



# ***Analysis of Integration and Test (I&T) Costs for Recent NASA Missions***

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# Introduction

- **Common practices:**
  - **Percentage of spacecraft hardware costs**
  - **Analogies to similar missions adjusted for mission specifics**
  - **Bottom Up Estimate (BUE)**
- **Objective is to develop a parametric CER from APL's historical data that calculates the total cost of I&T based on parameters**
  - **Parameters considered:**
    - **Number or type of instruments, number of spacecraft, year the mission launched, total mission cost, total hardware cost, etc.**

# Assumptions

## ■ **Cost Assumptions:**

- **Costs gathered by month from internal records**
- **Inflated to FY15\$ using NASA New Start Inflation**
- **APL missions used as the basis for the CER are:**
  - **NEAR, Contour, New Horizons, MESSENGER, STEREO, and Van Allen Probes**
- **Costs for I&T include:**
  - **Integration of the spacecraft subsystems and instruments**

# Assumptions *(continued)*

## ▪ **Points of Integration Calculation:**

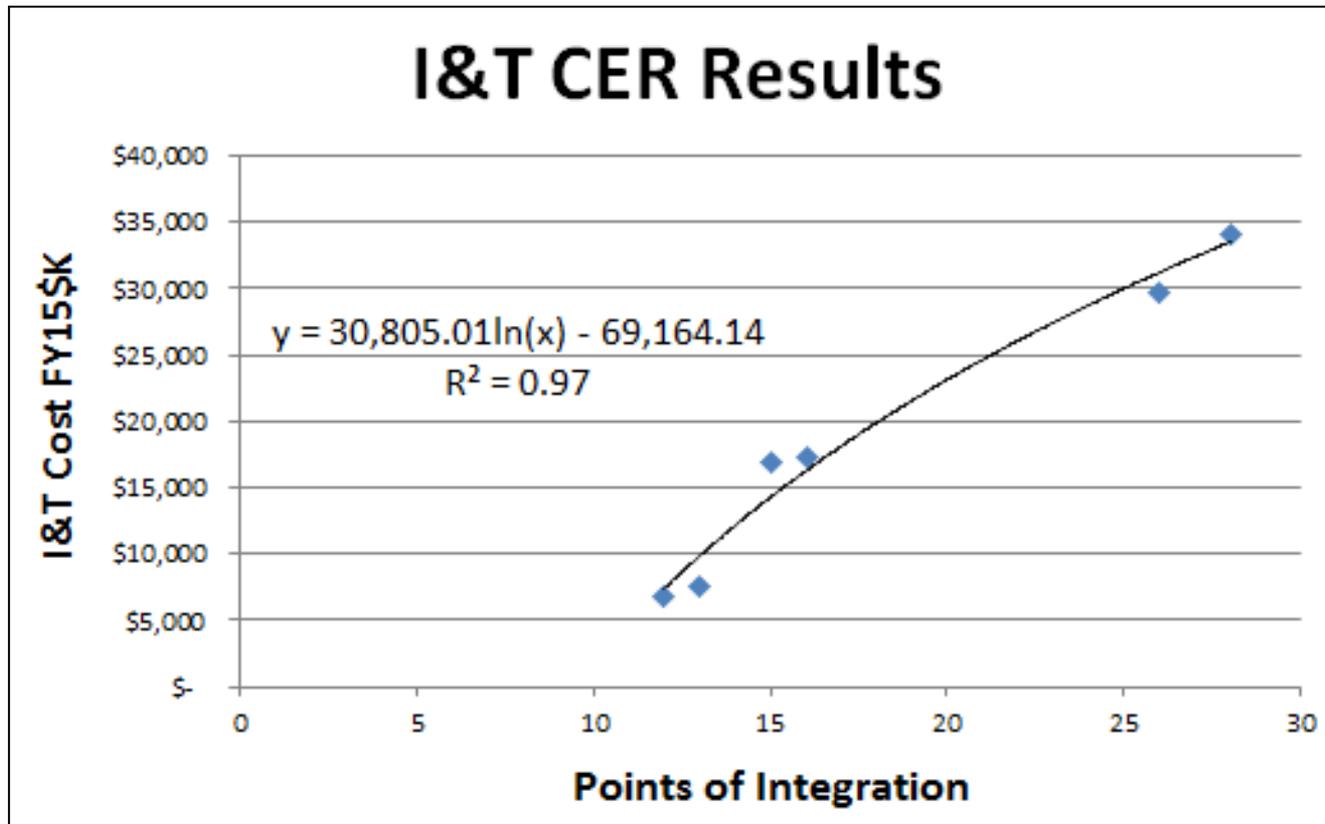
- **Count up the number of spacecraft subsystems across all spacecraft**
  - Excludes software and count PDU separately
- **Count up the number of instruments across all spacecraft**
  - Treat instrument suites as one point of integration
- **If spacecraft I&T costs are not bookkept with observatory I&T you can exclude their points of integration in the total count**

## ▪ **Example:**

- **STEREO (2 spacecraft)**
  - 18 Subsystems + 8 instruments = 26 points of integration

# Results

- The below chart shows the results of the regression analysis of the points of integration vs. cost



# Risk Analysis

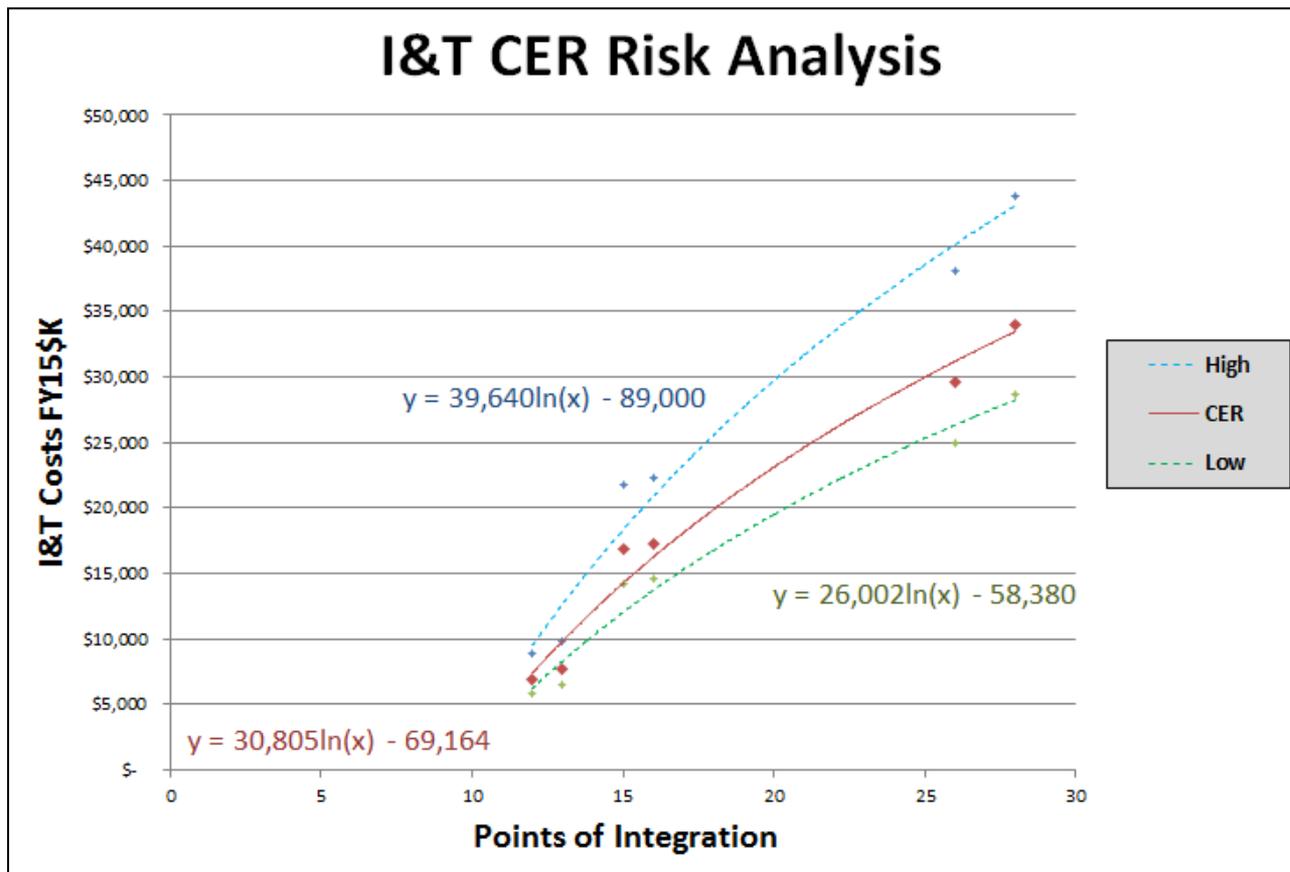
- Using the CER to predict the I&T costs for the historical missions shows the prediction error ranges of the CER.

| Mission          | Prediction Error |
|------------------|------------------|
| New Horizons     | -6%              |
| STEREO           | 5%               |
| MESSENGER        | -16%             |
| Van Allen Probes | -2%              |
| Contour          | 7%               |
| NEAR             | 29%              |

- As shown the CER is bounded by 29% and -16% on the extremes.
  - This information can be used to construct uncertainty ranges around cost generated by the CER.

# Risk Analysis (continued)

- The figure below shows the uncertainty ranges inherent in the CER.



# ***Conclusion***

## **▪ Further Investigations**

- Explore points of integration down to a lower level**
- Incorporate external missions**



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