Summary of Lessons from Previous PI-Led Missions: Studies and Assessments

Presentation to the New Frontiers 4 CSR Kickoff

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TMC Studies and Assessments

There are five lessons learned studies on the evaluation of Step 1 proposals and Step 2 CSRs that are available on the SOMA homepage. They are:

1) **Lessons Learned from TMC Review of Step 1 Proposals**
2) **Lessons Learned from TMC Review of Step 2 Concept Study Reports**
3) **Instrument Considerations for Pre-Phase A Proposals**
4) **Instrument Considerations for Step 1 and Step 2 Proposals**
5) **TMC Phase A Performance Study**

This is an update to the first 2 studies adding data and analysis from Step 1 and Step 2 evaluations completed between 2009 and 2017.

This presentation will only cover the lessons learned for Step 2 CSRs.

SOMA homepage - http://soma.larc.nasa.gov/

Step 2 Lessons Learned Study Update

Study Questions

What is the history of TMC Risk Ratings?

Are there common causes of major weaknesses?

Results

Conduct a review of formal records of more than 1000 proposals and concept studies retained by SOMA in the on-site archive library.

Step 2 Risk Distribution
Step 2 Major Weakness Trends and Common Causes

Step 2 Common Causes of Major Weaknesses (1 of 5)

The common causes of Major Weaknesses from 112 CSRs are summarized.

Step 2 Technical Major Weaknesses

Issues with requirements definition and flow down, overstated heritage, and inadequate plans for verification dominate the technical category

- Requirements - 18% of Technical major weaknesses are due to problems with requirements definition, traceability and flow down

- Verification – 13% are due to issues with inadequate plans for verification
  - CSRs with this weakness also often had a major weakness related to requirements, system complexity, or design maturity

- Heritage – 12% are due to issues with the implementation of heritage elements
  - Overstatement of the benefits of the heritage
  - Modifications of the heritage element is required but not adequately accounted for

Step 2 Common Causes of Major Weaknesses (2 of 5)

Step 2 Technical Major Weaknesses (continued)

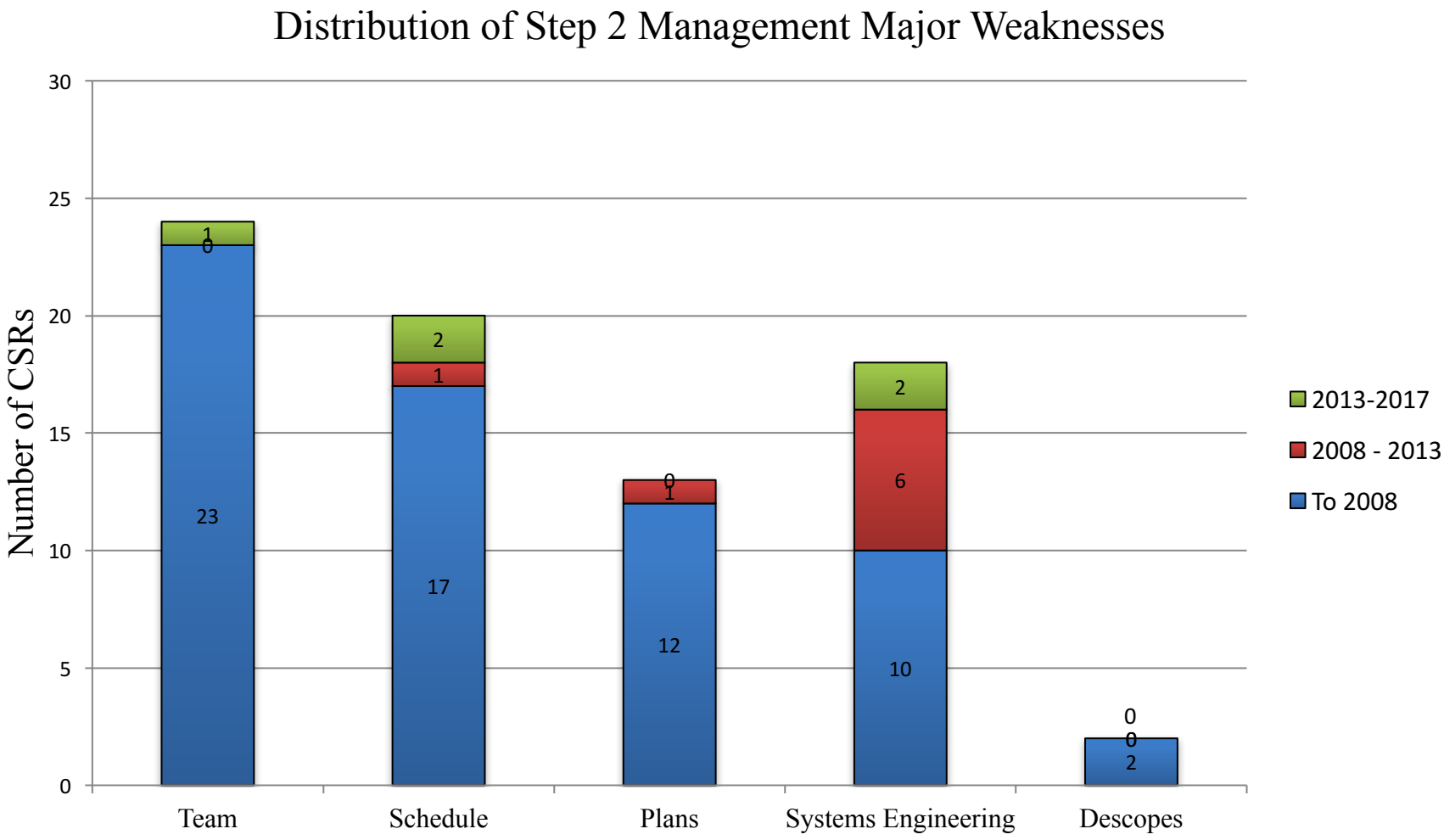
- TRLs – 9% are related to overstated TRLs or inadequate technology development plans
  - These are primarily instrument related
- Mass Margin – 7% are issues with mass margin
  - Mass margin major weaknesses still occur but less frequently than in Step 1
- Thermal – 7% are due to inadequate thermal design
  - These are primarily instrument related
- ACS – 7% are issues with attitude determination and control
  - Inadequate description of the pointing budget
  - Mismatch between hardware capability and required performance
- Optics or Focal Plane – 5% are related to the design and development of the instrument optics and focal plane
  - Overstatement of performance is often cited

Step 2 Common Causes of Major Weaknesses (3 of 5)

Step 2 Management Major Weaknesses

- 30% are issues associated with key individuals
  - Lack of relevant experience among core team
    - Many recent PM candidates proposed have good management credentials, but limited or no history of flight project accountability
  - Low time commitments for key members of the core team: Project Manager, Systems Engineer, Flight System Manager, Key Instrument Engineer, etc.
- 25% are schedule related major weaknesses
  - Inadequate or inappropriately placed schedule reserve
  - Missing key elements
  - Inadequate definition or missing critical path
- 16% are related to management plans
  - Key elements such as risk management are inadequate
- 23% are due to systems engineering
  - Often reflects lack of consistency among project elements
- 3% are due to descopes taking the mission below Threshold

Step 2 Distribution of Management Major Weaknesses*



*Includes only the most common major weaknesses

Step 2 Common Causes of Major Weaknesses (4 of 5)

Step 2 Systems Engineering Major Weaknesses

There are two primary sources of Step 2 Systems Engineering major weaknesses for evaluations completed after 2008 are:

1) The flowdown, traceability, completeness, consistency or stability of the top level mission or flight hardware requirements is flawed.

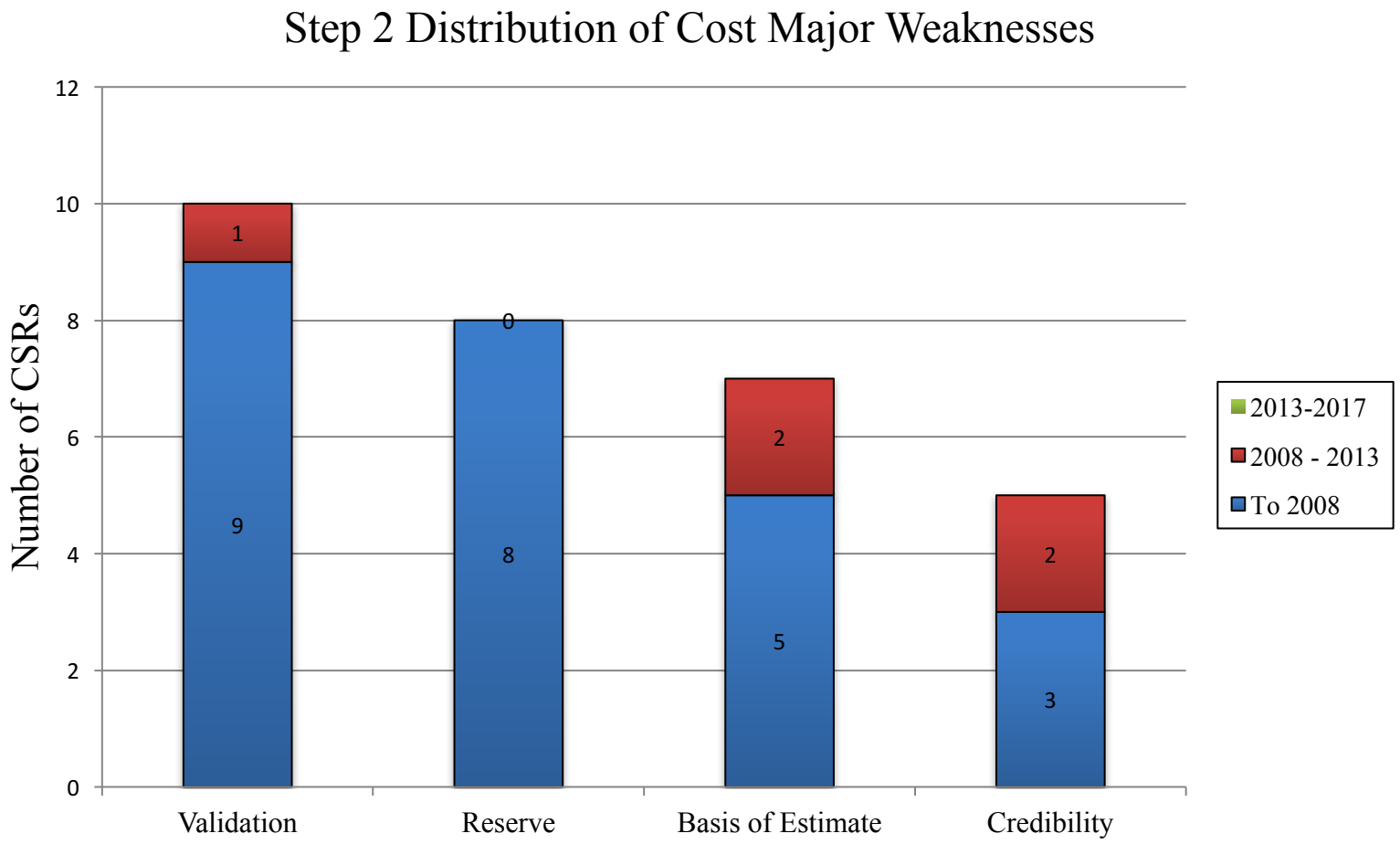
2) The Systems Engineering plans or approach, including clearly identifying the roles and responsibilities of the Project Systems Engineer are flawed.

Step 2 Common Causes of Major Weaknesses (5 of 5)

Step 2 Cost Major Weaknesses

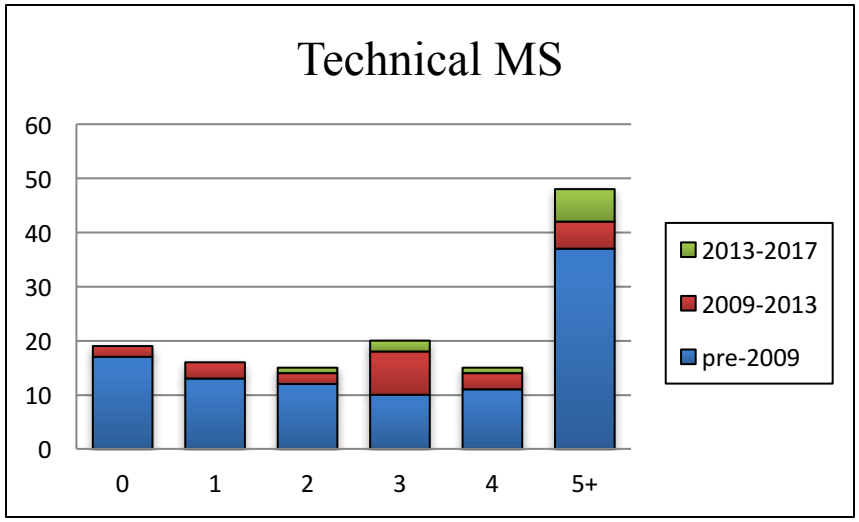
- 29 % are due to inadequate cost reserves
  - Increased definition in the design and implementation in Phase A often results in erosion of cost reserve
  - Cost reserve is often an issue in proposals with low maturity or overstated heritage
- 32 % are related to significant and unreconciled differences between the proposed cost and the independent cost estimates.
  - This is often associated with a dispute in the proposer's underlying assumptions in areas such as technical performance, TRLs, heritage, etc.
- 23 % are due to an inadequate basis of estimate
- 13 % are related to the credibility or relevance of the supporting cost data

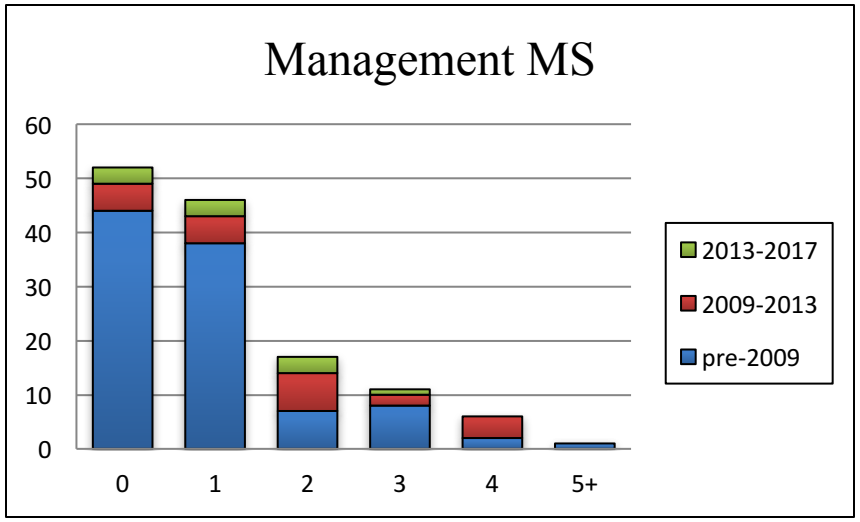
Step 2 Distribution of Cost Major Weaknesses*

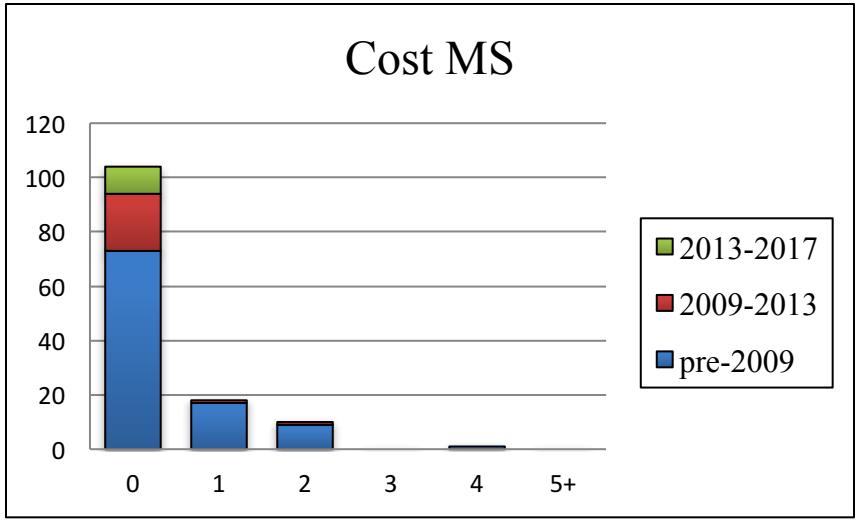


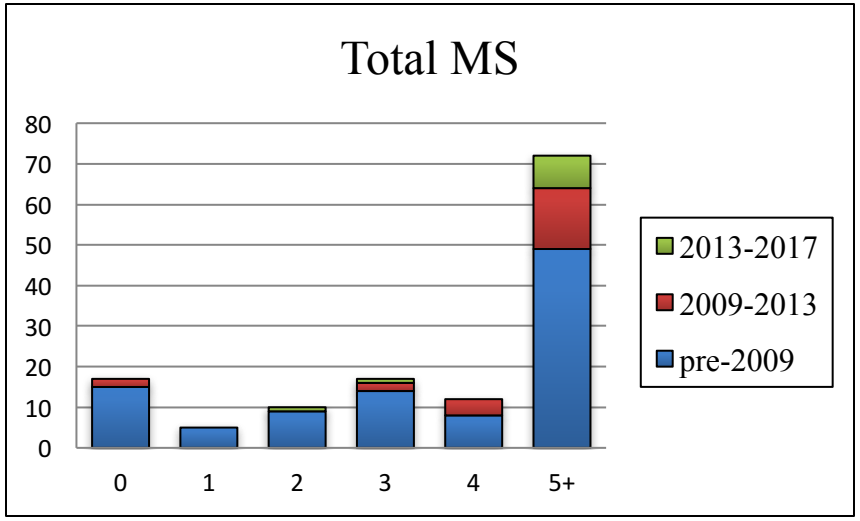
*Includes only the most common major weaknesses

Number of Proposals Versus Number of Step 2 Major *Strengths*









Summary

SOMA has directed the evaluation of more than 1000 proposals and concept studies submitted by PI-led teams since the office was formed. Are there other common causes of major weaknesses in TMC reviews? Yes! Certain types of weaknesses persist, specifically:

Overstated instrument TRLs (usually based on overstated heritage) or inadequate plans to demonstrate existing component technologies in newly integrated systems or operating in new environments. A related weakness is a missing or inadequate technology backup plan in the event that the TRL development efforts are unsuccessful.

Insufficient support for instrument performance claims that is usually combined with insufficient instrument design information to independently verify it's feasibility.

Proposed costs with their supporting BOEs could not be validated using independent cost models.

Inadequate management plans that usually include unclear or incomplete discussions of organization roles, responsibilities or lines of authority.

Development schedules that lack sufficient detail to verify their feasibility, have missing elements, allocate too little time for typical activities without sufficient rationale (e.g., AI&T), or have too little funded schedule reserve for the identified development risks.