Crash the schedule without crashing the project: Lessons learned on scheduling risk techniques

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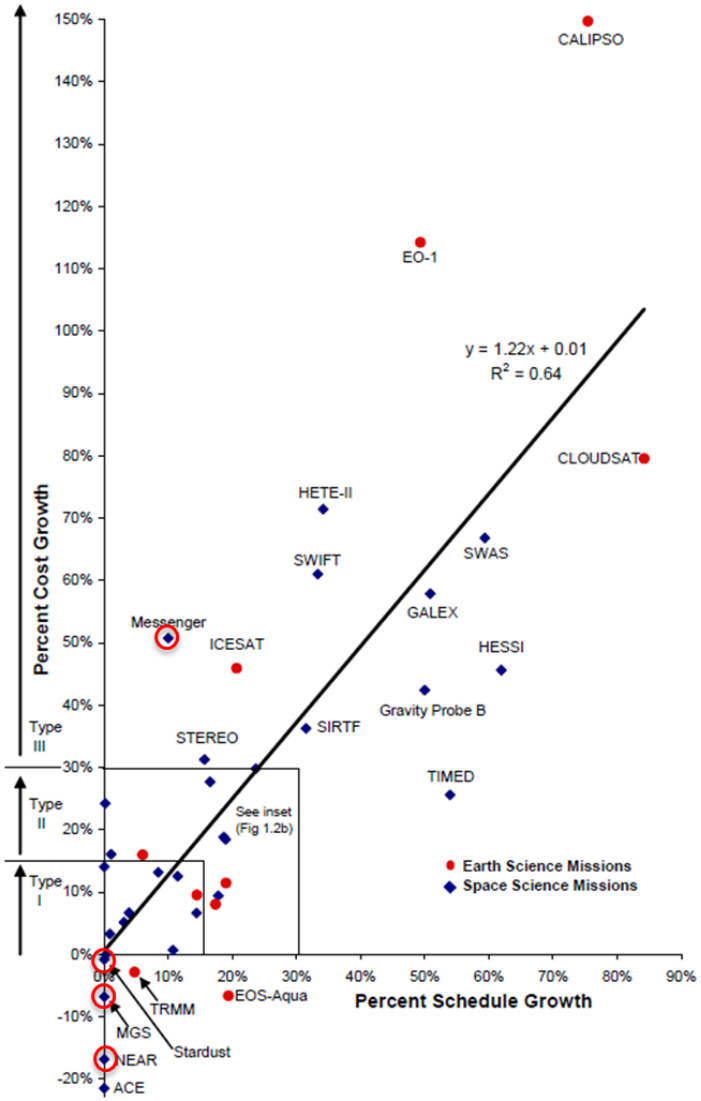
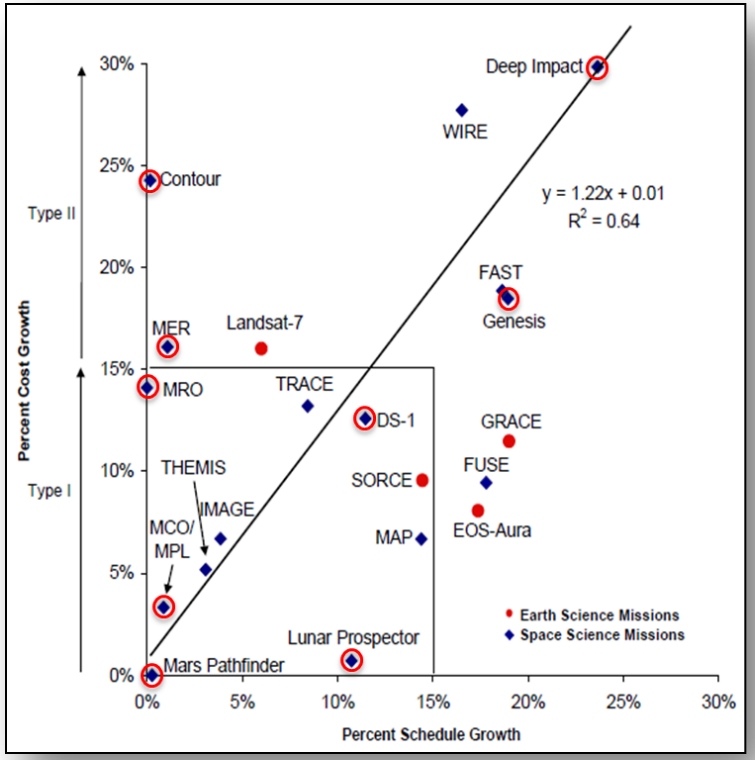
Background

- This presentation highlights unique JCL modeling techniques implemented by the Origins Spectral Interpretation Resource Identification Security Regolith Explorer (OSIRIS-REx) project at PDR
- OSIRIS-REx is a planetary mission intended to bring samples back from an asteroid for analysis
- Project faces a constrained 39-day launch window in 2016
- Initial JCL results indicated that while capable of meeting budget objectives, meeting the launch date was not feasible based on risk and uncertainties
- Failure to hit launch window would result in 18 months schedule for the next launch opportunity
- Utilizing a 2010 NRC study on Science missions to assess cost and schedule growth, the project realized that Planetary and “Earth orbiting” are categorically different with regard to growth experienced
- Most planetary missions are constrained to a specific launch window based on orbital mechanics.
- Typically, planetary missions respond to late-breaking technical issues through increasing resources to maintain schedule, as opposed to realizing schedule slip.

2010 NRC Study of Space and Earth Science Missions





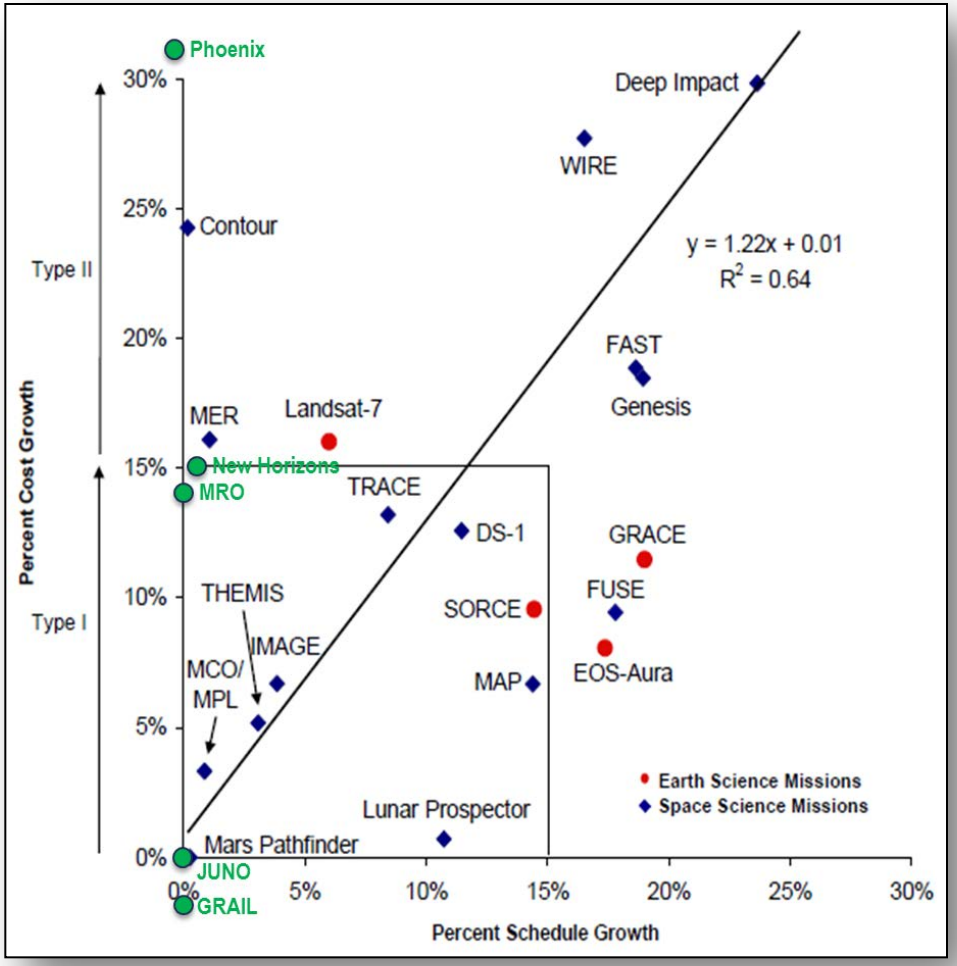
Planetary missions have been circled in red.

- Of the 40 sample missions, 13 (33%) are Planetary.
- All, except Messenger, are below 30% cost & schedule growth (Types I & II).
- 8 (62%) of the 13 Planetary are below 15% cost & schedule growth (Type I)
- 6 (46%) of the 13 Planetary no schedule growth at all

Reassessing Mission Selection

Superimposed OSIRIS-REx analogs in green

- Data extracted from CADRe
- LM-built Spacecraft
- Shows growth from PDR to Launch
- Excludes Launch Vehicle and Phase E
- Stardust & Mars Odyssey missing PDR CADRe
- 5 of the 6 are below 30% cost & schedule growth (Types I & II).
- 5 of the 6 are within 1% of the baseline schedule



JCL Schedule Modeling Approach

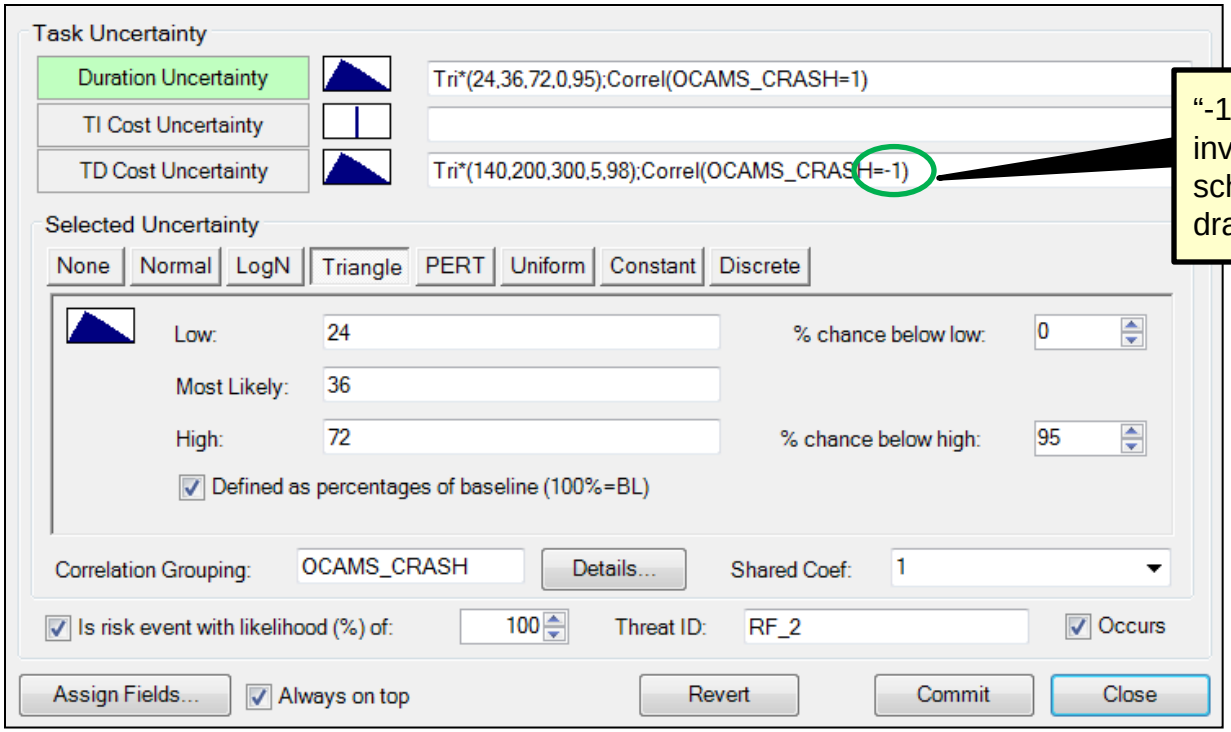
- The project used the traditional schedule risk method of applying uncertainty and risks to the schedule, which resulted in significant schedule growth
- The project then took an innovative approach to analyze mitigation options for compressing schedule by increasing resources
- The project applied mitigation to reduce durations for critical element tasks and ATLO by increasing the number of days and shifts worked
- The JCL model was constructed utilizing “Risk Factors”, additional resources and schedule duration compression were modeled with an inverse correlation

Uncertainty Distribution Range Calculations

- Schedule risk factors were applied through uncertainty for schedule durations
  - Low = go to 7 days from 5 days = 5/7 =~72% of remaining duration
  - Most Likely = double shift = 1 / 2 * 5/7 = 0.5 * 0.72 = 36% of remaining duration
  - High = Triple shift = 1 / 3 * 5/7 = 0.33 * 0.72 = 24% of remaining duration
- Cost risk factors were applied through uncertainty for TD cost rates to hammock tasks
  - Low = 7/5 = 140% rate
  - Most Likely = 10/5 = 200% rate
  - High = 15/5 = 300% rate
- Distributions are correlated at negative 100% so that a low duration draw (max compression) correlates to maximum cost burn rate
- Risk Factors were created for specific critical elements within the JCL model and not applied in a “peanut butter” fashion across the entire model

JACS JCL Modeling Methodology

- OSIRIS-REx utilized JACS to run the JCL analysis
- Below is a screen shot of how JACS was configured to capture schedule compression through increased resource utilization



"-1" represents an inverse correlation to schedule distribution draws during simulation

Primavera Risk Analysis
JCL Modeling Methodology

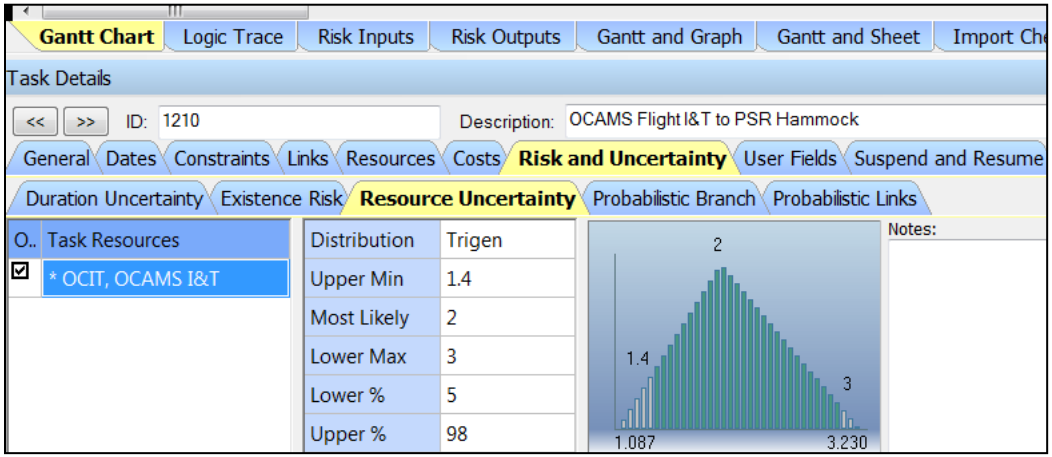
PRA "Risk Factors" utilized to apply schedule uncertainty for schedule compression

- Triangle distribution utilized with Trigen bounds to replicate JACS model
- Risk factor function was utilized for schedule durations only, can not be applied to hammock tasks for cost

Edit Risk Factors

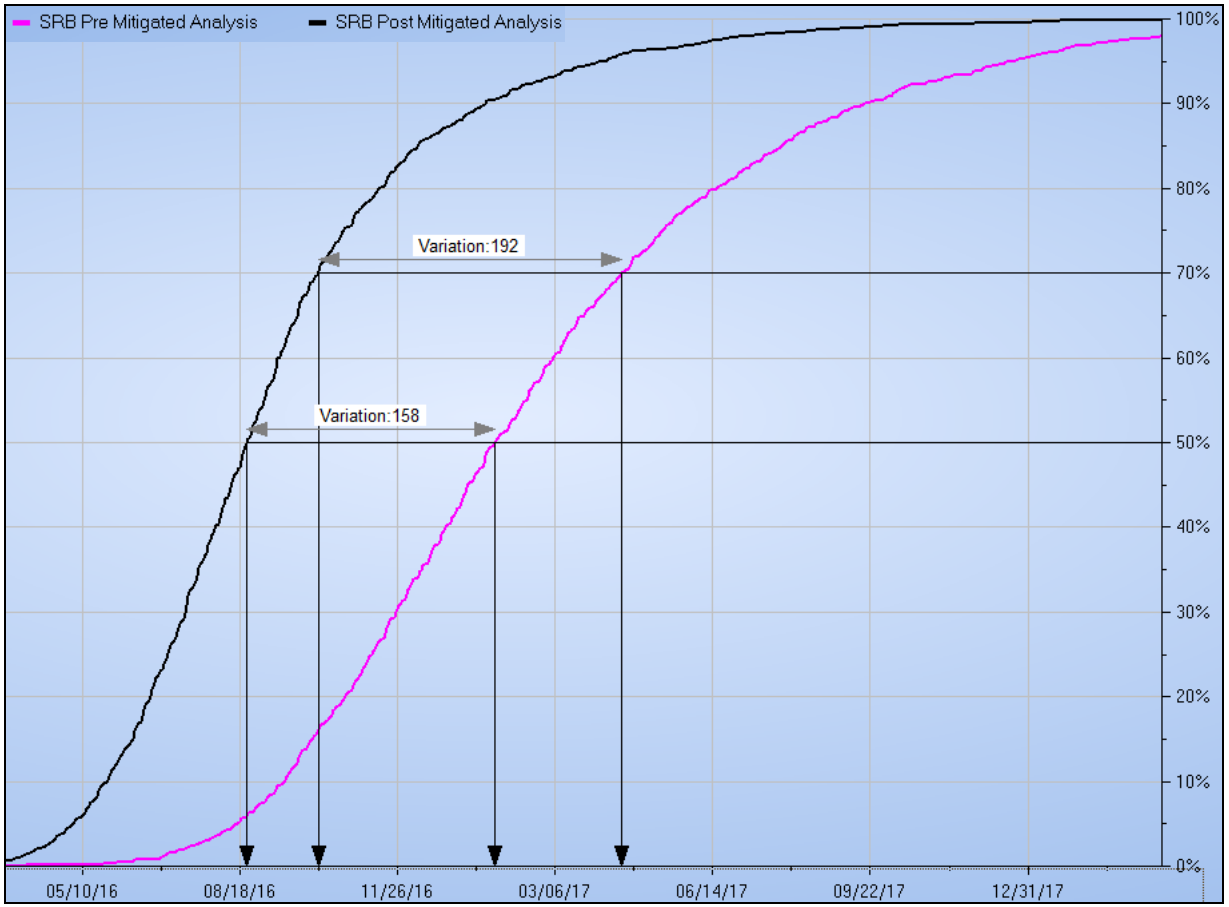
	Description	Dur Min	Dur Likely	Dur Max	Cost Min	Cost Likely	Cost Max	Likelihood
1.	Schedule	16.70%	36.00%	70.00%	100.00%	100.00%	100.00%	100.00%

- PRA Resource Uncertainty was utilized to replicate JACS modeling for increased resources



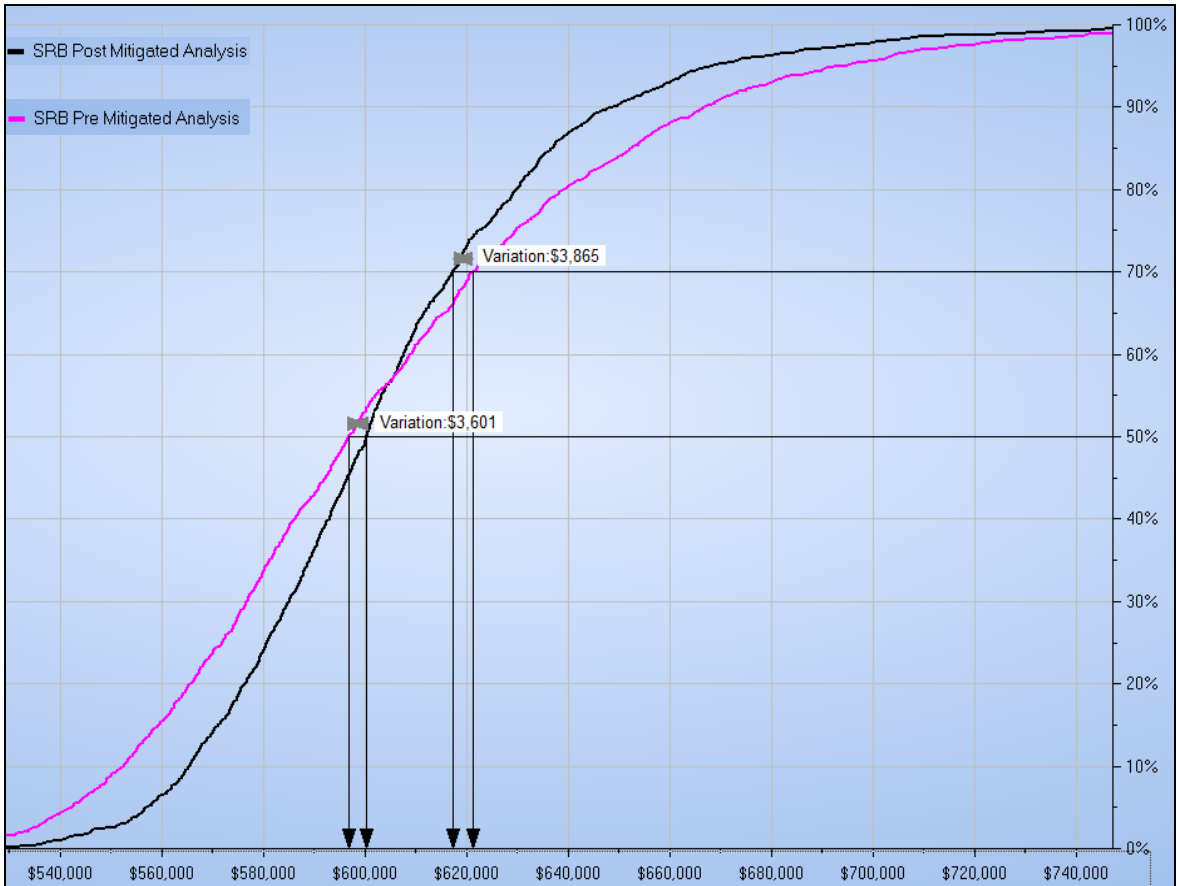
JCL Analysis Results – Schedule

- Pre-mitigated analysis resulted in ~6 month schedule slip to launch window
- The “schedule crash” mitigation approach modeled resulted in reduction of pre-mitigated schedule slip by ~6 months back to the required launch date



JCL Analysis Results – Cost

- By reducing key tasks within the schedule, the overall project duration is reduced, therefore minimizing total cost growth even with increased resource utilization applied
- Since schedule crash pertain to only a few key tasks driving the launch, increased resource costs only applied to specified areas



JCL Modeling Disclaimer

- JCL methodology utilizing modeling techniques was for analytical purposes, it does not necessarily reflect management's approach for the project
- The Project will manage by traditional planetary mission technique, e.g. application of reserves to protect delivery schedules, use of engineering models, schedule adjustments, overtime and multiple shifts as appropriate.
- This approach did not take into account resource availability and assumes additional resources will achieve schedule compression
- JCL modeling technique is to enhance management risk informed decision making capabilities, not a gospel truth

Lessons Learned

- Hammock tasks need to align with tasks schedule compression is being applied to
  - Initial modeling of hammocks stretched across the entire element and resulted in unrealistic cost growth
  - Unrealistic cost growth was due to increase resource utilization applied across entire hammock duration, not isolated to schedule compression efforts
- “Peanut butter” approach for compression is not beneficial from management decision standpoint
  - Application of this technique should be strategically applied in a manner consistent with program management approach
- Resource availability should be assessed to determine if feasible to increase shifts, manpower, etc.

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