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*Since 1973*

# Introducing Joint Analysis of Cost and Schedule (JACS) ~ a new ACEIT Application ~

## 2012 ACEIT User Workshop

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**Mike Stelly – NASA JSC**  
**18 September, 2012**

- Los Angeles ■ Washington, D.C. ■ Boston ■ Chantilly ■ Huntsville ■ Dayton ■ Santa Barbara
- Albuquerque ■ Colorado Springs ■ Goddard Space Flight Center ■ Johnson Space Center ■ Ogden ■ Patuxent River ■ Washington Navy Yard
- Ft. Meade ■ Ft. Monmouth ■ Dahlgren ■ Quantico ■ Cleveland ■ Montgomery ■ Silver Spring ■ San Diego ■ Tampa ■ Tacoma
- Aberdeen ■ Oklahoma City ■ Eglin AFB ■ San Antonio ■ New Orleans ■ Denver ■ Vandenberg AFB

- **What is JACS?**
- What Additional Insight Does it Provide?
- How Has it Been Used? – a NASA JSC Perspective
- Summary



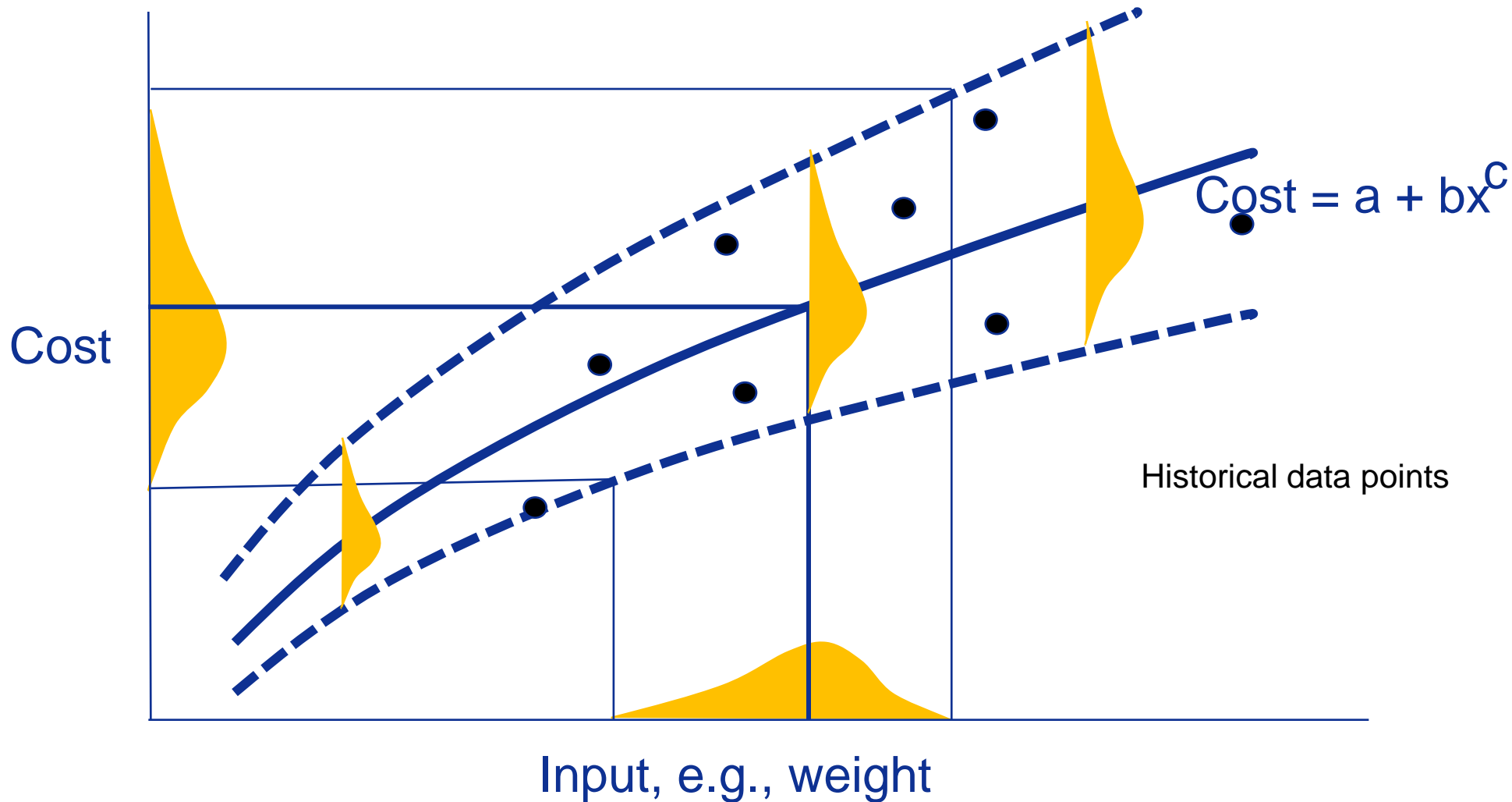
# What is Joint Analysis of Cost and Schedule (JACS)?

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- **Joint Analysis of Cost and Schedule (JACS), is a new member of the ACEIT suite and was released with ACEIT 7.3a**
- **JACS is a Microsoft Project add-in that combines ACE RI\$K with MS Project to enable**
  - Schedule risk analysis
  - Schedule based cost models
  - Integrated cost and schedule risk analysis
- **JACS does not require you to know ACE to build or run a model**
- **JACS is the next evolutionary step in programmatic analysis**

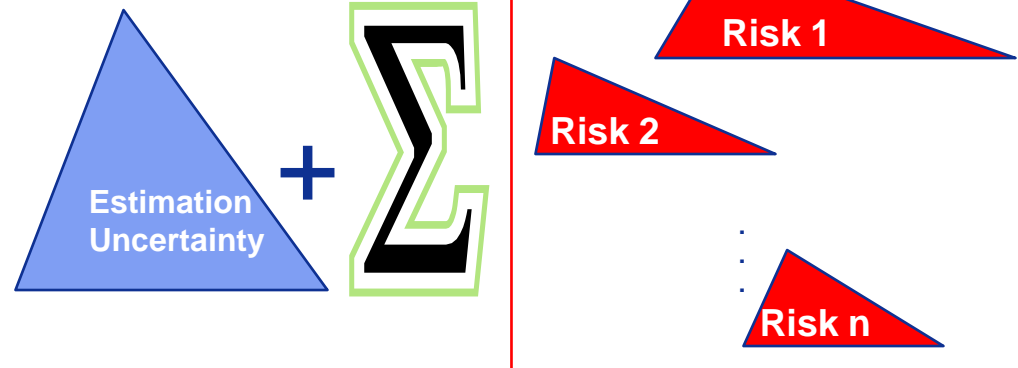


# Current State of the Art in Cost Estimating Uncertainty – Consider the Input Drivers

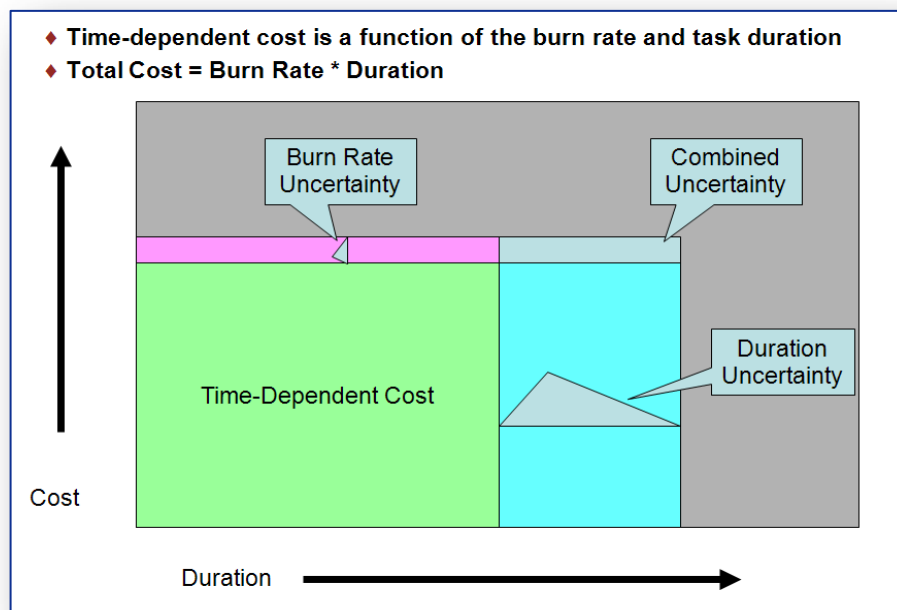


# Evolving Trends – Consider Schedule Impacts and Discrete Risks

## ■ Inclusion of Discrete Risks (5x5's)



## ■ Inclusion of Schedule Duration Impacts for Time-Dependent Costs

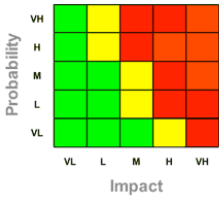




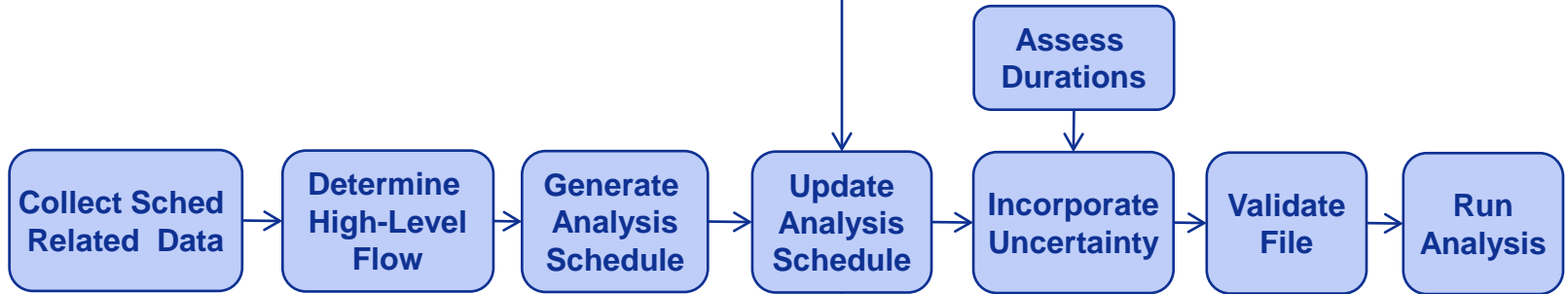
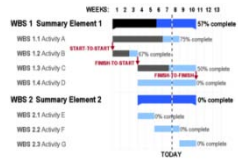
# The Complete JACS Modeling Process

## Risk

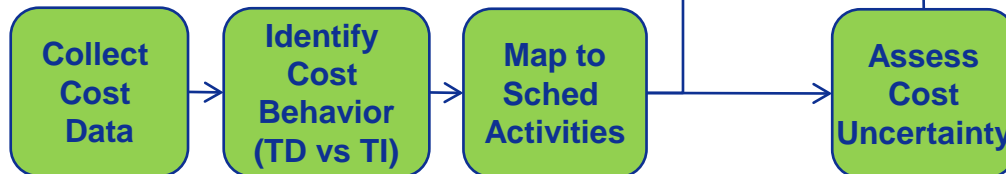
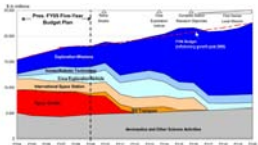
RISK MATRIX



## Sched



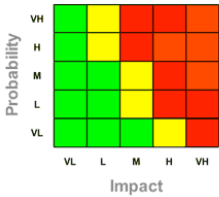
## Cost



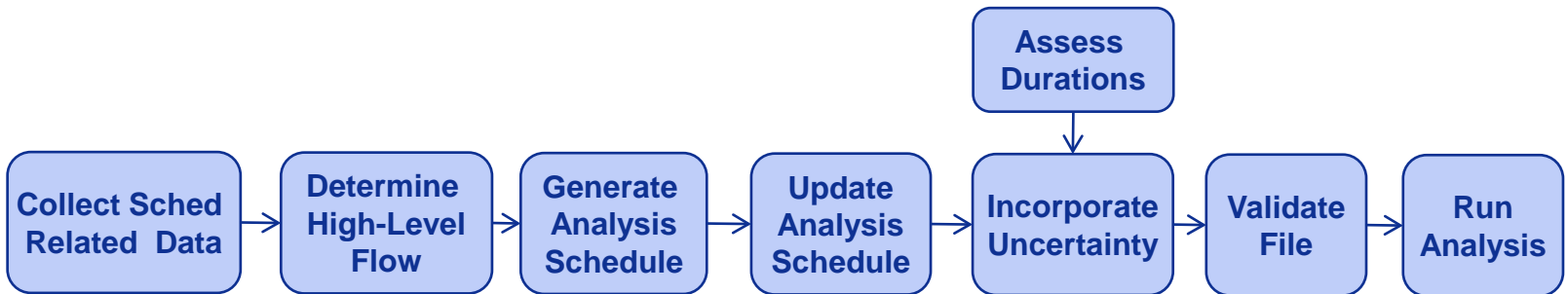
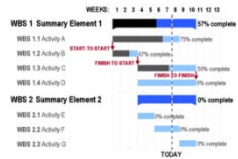
# The SRA Process

## Risk

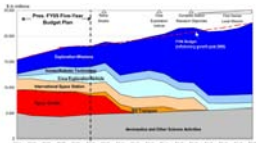
RISK MATRIX



## Sched



## Cost

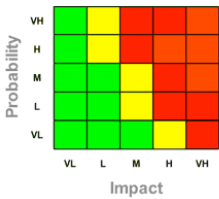




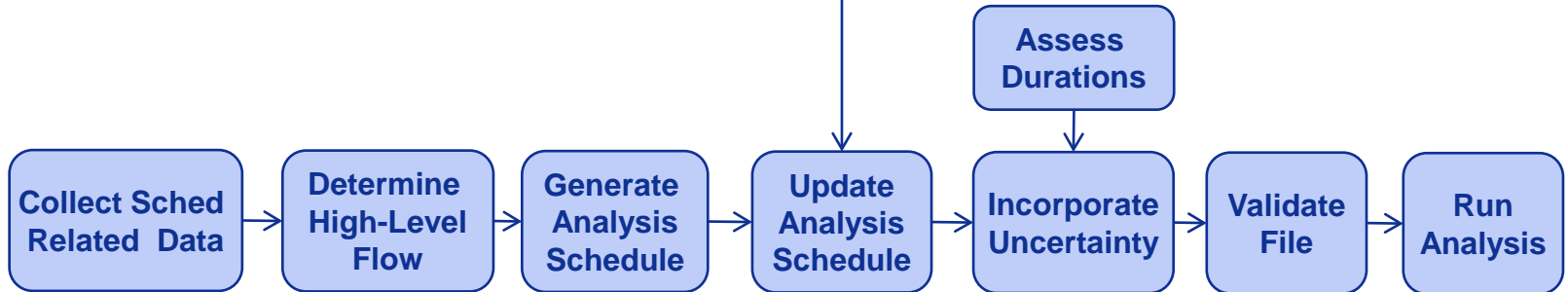
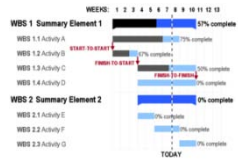
# The Discrete Risk SRA Informed Modeling Process

## Risk

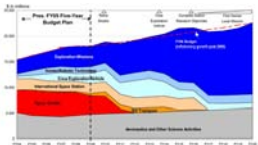
RISK MATRIX



## Sched



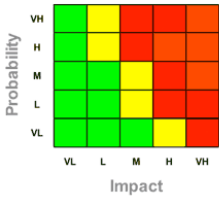
## Cost



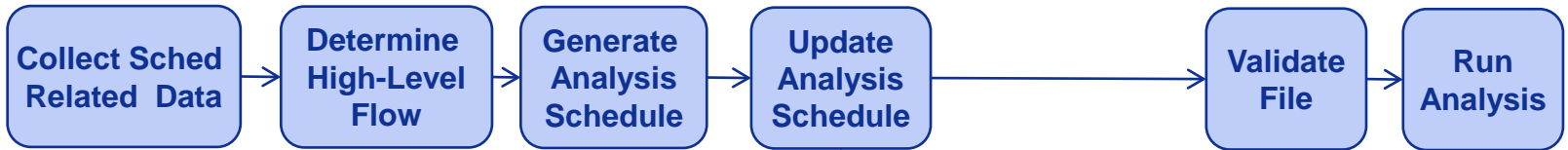
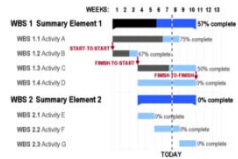
# The Integrated Cost and Schedule Modeling Process

## Risk

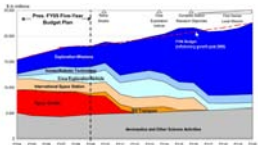
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## Sched



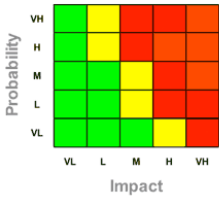
## Cost



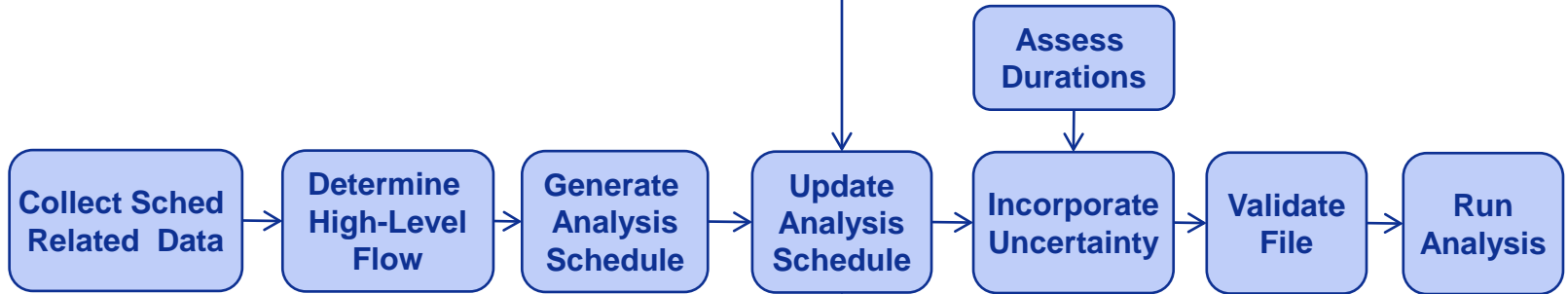
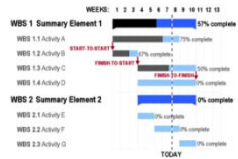
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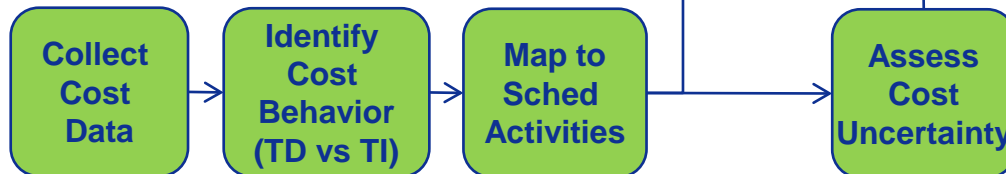
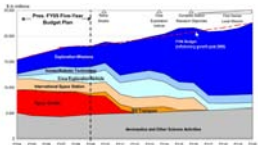
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## Sched



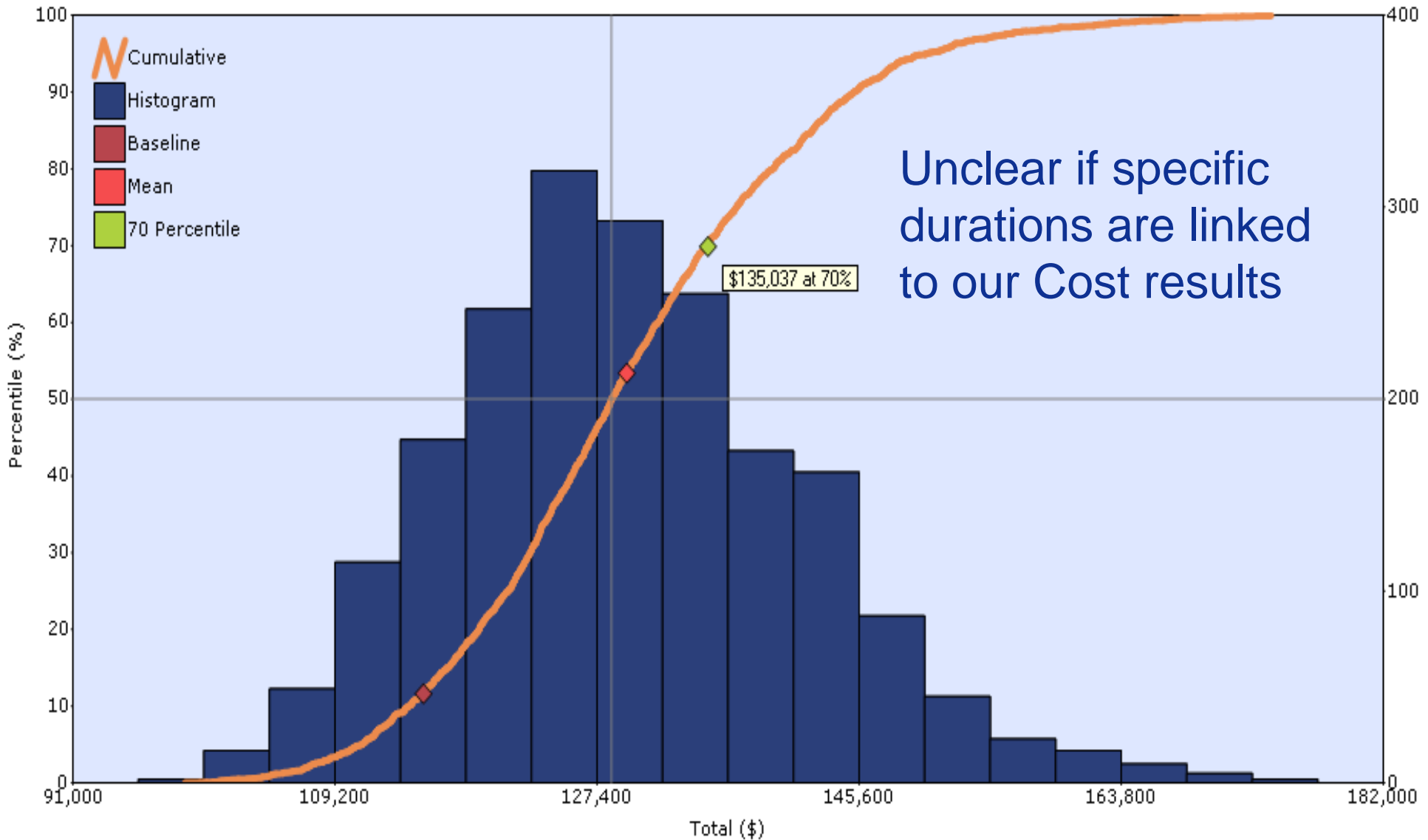
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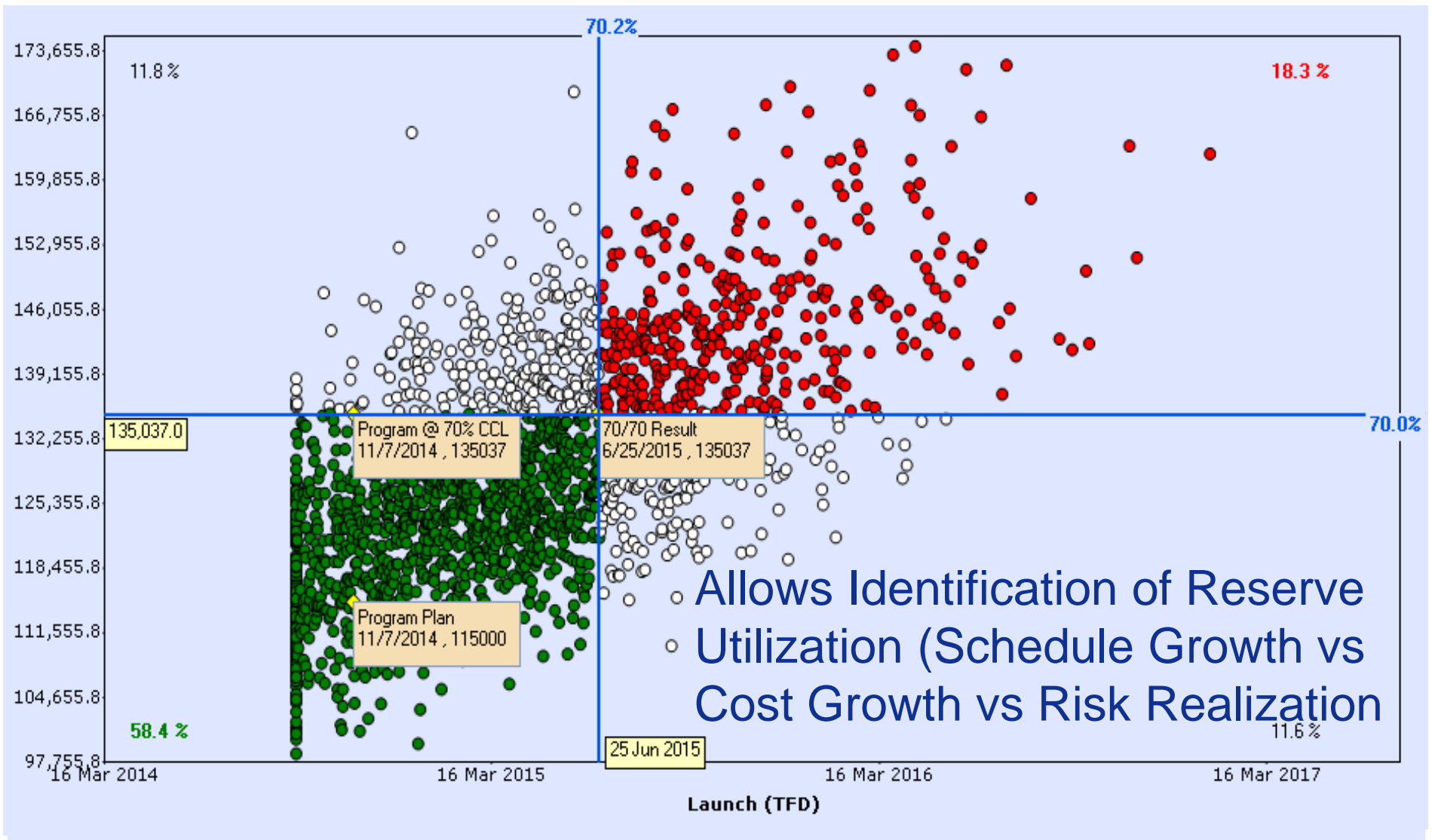
- What is JACS?
- **What Additional Insight Does it Provide?**
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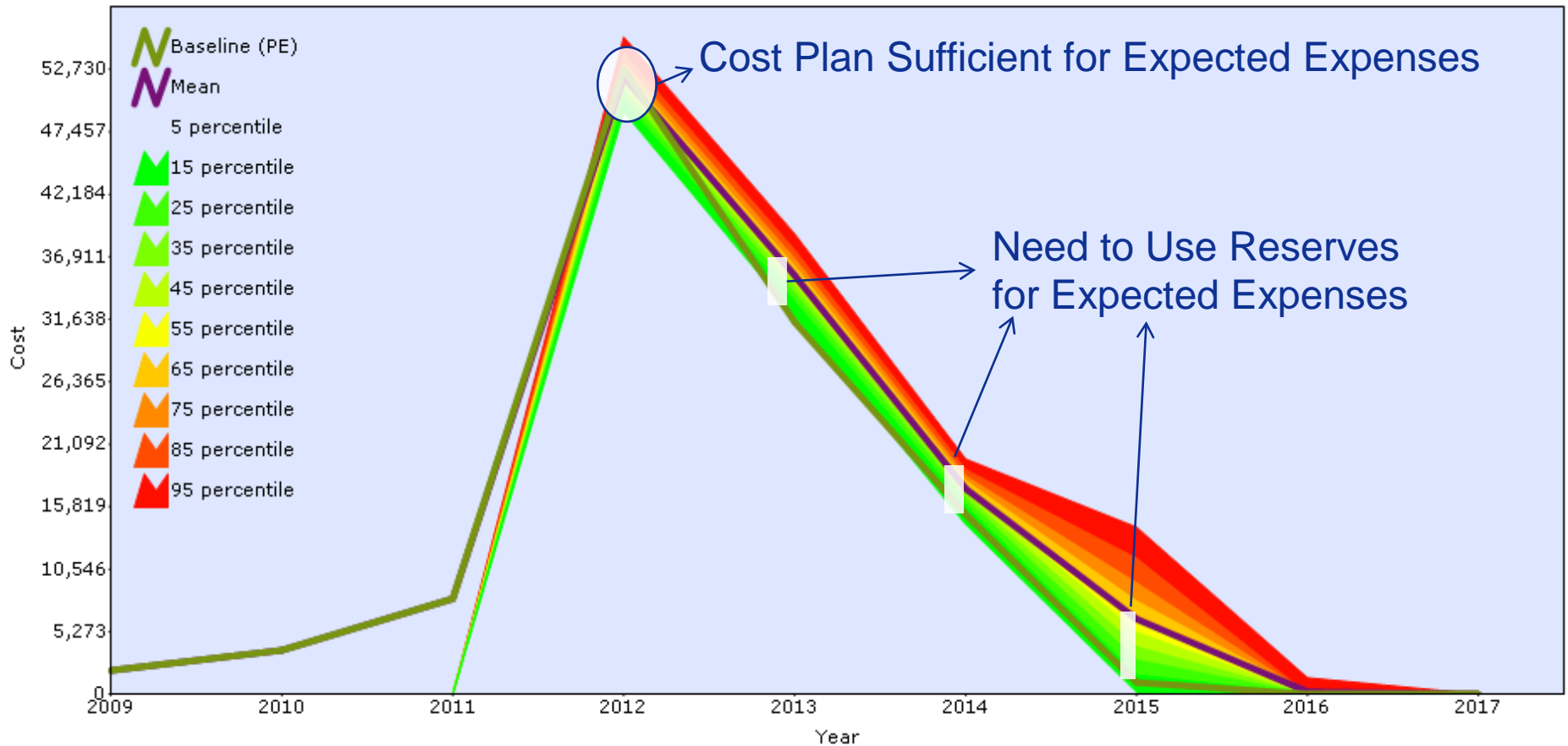
# Our Current "Traditional" View does not Relate Cost with Time



# JACS Relates Cost with Time



# Annual View of Uncertainty Allows for Quick Assessment of Reserves







- What is JACS?
- What Additional Insight Does it Provide?
- **How Has it Been Used? – a NASA JSC Perspective**
- Summary



# A NASA JSC Perspective

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- **Why we are using JACS**
- **What data we use**
- **How we're using it now: schedule analysis**
- **What we're moving to: joint cost and schedule analysis**

Disclaimer: All data and analyses seen in this portion of the presentation are from JACS, but many of the graphs are custom made

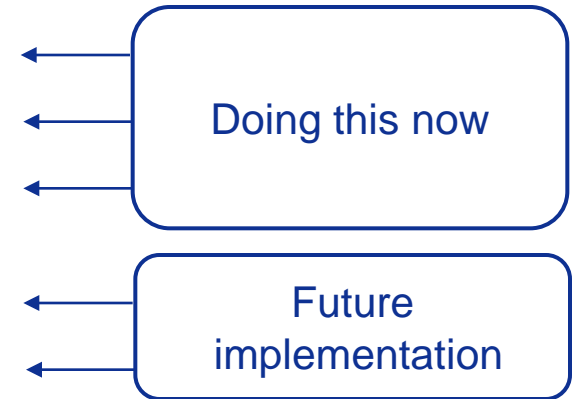


# Why Johnson Space Center is Using JACS

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## ■ Program management insight

- Schedule probability of success
- Impacts of discrete program risks
- What if scenarios
- Cost probability of success
- Recommended annual funding reserve



## ■ Regulatory requirement (7120.5 E)

- Identify a cost and schedule range by milestone KDP (~milestone) B
- Baseline program to a specific joint confidence level by KDP (~milestone) C



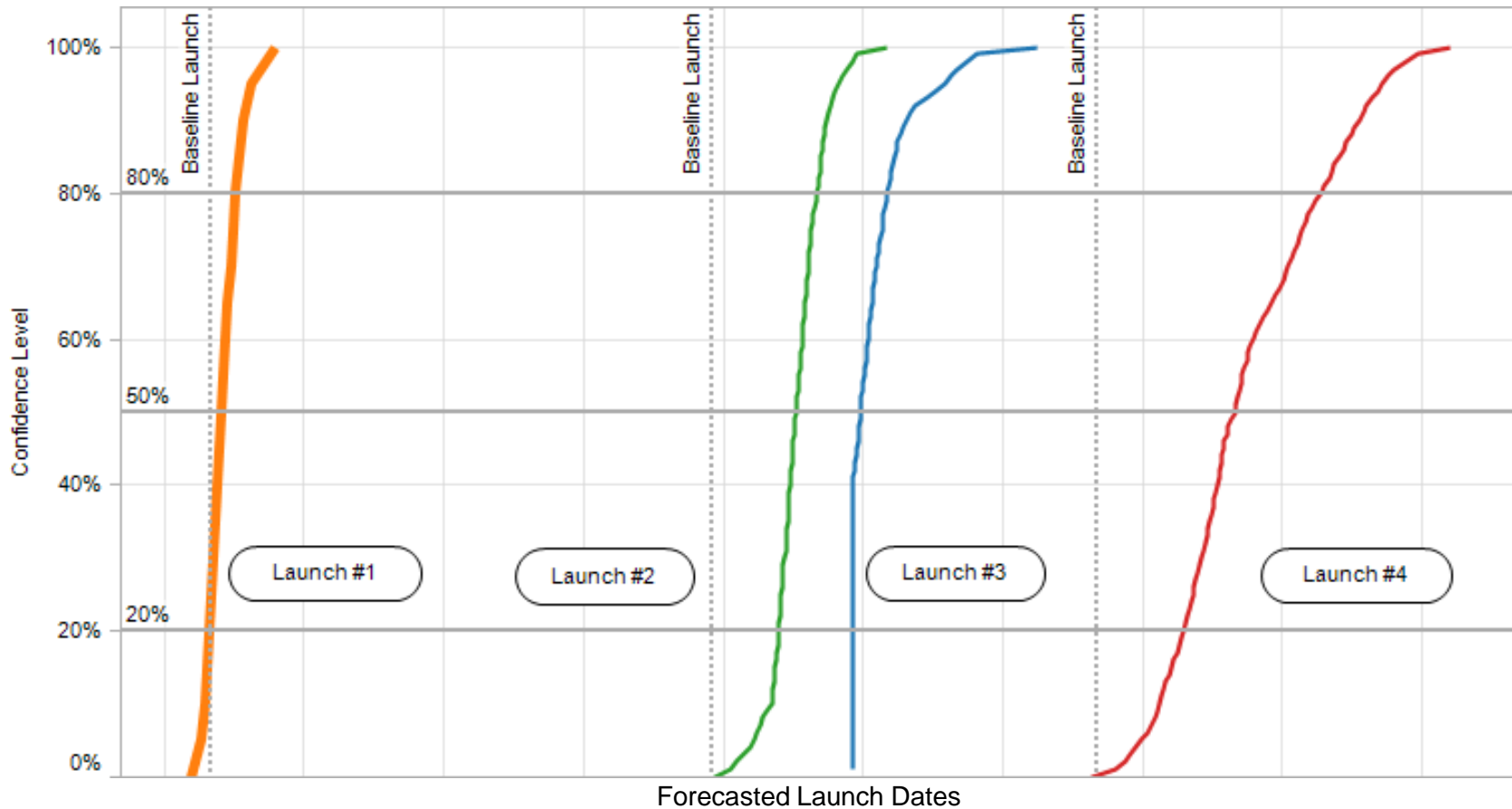
# What Data Do We Need?

- **Schedule + Risks + Costs = JCL Model**
- **Can use *any* of the below, as long as you have one data source for each category**
- **Schedule**
  - Detailed IMS
  - Simple schedule with just a few moving parts
- **Costs – preferably time phased**
  - Budget data
  - Lower level cost data (LCC databases) / EVM data
  - Parametric costs
- **“Risks”**
  - Risk management system
  - What –if’s
  - Basic uncertainty

**Keep it simple and use what you have**



# Schedule Uncertainty - S-Curve



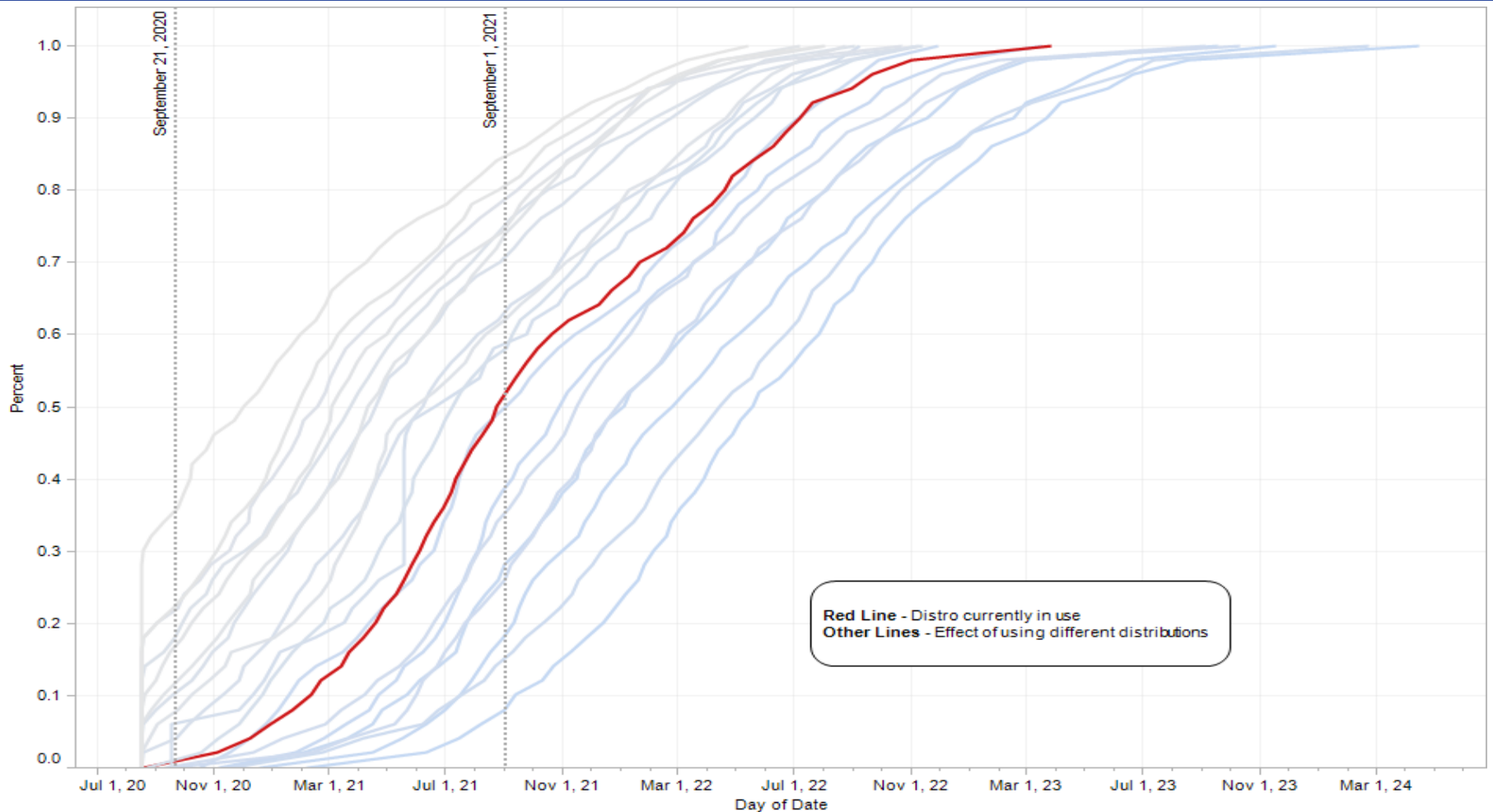
## Basic schedule uncertainty by milestone

- Identifying range of dates

- Margin recommendation: How certain confidence levels compare to the baseline



# Schedule Ranges - Changing Base Assumptions

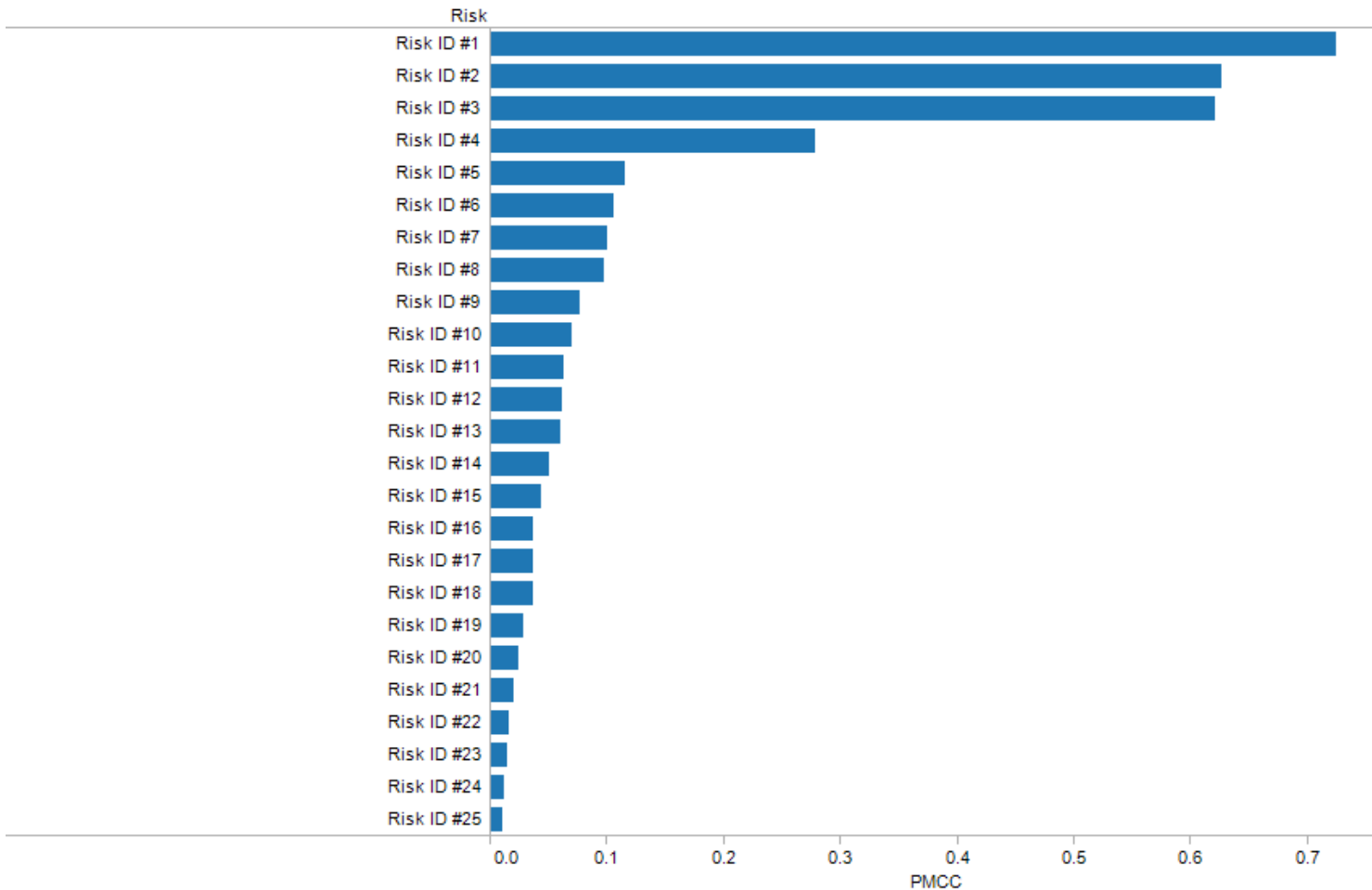


## Sensitivity to changing modeling assumptions and how it could affect margin

- How sensitive is your model to things like distribution type, correlation, etc?

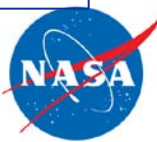


# Schedule Drivers - Tornado Chart

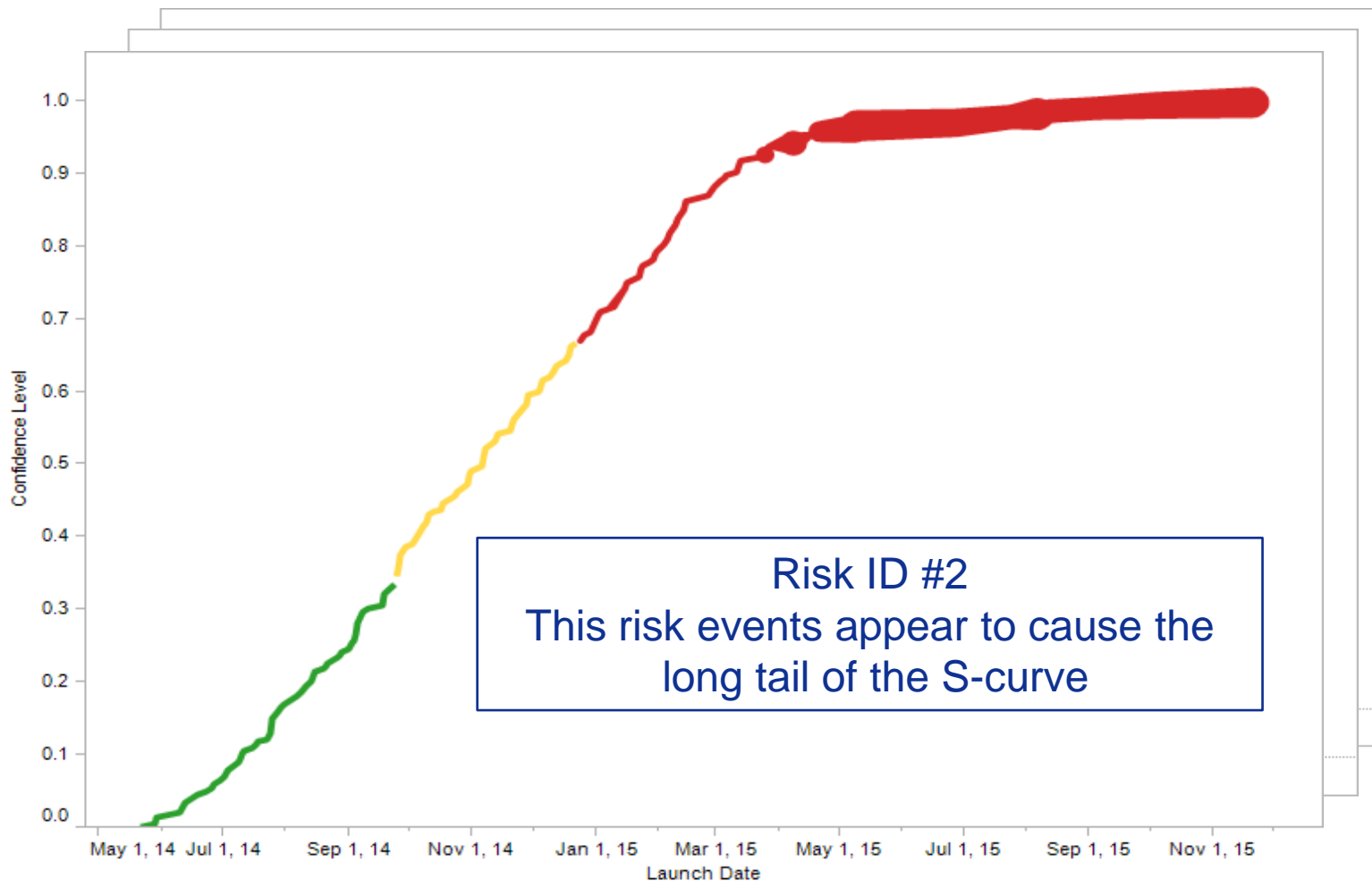


## What's Driving the Schedule

- Critical to help determine where the problem spots are in the program



# Schedule Drivers - "Blob" S-Curve



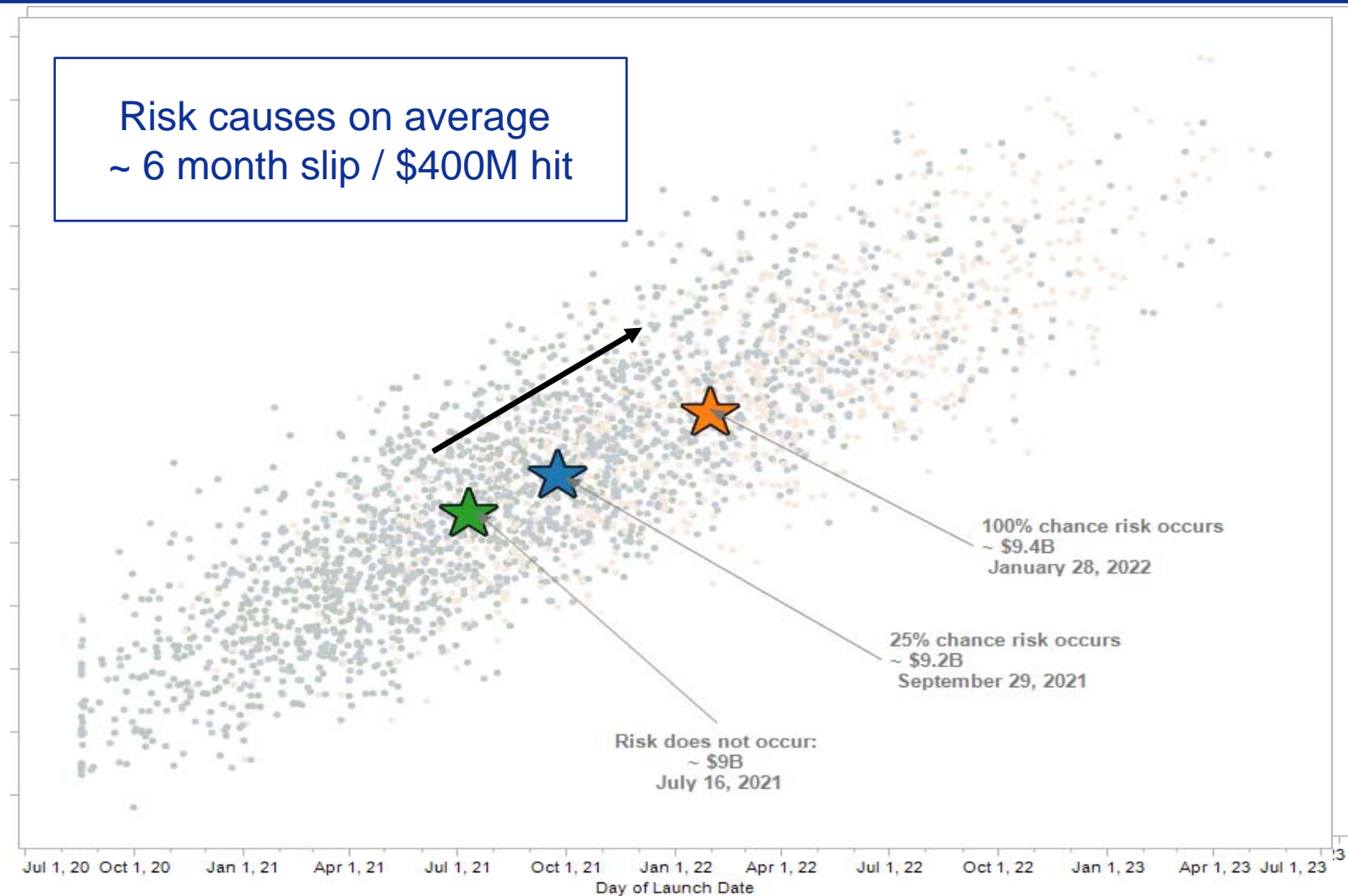
## Showing where risk events appear on the S-curve

- Look at risks individually – map the average risk impact per launch date to the curve
- Can be done for cost S-curves as well





# Cost and Schedule Combined with Scenarios

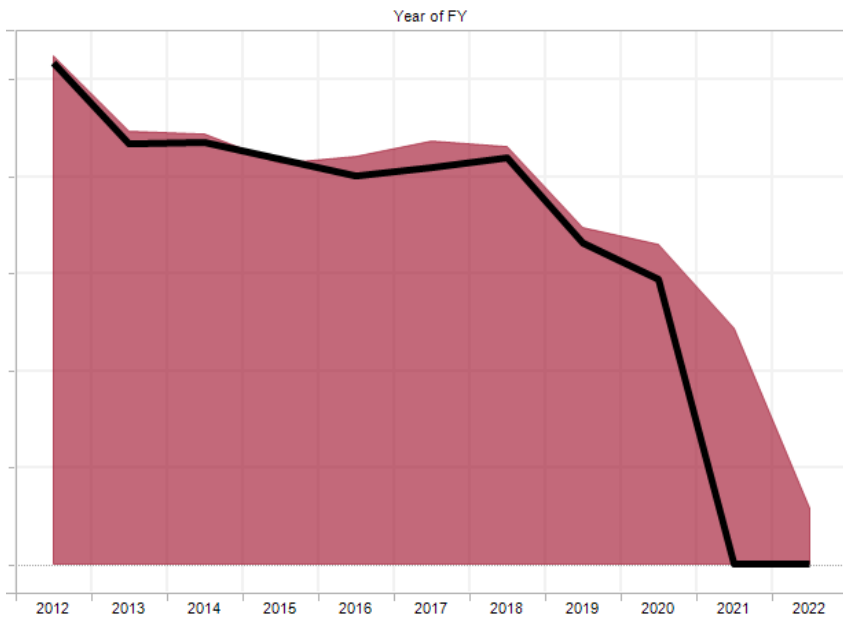


## Multiple scatter plot overlay

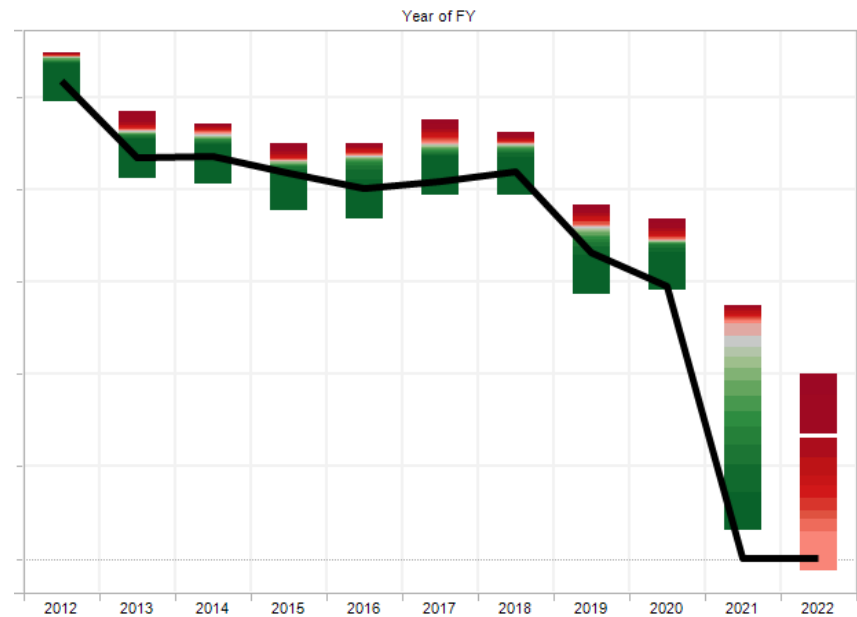
- Turn on and off a specific risk to measure the impact
- Appears messy – until you look at the average of each scatter plot



# Annual Funding Charts



Pt Estimate vs 80% PL Annual Margin



Pt Estimate vs Annual Uncertainty

## Annual funding

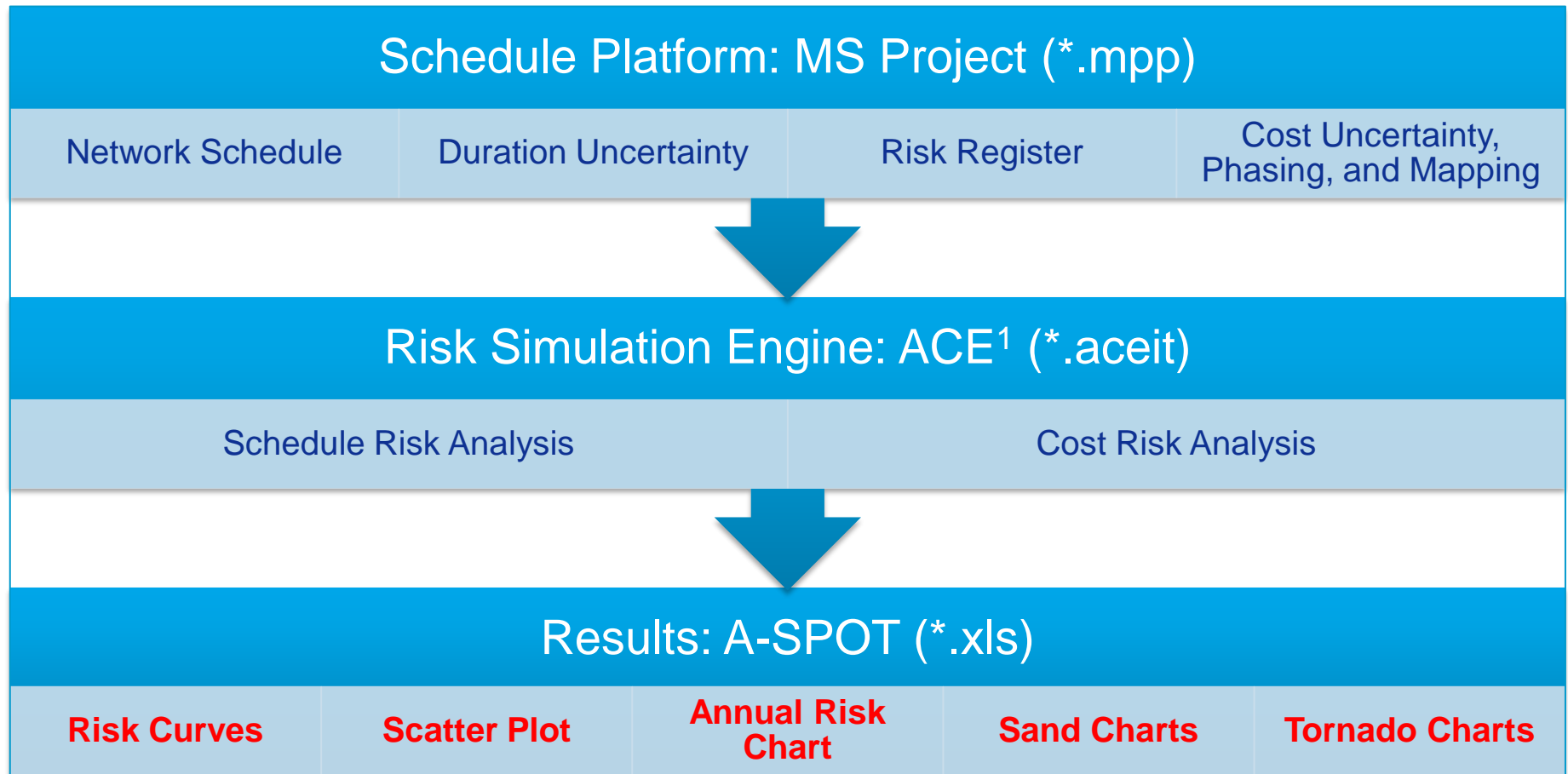
- Time-phased estimates are a natural byproduct of linking cost and schedule
- Important for identifying/ justifying future funding needs



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- **Summary**



# JACS is a MS-Project Add-in



- Uses schedules built within MS-Project
- In the background, auto-creates ACE files and uses ACE engine for stochastic analysis
- Activates ACEIT Scatter Plot Observation Tool (A-SPOT) for reports

<sup>1</sup>Technology runs in background and invisible to user



# Single Interface for Data Entry

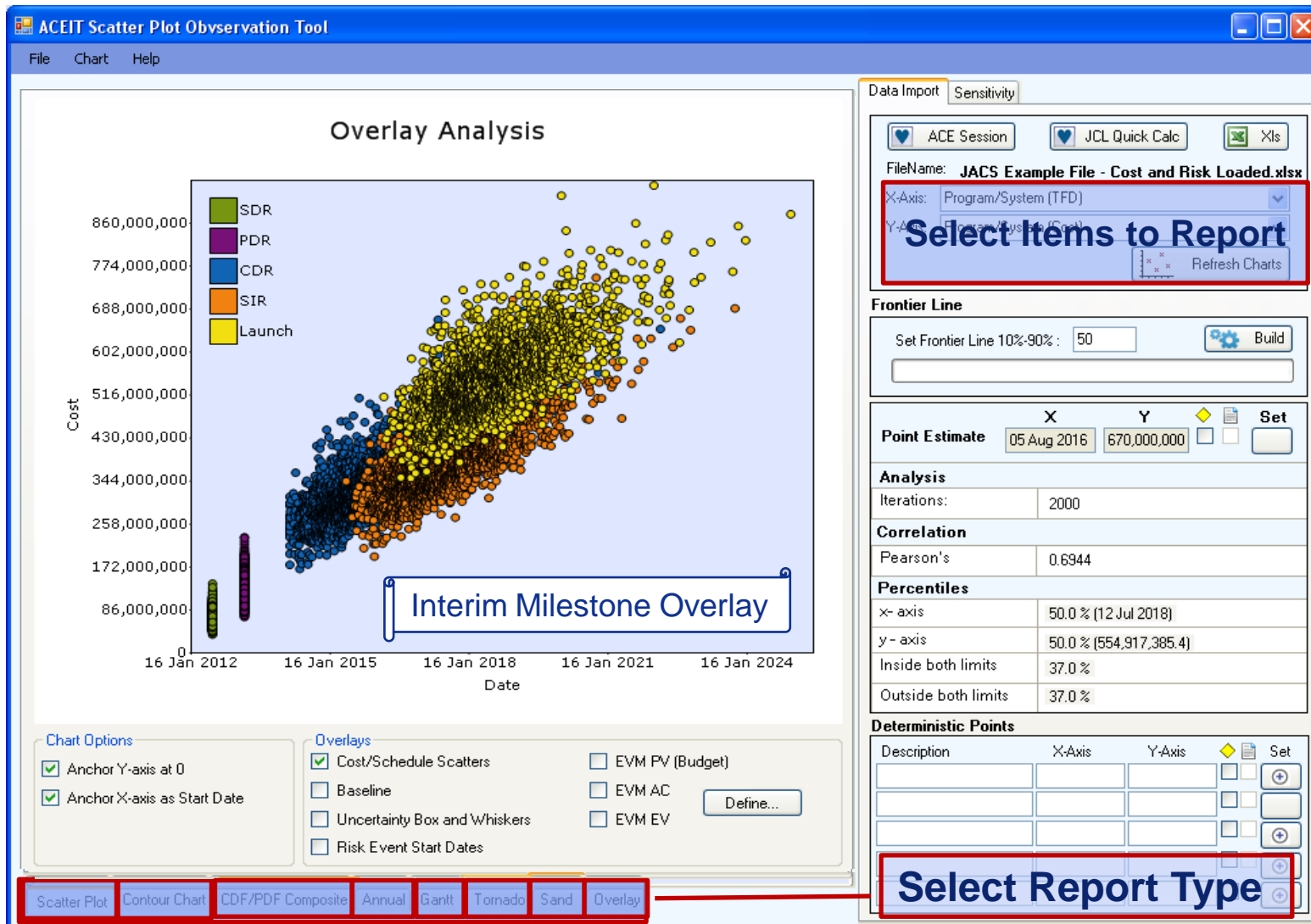
- JACS provides capability to specify Costs and uncertainty distributions for all durations and costs
- Seven distributions available
  - Normal
  - Lognormal
  - Triangle
  - BetaPert
  - Uniform
  - Constant
  - Discrete
- Distributions can be in absolute or relative value terms
- Correlation can also be specified

The screenshot shows the 'JACS Edit Form - JACS Example File - Cost and Risk Loaded' window. The interface includes a menu bar with 'Config', 'Edit', 'Threats', 'Multi-U', 'Correl', 'Health', 'Analyze', and 'Charts'. The main form is divided into several sections:

- Current Task:** Shows '13' in a dropdown, 'Structure', 'WBS', 'Duration (days): 680', and 'Remaining: 680'. A red box labeled 'Total Cost' points to the 'Total Cost (\$): 41,250,000' field.
- Spending Detail:** Contains 'Total Cost (\$): 41,250,000', 'w/ remaining: 0', and two sub-sections: 'Time-independent portion of task cost' (with 'TI (\$): 33,000,000' and 'TI as % of Total Cost: 80.00') and 'Time dependent portion of task cost' (with 'TD (\$): 8,250,000' and 'TD as % of Total Cost: 20.00'). A red box labeled 'TD Cost' points to the 'TD (\$)' field.
- Spending Contour:** Features two dropdowns: 'Early Peak' and 'Turtle', each with a small graph icon. A red box labeled 'TI and TD Phasing' points to this section.
- Task Uncertainty:** Includes three rows for 'Duration Uncertainty', 'TI Cost Uncertainty', and 'TD Cost Uncertainty', each with a distribution icon and a text box containing a lognormal distribution formula (e.g., 'LN\*(113,8);Correl(DURATION=0.6)'). A red box labeled 'Uncertainty Specification' points to the 'TI Cost Uncertainty' row.
- Selected Uncertainty:** Shows a 'None' button and a 'Normal' distribution icon. Below are fields for 'Mean: 113' and 'Std Dev: 8', and a checked checkbox for 'Mean and Std Dev defined as percentages of baseline (100% = baseline)'. A red box labeled 'Correlation' points to the 'Correlation Coef: 0.6' dropdown.
- Bottom Section:** Includes 'Correlation Grouping: DURATION', 'Details...', 'Shared Coef: 0.6', and 'Is risk event with likelihood (%) of: 0'. A red box labeled 'Correlation' also points to the 'Threat ID:' field.



# Single Interface to View Results



## ■ Obtain Software

- Included with ACEIT 7.3a
- Need to install separately
- [www.ACEIT.com](http://www.ACEIT.com)

## ■ General Support

- ACEIT Help Desk





**Thank You**