EVM?

- Earned Value Management (EVM) is an integrated management system that integrates the work scope, schedule, and cost parameters of a program in a manner that provides objective performance measurement data
- General reference for EVM: 'Gold Card'
  1. Define common EVM terminology
  2. List EVM metric equations
  3. Labels the most common EVM graph
  4. It also summarizes DoD EVM policy



## Using EVM to Develop an EAC:

- Developing an Estimate at Completion (EAC) traditionally involves establishing a performance-based estimate using Earned Value Management (EVM) analysis

$$EAC = \text{Actuals to Date} + \frac{\text{Work Remaining}}{\text{Performance Factor}}$$

Equation per EVM Gold Card

# Background: Pros and Cons of EVM

- There are many guidance documents, studies, and assessments on the Earned Value Management (EVM) system, including:
  - Department of Defense EVM Implementation Guide. Dated January 18, 2019. By OUSD A&S (AE/AAP)
  - “The Costs and Benefits of the EVM Process.” Dated Fall 1998. By David Christensen.
  - “5 Pitfalls that Derail EVM Success.” Dated Nov 6, 2009. By Alan Joch.
- Described below are some potential advantages and disadvantages of using EVM data:

## Advantages:

- Provides a single management control system
- Improves insight into program performance
- Provides objective information for managing the program

## Disadvantages:

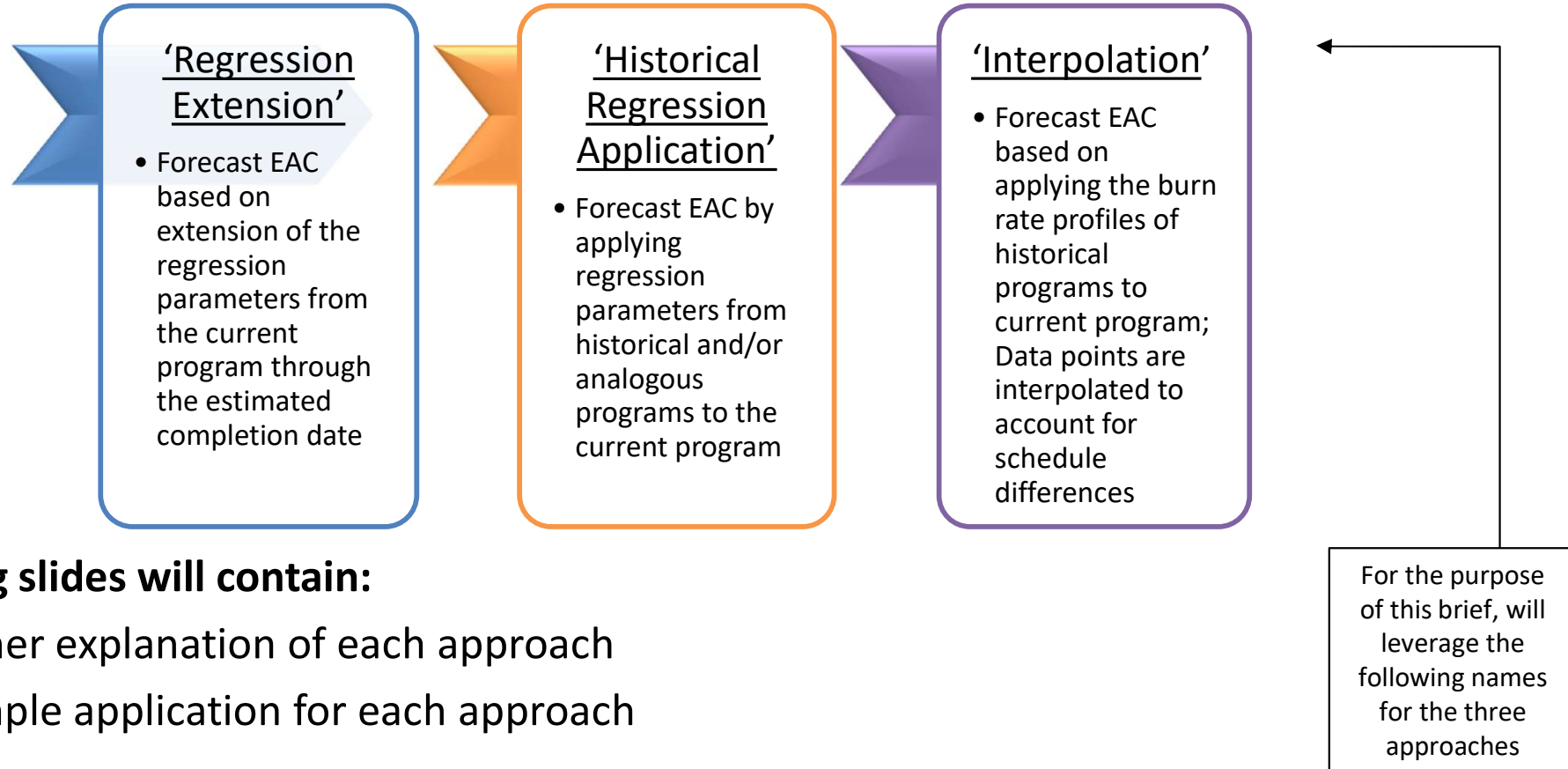
- Data limitations (e.g., within DoD, programs <\$20M contract value, EVMS not required)
- Inconsistency in contractor reporting of EVM data
- Does not provide root cause and/or context associated with variance

The purpose of this presentation is not to debate the pros/cons of the EVM system, but rather to provide awareness of existing literature on EVM and explain alternative EAC approaches

- Historical data shows that major acquisition programs experienced significant cost overruns and schedule delays. Alternative EAC approaches can support/replace EVM EACs and provide additional insights that EVM may not.

# Overview

- **Objective:**
  - To explore alternative approaches to develop an EAC by leveraging burn rate profiles
- **Alternative Approaches:**
  - Three alternative approaches are defined and assessed in this presentation
  - Developing an EAC is not limited to these three approaches, other approaches also exist



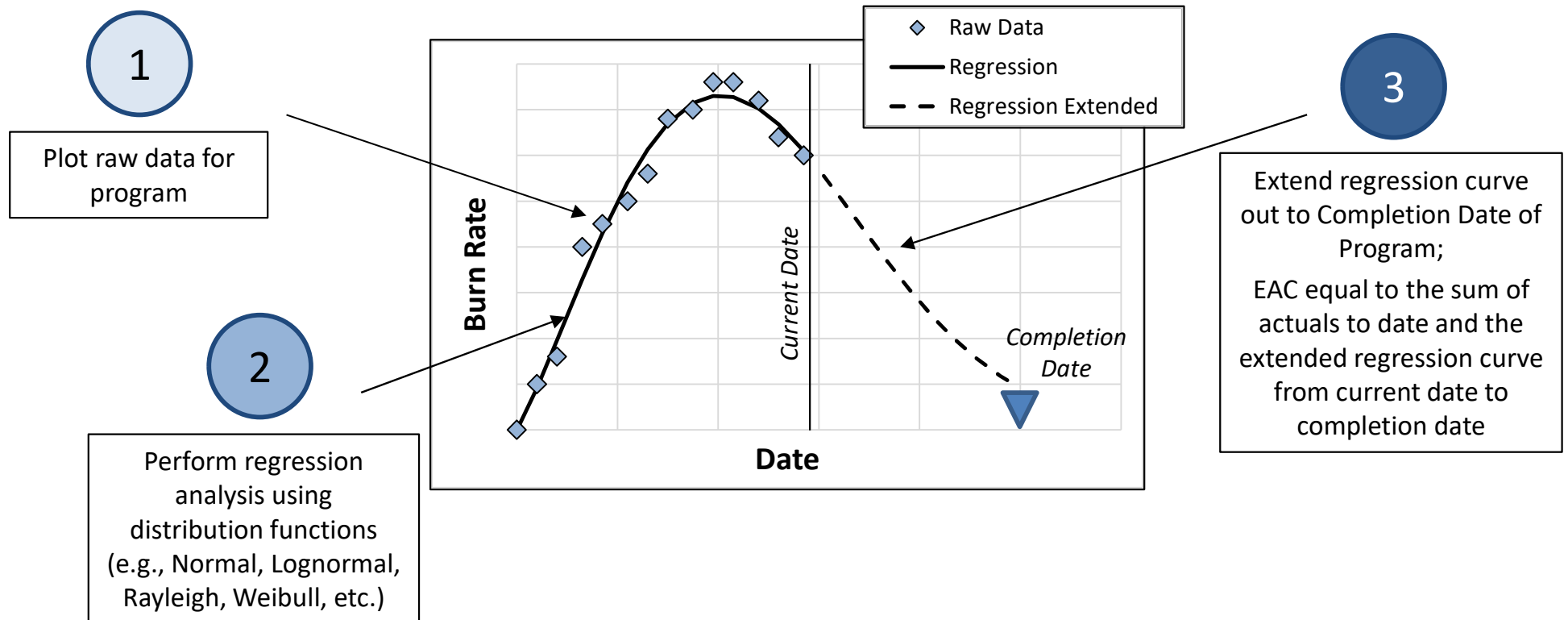
- **Following slides will contain:**
  - Further explanation of each approach
  - Example application for each approach

# EAC Approach 1: 'Regression Extension'

- **Overarching Description:**

- Forecast EAC based on extension of the regression parameters through the estimated completion date

- **Methodology:**



# EAC Approach 2: 'Historical Regression Application'

- Overarching Description:**

- Forecast EAC by applying regression parameters from historical and/or analogous programs to the current program

- Methodology:**

1

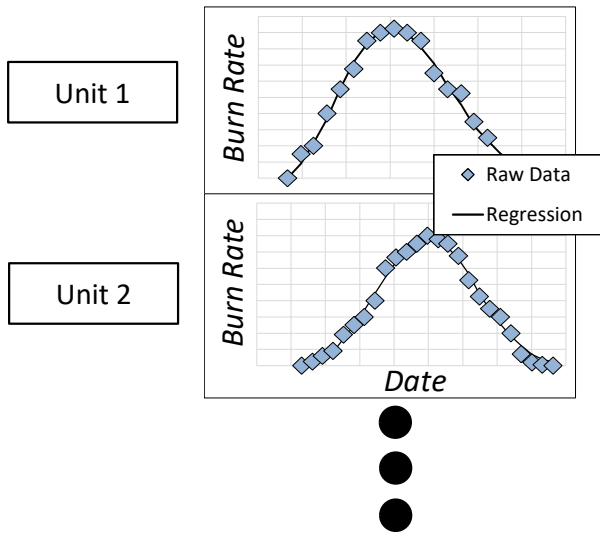


2



3

Perform regression for each historical and/or analogous program



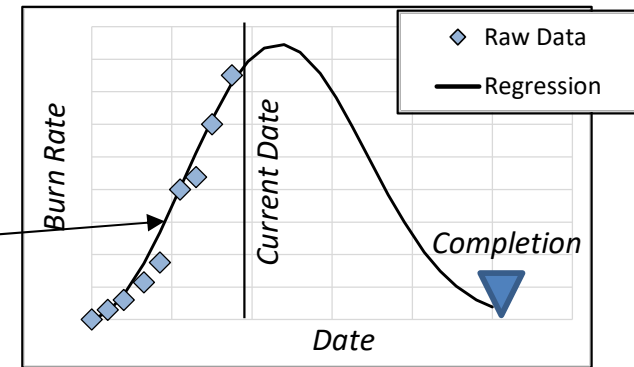
Different distributions could be used for regression (e.g., Normal, Lognormal, Rayleigh, Weibull, etc.)

Record regression parameters from Step 1

| Distribution Parameters |             |             |              |
|-------------------------|-------------|-------------|--------------|
|                         | A           | B           | C            |
| Unit 1                  | 2.48        | 0.54        | 3,344        |
| Unit 2                  | 2.63        | 0.55        | 3,544        |
| Unit 3                  | 3.07        | 0.57        | 3,428        |
| <b>Avg</b>              | <b>2.72</b> | <b>0.55</b> | <b>3,439</b> |

\*values used for example purposes

Use Average Regression parameters from Step 2 to develop curve to Program Completion Date



- Curve based on parameters from historical programs  
 - EAC equal to the sum of actuals to date and the regression curve from current to completion date



# EAC Approach 3: 'Interpolation'



- Overarching Description:**

- Forecast EAC based on the burn rate profiles of historical programs to current program; Data points are interpolated to account for schedule differences

- Methodology:**

1



2

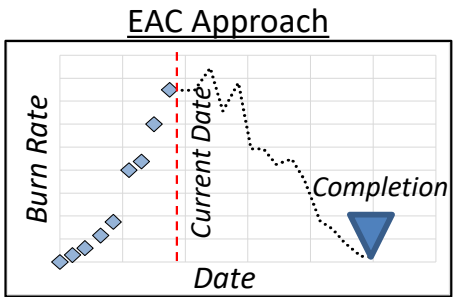
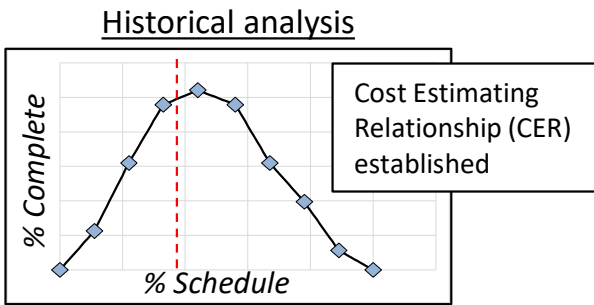
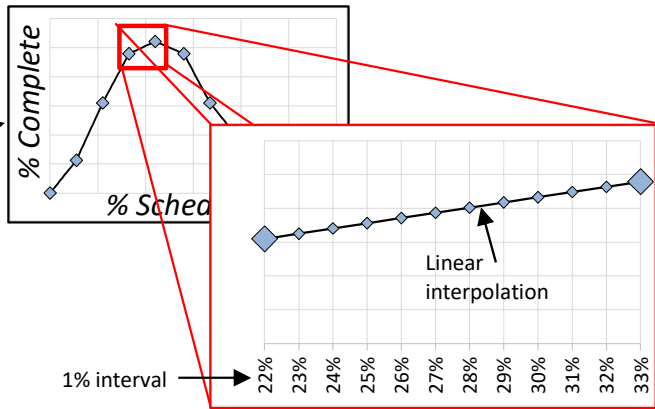
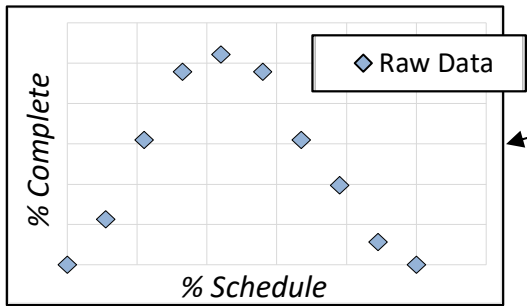


3

Normalize data to '% Complete' and '% Schedule' for each historical and/or analogous program

Define '% Schedule' intervals and use interpolation to define missing intervals

Forecast the EAC based on the historical % complete at each % schedule interval for the current program



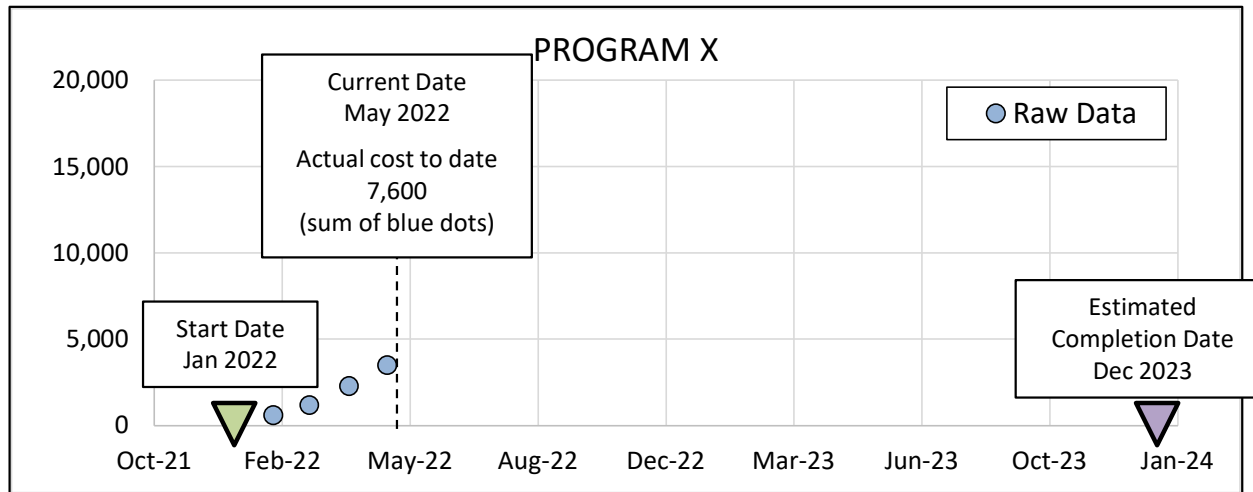
- % Complete:
  - Defined as 'actual cost to date' / 'total cost'
  - Accounts for cost differences b/w programs
- % Schedule:
  - Defined as 'duration to date' / 'total duration of program'
  - Accounts for schedule differences b/w programs

- For the purpose of presentation, assumed:
  - Linear interpolation
  - Defined 1% intervals
  - Assumptions can be adjusted

Example: Current date = 36% Schedule  
 From CER, 36% Schedule = 40% Complete  
 EAC = Actual cost to date / 40% Complete

# Application: Example 1 Overview

- Let's develop an EAC for Program X with the provided information:



**Calculations:**

$$\% \text{ Schedule} = \left[ \frac{\text{'duration to date'}}{\text{'total duration of program'}} \right]$$

$$\% \text{ Schedule} = \left[ \frac{\text{May 2022} - \text{Jan 2022}}{\text{Dec 2023} - \text{Jan 2022}} \right]$$

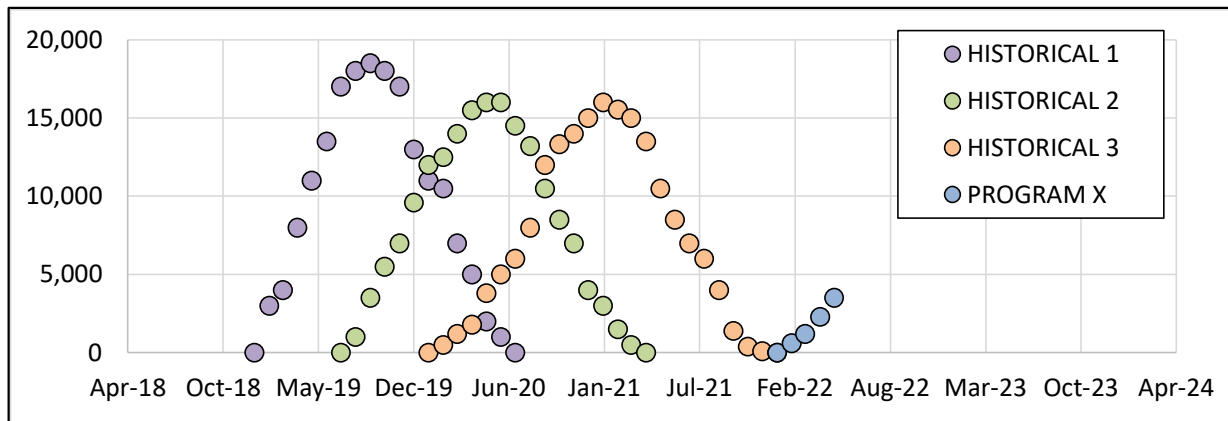
% Schedule = 17%

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$$\% \text{ Complete} = \left[ \frac{\text{'actual cost to date'}}{\text{'total cost' (EAC)}} \right]$$

$$\% \text{ Complete} = \left[ \frac{7,600}{?} \right]$$

- Analogous historical programs to Program X were identified



**Historical Program Data**

|                        | HIST. 1 | HIST. 2 | HIST. 3. |
|------------------------|---------|---------|----------|
| <b>Start Date</b>      | Jan-19  | Jul-19  | Jan-20   |
| <b>Completion Date</b> | Jul-20  | Apr-21  | Jan-22   |
| <b>Duration (mths)</b> | 19      | 22      | 25       |
| <b>Total cost</b>      | 177,500 | 175,300 | 178,583  |

This presentation does not reflect real data and is intended for conceptual purposes only.

# Application: Example 1 Results

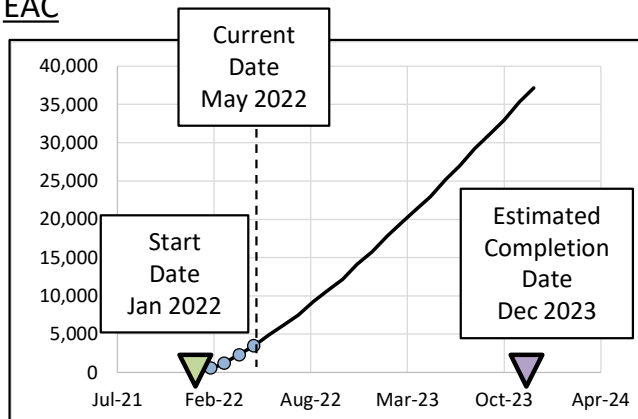


## 'Regression Extension'

### Analysis

- Program X currently at relatively low % Schedule (~17%)
- Regression Extension approach not as accurate as regression continues to trend upward due to apex not yet defined

### EAC

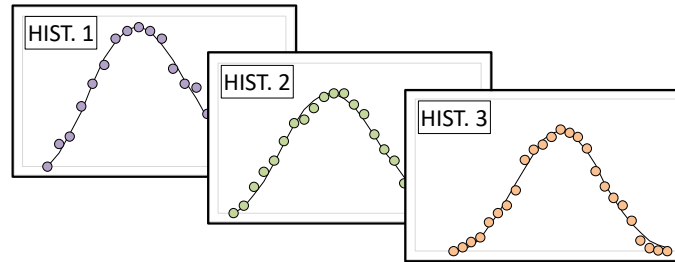


|                 |         |
|-----------------|---------|
| Actuals to Date | 7,600   |
| Remaining       | 379,886 |
| EAC 1           | 387,486 |



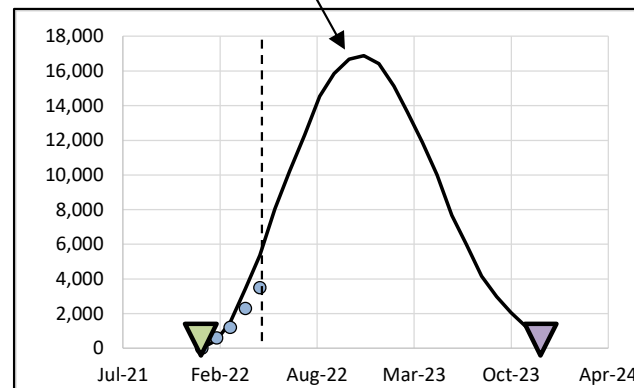
## 'Historical Regression Application'

### Analysis



- Regression analysis performed on historical programs
- An average of regression parameters used to develop burn rate profile for Program X

### EAC

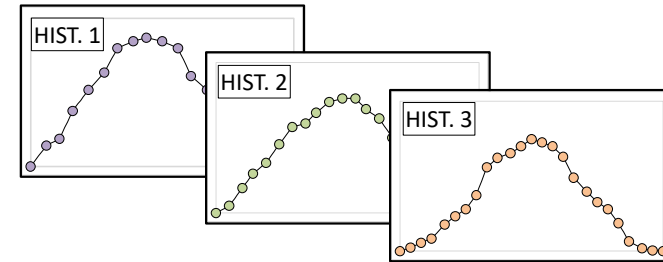


|                 |         |
|-----------------|---------|
| Actuals to Date | 7,600   |
| Remaining       | 186,338 |
| EAC 2           | 193,938 |



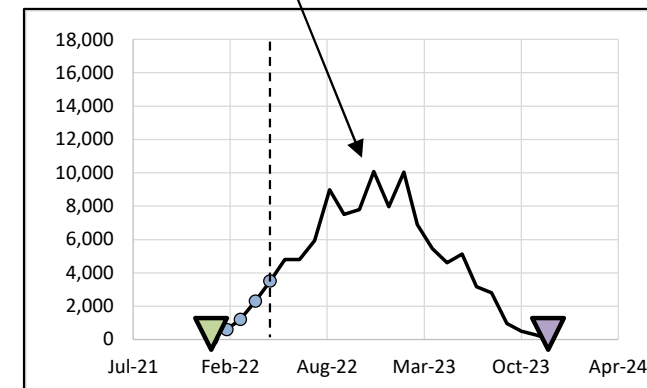
## 'Interpolation'

### Analysis



- % Schedule vs % Complete CER developed based on historical programs
- At 17% Schedule, assumed to be ~7% Complete; Remaining profile applied to Program X

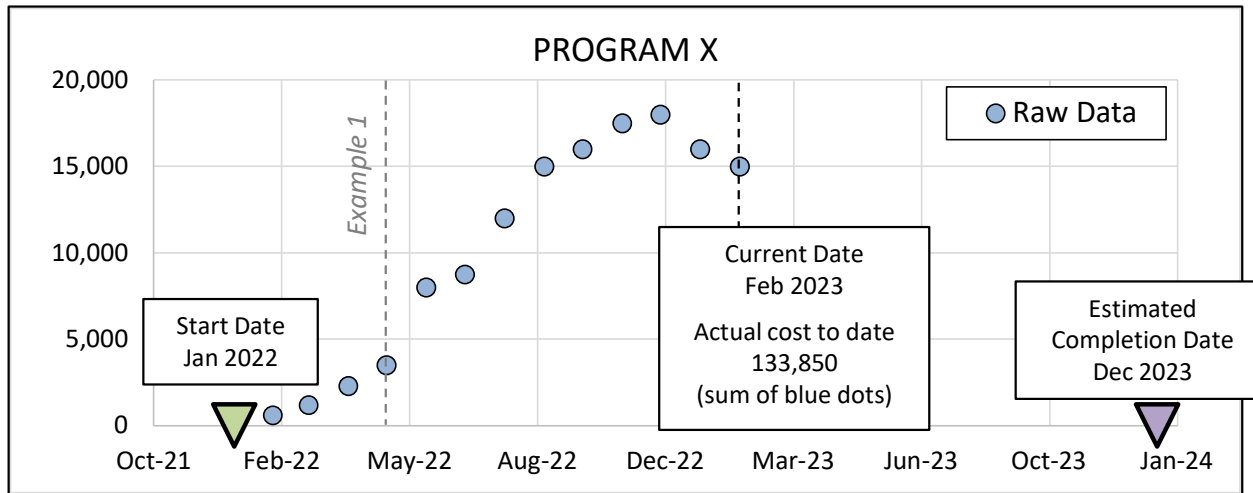
### EAC



|                 |         |
|-----------------|---------|
| Actuals to Date | 7,600   |
| Remaining       | 97,606  |
| EAC 3           | 105,206 |

# Application: Example 2 Overview

- For Example 2, assume same Program X, nine (9) months later  
(Current Date shifts from May 2022 to Feb 2023)



Calculations:

$$\% \text{ Schedule} = \left[ \frac{\text{'duration to date'}}{\text{'total duration of program'}} \right]$$

$$\% \text{ Schedule} = \left[ \frac{\text{Feb 2023} - \text{Jan 2022}}{\text{Dec 2023} - \text{Jan 2022}} \right]$$

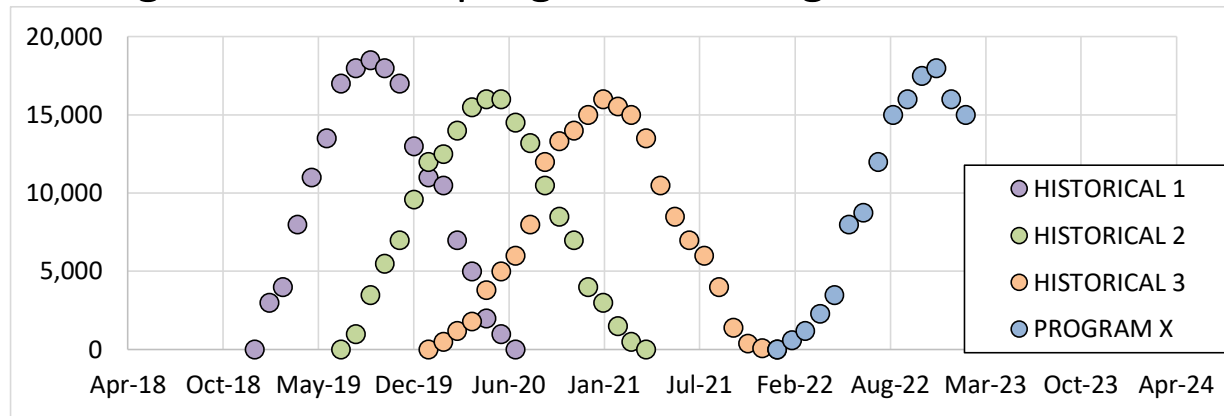
% Schedule = 57%

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$$\% \text{ Complete} = \left[ \frac{\text{'actual cost to date'}}{\text{'total cost' (EAC)}} \right]$$

$$\% \text{ Complete} = \left[ \frac{133,850}{?} \right]$$

- Analogous historical programs to Program X were identified



**Historical Program Data**

|                        | HIST. 1 | HIST. 2 | HIST. 3. |
|------------------------|---------|---------|----------|
| <b>Start Date</b>      | Jan-19  | Jul-19  | Jan-20   |
| <b>Completion Date</b> | Jul-20  | Apr-21  | Jan-22   |
| <b>Duration (mths)</b> | 19      | 22      | 25       |
| <b>Total cost</b>      | 177,500 | 175,300 | 178,583  |

This presentation does not reflect real data and is intended for conceptual purposes only.

# Application: Example 2 Results

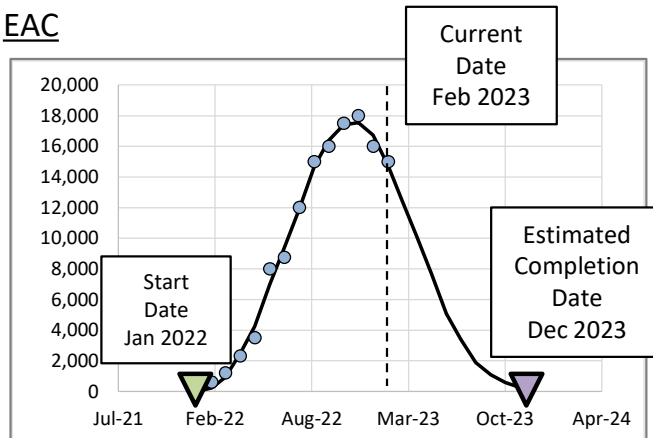


## 'Regression Extension'

### Analysis

- Program X at a higher % Schedule (~57%)
- Regression Extension approach more accurate as apex exists in burn rate curve, enables regression to 'burn down'

### EAC

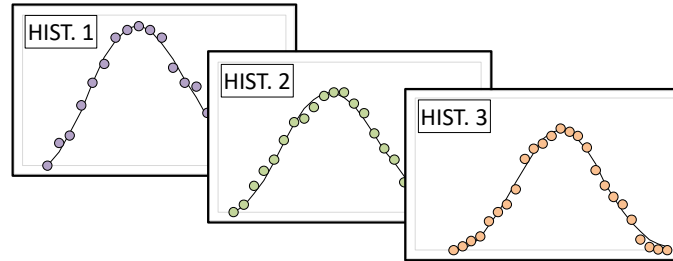


|                 |         |
|-----------------|---------|
| Actuals to Date | 133,850 |
| Remaining       | 42,683  |
| EAC 1           | 176,533 |



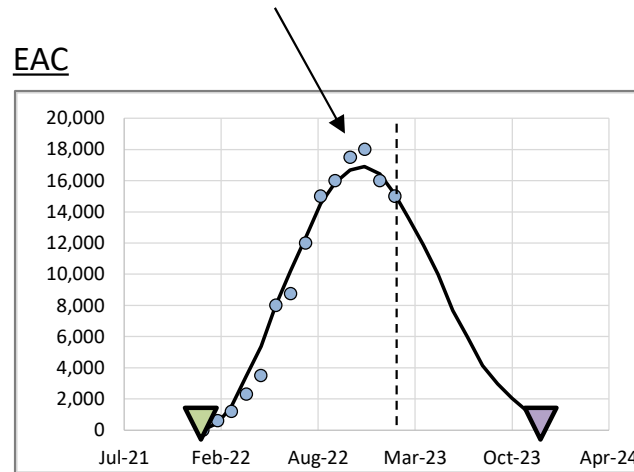
## 'Historical Regression Application'

### Analysis



- Regression analysis performed on historical programs
- An average of regression parameters used to develop burn rate profile for Program X

### EAC

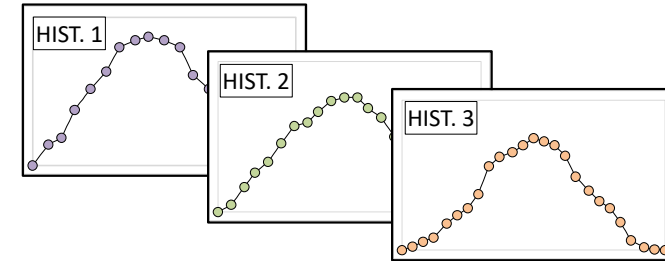


|                 |         |
|-----------------|---------|
| Actuals to Date | 133,850 |
| Remaining       | 60,313  |
| EAC 2           | 194,163 |



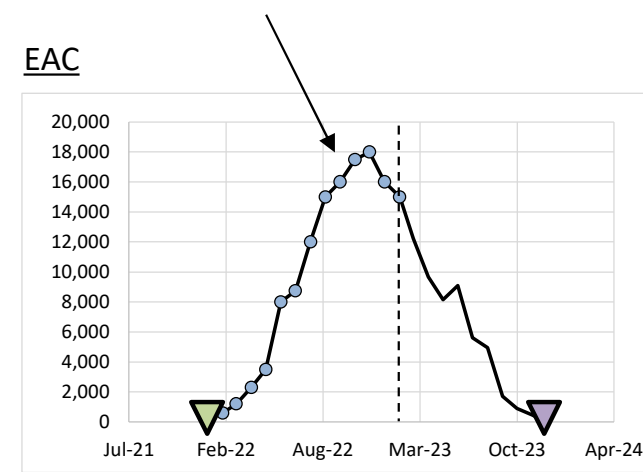
## 'Interpolation'

### Analysis



- % Schedule vs % Complete CER developed based on historical programs
- At 57% Schedule, assumed to be ~72% Complete; Remaining profile applied to Program X

### EAC

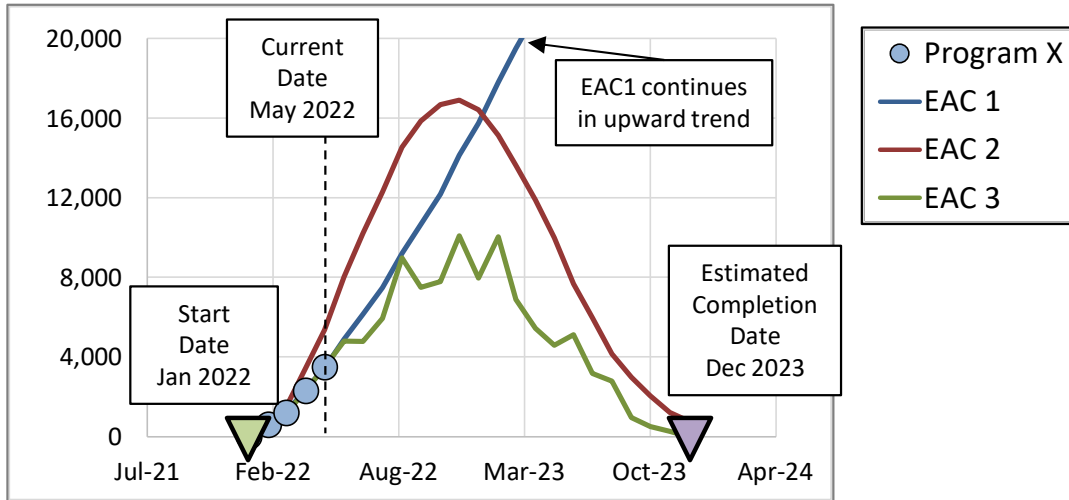


|                 |         |
|-----------------|---------|
| Actuals to Date | 133,850 |
| Remaining       | 52,744  |
| EAC 3           | 186,594 |

# Comparison of Results

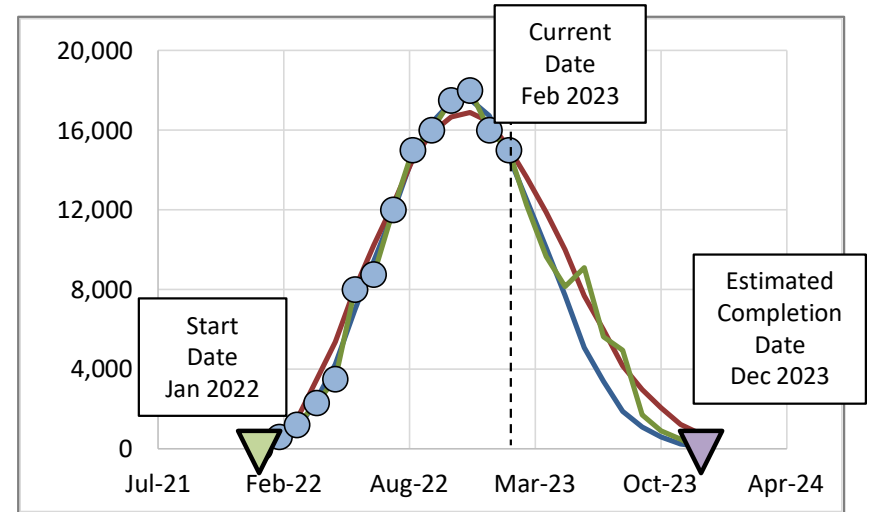
- Shown below is a comparison of results for Examples 1 and 2

**Example 1: Program X @ 17% Schedule**



|                        | EAC 1   | EAC 2   | EAC 3   |
|------------------------|---------|---------|---------|
| <b>Actuals to Date</b> | 7,600   | 7,600   | 7,600   |
| <b>Remaining</b>       | 379,886 | 186,338 | 97,606  |
| <b>Total EAC</b>       | 387,486 | 193,938 | 105,206 |

**Example 2: Program X @ 57% Schedule**



|                        | EAC 1   | EAC 2   | EAC 3   |
|------------------------|---------|---------|---------|
| <b>Actuals to Date</b> | 133,850 | 133,850 | 133,850 |
| <b>Remaining</b>       | 42,683  | 60,313  | 52,744  |
| <b>Total EAC</b>       | 176,533 | 194,163 | 186,594 |

- Early in the program's life, EACs have higher uncertainty (as shown from wider range in Ex 1)
- As program progresses, EACs tend to converge (as shown from narrower range in Ex 2)
- Approaches presented can be either used as primary EACs and/or assessments of EACs

# Conclusions & Future Work

## Conclusions

- Developing an Estimate at Completion (EAC) traditionally involves establishing a performance-based estimate using Earned Value Management (EVM) analysis
  - Earned Value Management (EVM) is an integrated management system that integrates the work scope, schedule, and cost parameters of a program in a manner that provides objective performance measurement data
  - Based on current literature, there are pros/cons to the EVM system (including that EVM data may not always be available)
- Explored three alternative EAC approaches leveraging burn rate profiles ('burn rate' EAC approaches)
  1. 'Regression Extension'
  2. 'Historical Regression Application'
  3. 'Interpolation'
- Using either EVM 'Gold Card' calculations and/or alternative 'burn rate' EAC approaches are credible methods for developing EACs
- Practitioners need to determine which methodology represents the best fit for their program based on factors including the program development stage, existing assumptions, and the historical data available

## Future Work

- Develop process and approach for EAC risk using burn rate profile methodologies
- Apply suggested 'burn rate' EAC approaches on an existing / completed program
- Perform a cross comparison of the results and lessons learned for both EVM 'Gold Card' EAC calculations and the suggested 'burn rate' EAC approaches

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