Earth Venture Instrument

Earth Venture Instrument-1 Common Causes of Major Weaknesses

Outline

- Introduction
- TMC Evaluation
- EVI-1 TMC Evaluation
- Concluding Remarks

Introduction

The NASA Science Office for Mission Assessments (SOMA) has performed a study to determine the common causes of major weaknesses identified during the Technical, Management and Cost (TMC) Panel evaluations of proposals submitted to the Earth Venture Instrument (EVI) - 1 solicitation.

NASA intends to add to the database as the solicitations continue and to present results to the community prior to each solicitation. NASA is providing this service to assist the community in continually improving the quality of proposals.

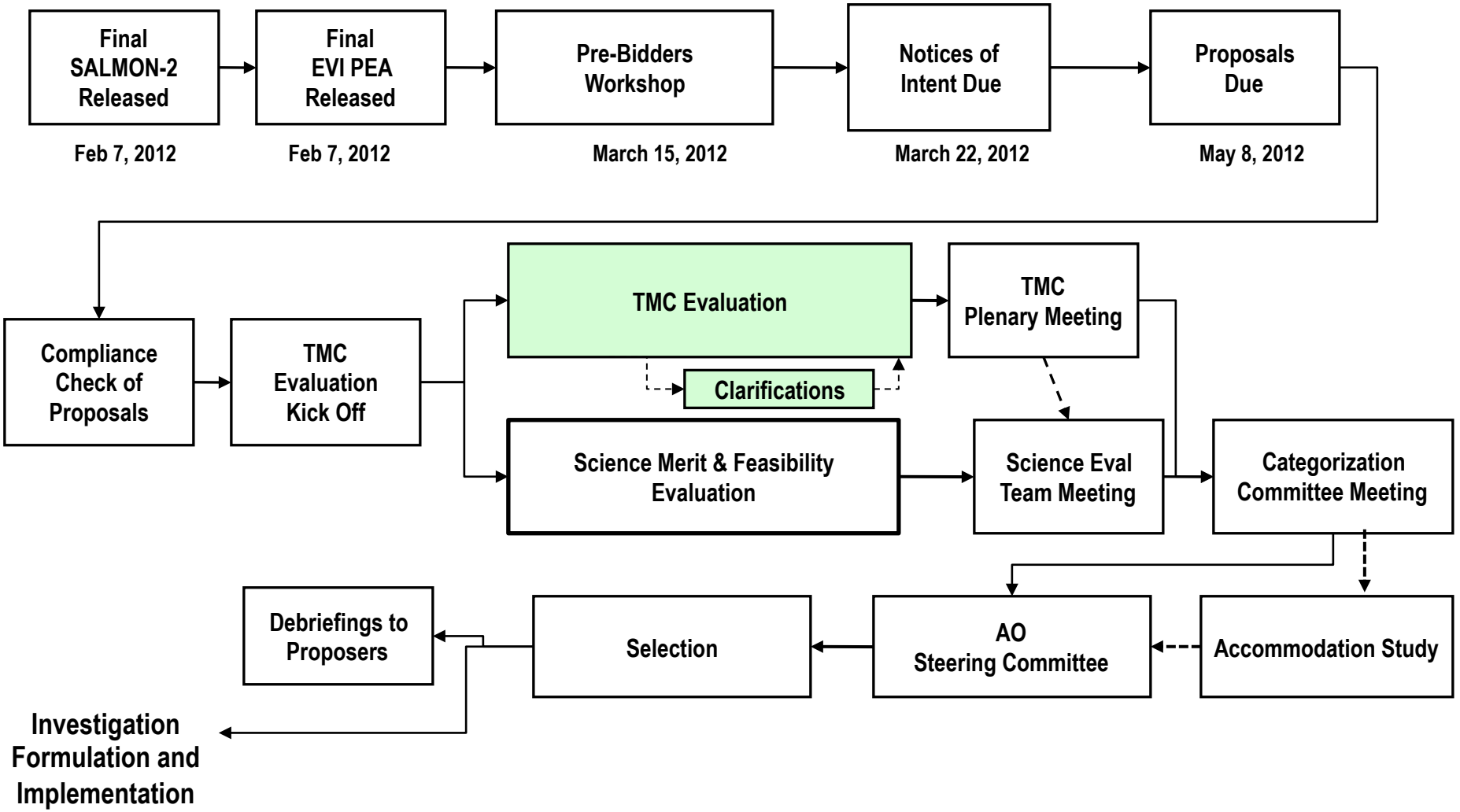
Introduction

EVI-1 was solicited via the Program Element Appendix (PEA) J of the Second Stand-Alone Missions of Opportunity Notice (SALMON-2) Announcement of Opportunity (AO).

TMC Feasibility of the Investigation Implementation, including Cost Risk evaluation criteria addressed in this presentation is found in Section 7.2.4 of the SALMON-2 AO and Section 6.1 of the EVI-1 PEA J.

TMC Evaluation: Evaluation Flow

TMC Evaluations are independent from the Science Evaluation



TMC Evaluation: Definition & Risk Ratings

The TMC Evaluation purpose is to assess the likelihood that the proposed investigations' technical and management approaches can be successfully implemented as proposed, including an assessment of the likelihood of their completion within the proposed cost and schedule.

Based on the narrative findings, each proposal will be assigned one of three risk ratings, defined as follows:

- **Low Risk**: There are no problems evident in the proposal that cannot be normally solved within the time and cost proposed. Problems are not of sufficient magnitude to doubt the Proposer's capability to accomplish the investigation well within the available resources.
- **Medium Risk**: Problems have been identified, but are considered within the proposal team's capabilities to correct within available resources with good management and application of effective engineering resources. Mission design may be complex and resources tight.
- **High Risk:** One or more problems are of sufficient magnitude and complexity as to be deemed unsolvable within the available resources.

TMC Evaluation: Findings

Major and minor strengths and weaknesses are defined as follows:

- **Major Strength:** A facet of the implementation response that is judged to be well above expectations and can substantially contribute to the ability of the project to meet its technical requirements on schedule and within cost.

- **Minor Strength:** A strength that is worthy of note and can be brought to the attention of Proposers during debriefings, but is not a discriminator in the assessment of risk.

- **Major Weakness:** A deficiency or set of deficiencies taken together that are judged to substantially weaken the project's ability to meet its technical objectives on schedule and within cost.

- **Minor Weakness:** A weakness that is sufficiently worrisome to note and can be brought to the attention of Proposers during debriefings, but is not a discriminator in the assessment of risk.

*Note: Findings that are considered "as expected" are not documented.

TMC Evaluation: Factors

TMC Evaluation Factors, as applicable to the investigation being proposed.

Criterion C: TMC Feasibility of the Investigation, Including Cost Risk:

- Factor C-1. Adequacy and robustness of the instrument implementation plan.
- Factor C-2. Adequacy and robustness of the investigation design and plan for operations.
- ~~Factor C-3. Adequacy and robustness of the flight systems.*~~
- Factor C-4. Adequacy and robustness of the management approach and schedule, including the capability of the management team.
- Factor C-5. Adequacy and robustness of the cost plan, including cost feasibility and cost risk.

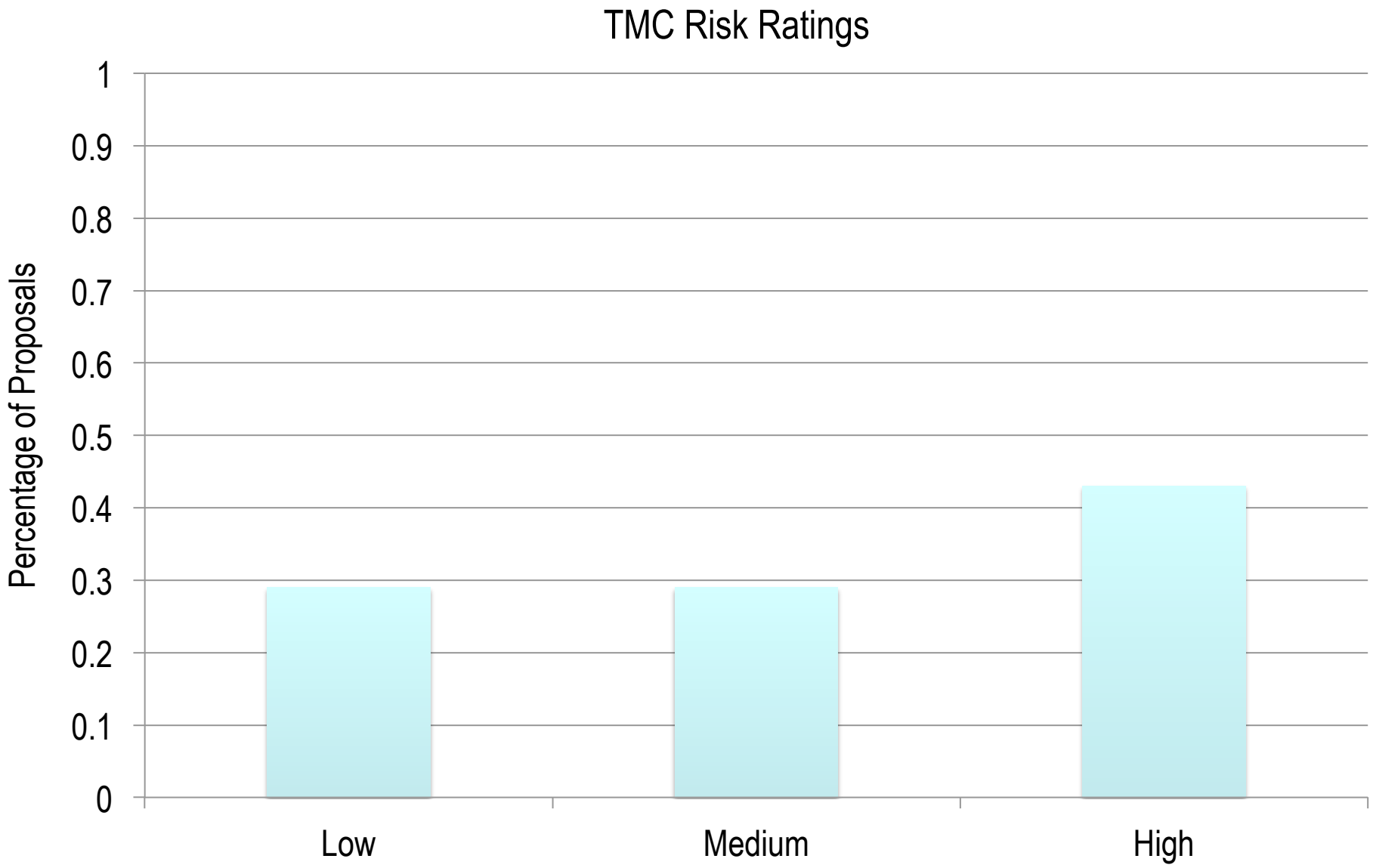
*Factor C-3 was not applicable to EVI-1

*EVI-1 PEA J does not modify the SALMON-2 AO Criterion C.

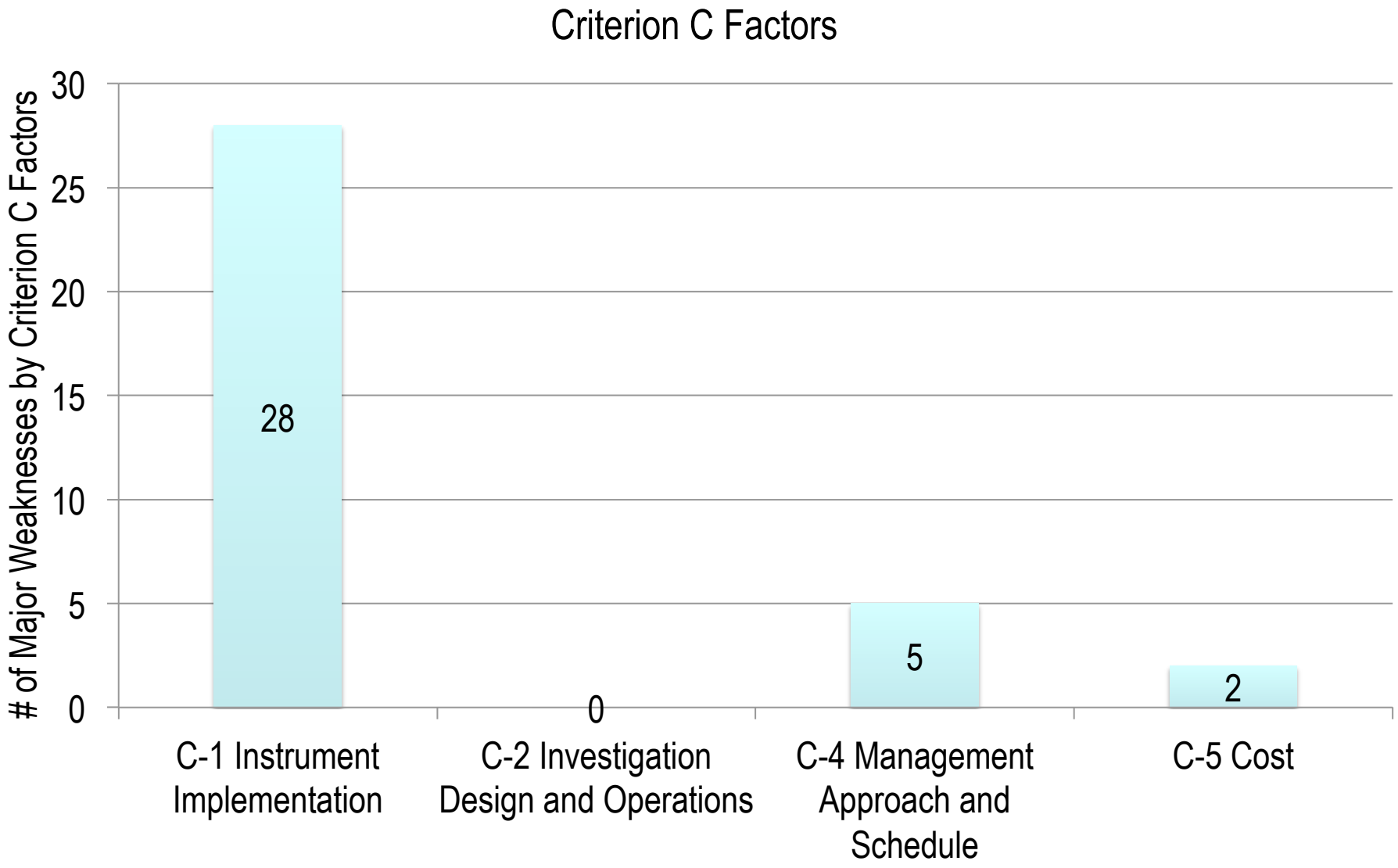
TMC Evaluation: Example Sub-factors

- **Instruments**
  - Instrument design
  - Design heritage
  - Environment concerns
  - Technology readiness
  - Hardware/Software design
  - Instrument systems engineering
  - Contingency
- **Investigation Design and Operations**
  - Science operations
  - Ground systems and facilities
  - Telecommunications
  - Investigation resiliency
- **Management and Schedule**
  - Roles, qualifications and experience of PI, PM and other key management members
  - Project management and systems engineering
  - Organizational structure and Work Breakdown Schedule (WBS)
  - International participation
  - Risk management, including mitigation plans
  - Project-level schedule, margins, and tools
- **Cost**
  - Basis of Estimate, Completeness, and Consistency
  - Cost risks and reserves
  - Application of heritage
  - Comparison with TMC estimates
  - Cost management tools

EVI-1 TMC: Ratings



EVI-1 TMC: Major Weaknesses



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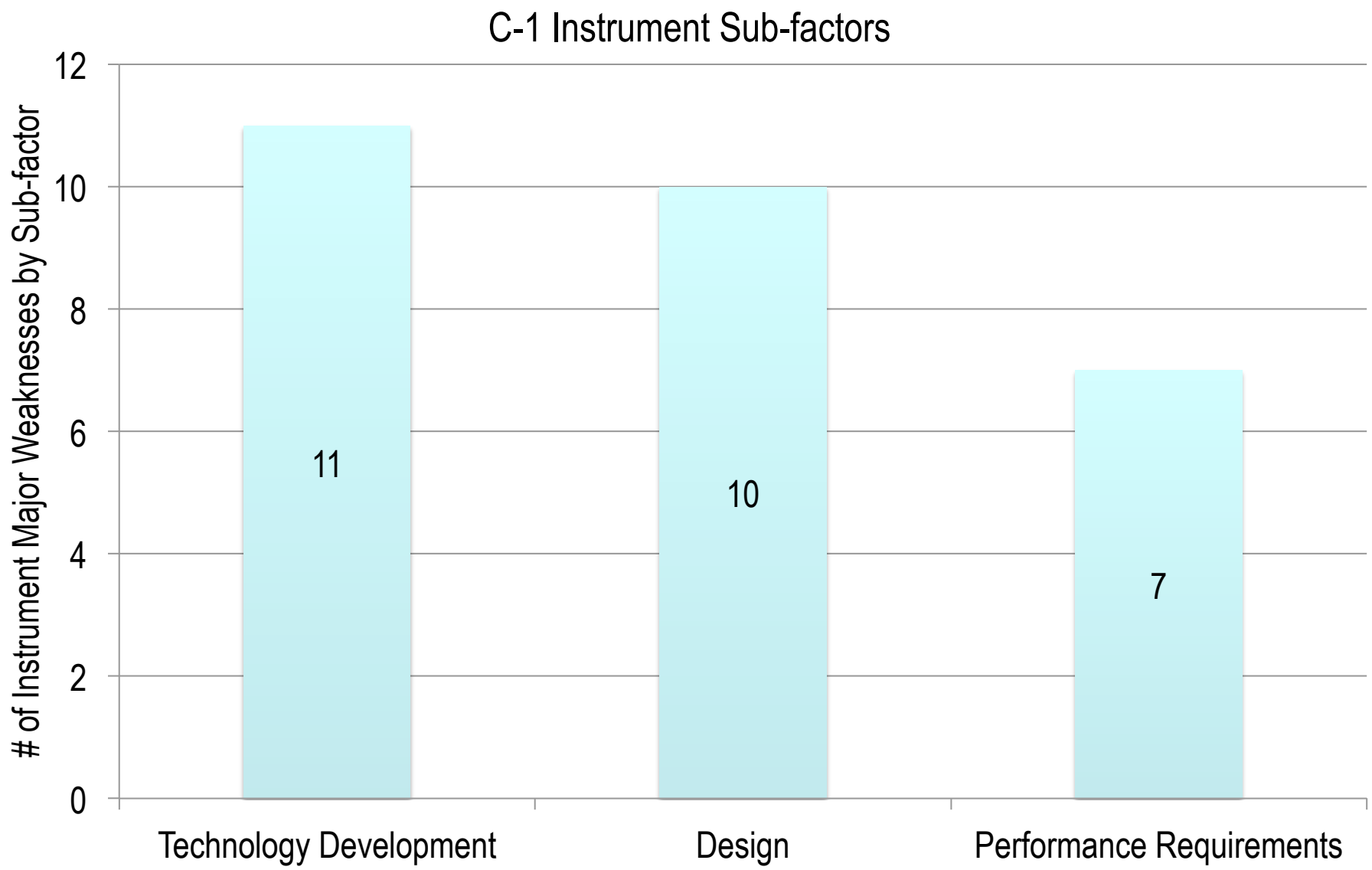

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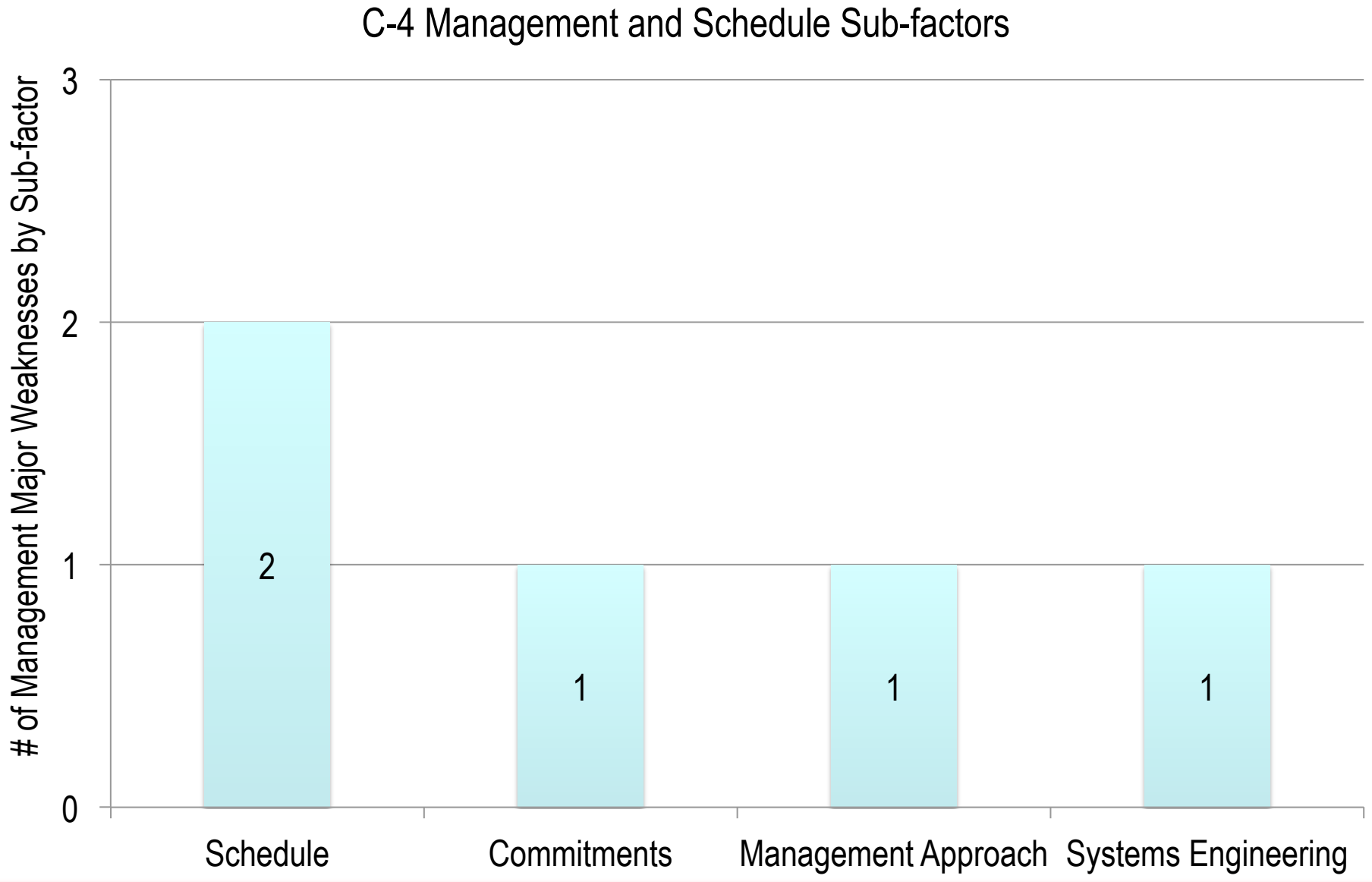

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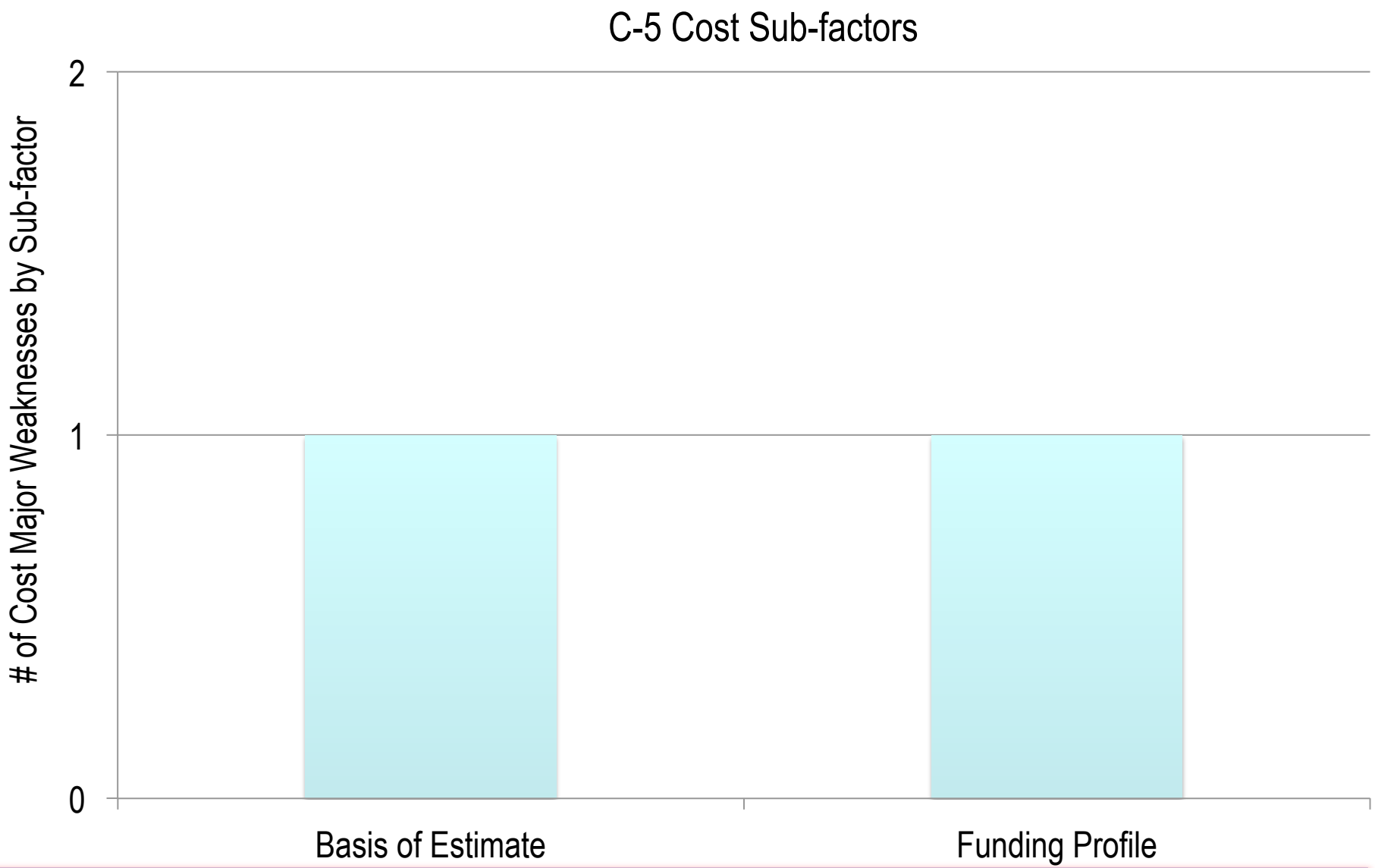

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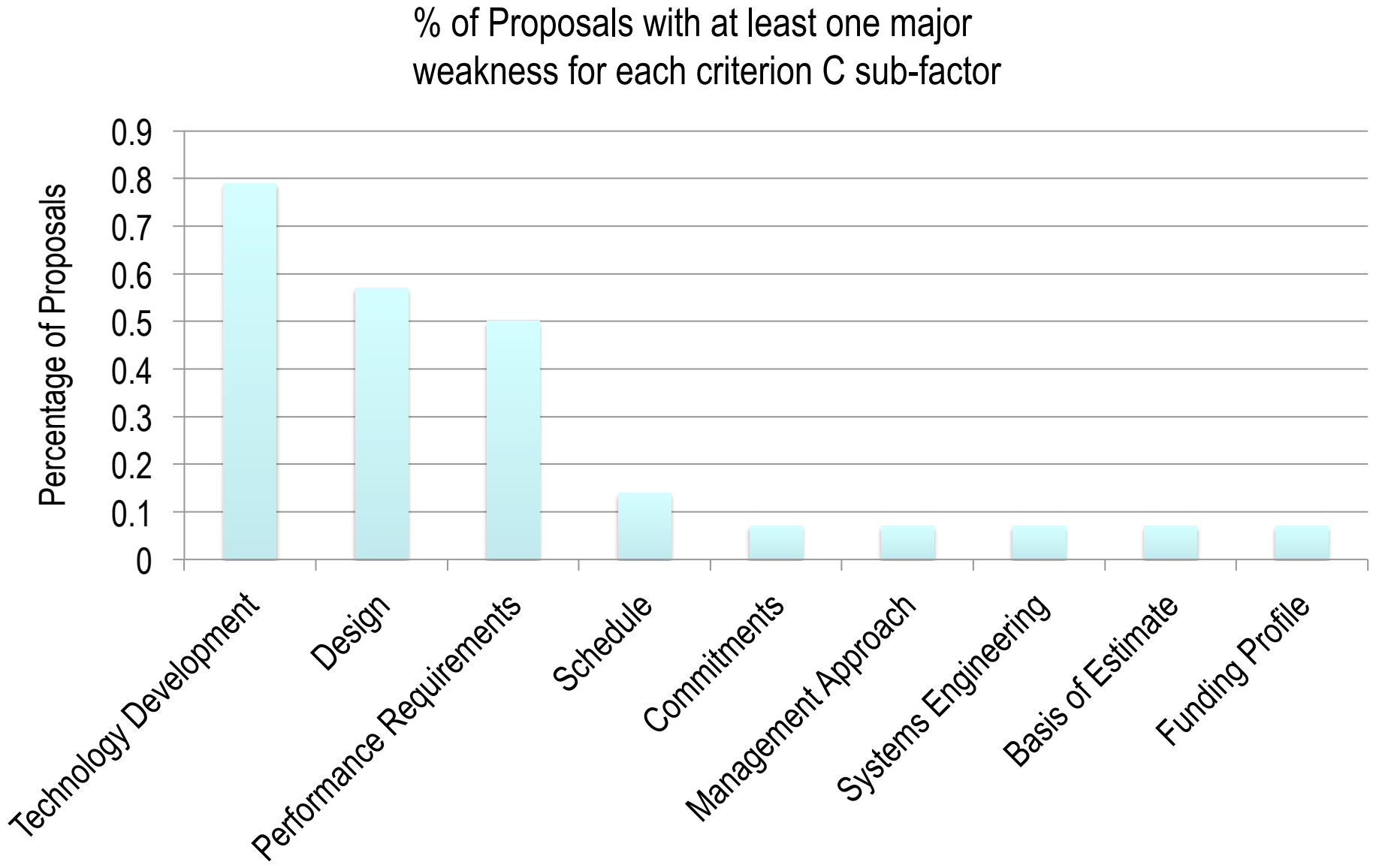

EVI-1 TMC: C1 Major Weaknesses

- Technology Development (SALMON-2 AO: Requirements 30, B-26, B-27, B-70)
  - Insufficient/inconsistent discussion for technology maturity claims
  - Lack of rationale for combining the Technology Readiness Level (TRL) values of components/subsystems to derive the full subsystem/system TRL
  - Does not substantiate heritage claims
  - Does not address testing in relevant environments
  - Does not compare test results to analytical predictions
  - Does not demonstrate that a system level TRL 6 will be accomplished by KDP-C
  - Insufficient discussion on development and schedule needed to advance to TRL 6 by KDP-C
  - Inadequate backup plans in case technology is not advanced to TRL 6 by KDP-C
  - Inadequate support for TRL claims of backup plans
  - Insufficient discussion of technology development risks
  - Inadequate proposed mitigations for technology development risks
  - Inadequate reserves to address mitigation of issues
  - Incomplete assessment of TRL for all critical components

Notes: Most common issues are those highlighted in red above. Applicable requirements encompass technology development and heritage requirements: SALMON-2 AO: 30, B-26, B-27, B-70

Requirement B-27 of the SALMON-2 AO references NPR 7120.8 for TRL definitions. The current set of TRL definitions are now in NPR 7123.1B, NASA Systems Engineering Processes and Requirements, Appendix E.

EVI-1 TMC: C1 Major Weaknesses

- Performance Requirements (SALMON-2 AO: Requirement B-15)
  - Performance requirements are missing, incomplete, or not clearly stated.
  - Performance requirements and predicted performance are not justified.
  - Performance requirements and predicted performance are not traceable to the science objectives and measurement requirements.
  - Performance requirements are not traceable to the data products.
  - Performance requirements in the Science Traceability Matrix (STM) are not quantitative.
  - Performance requirements may not be met by the proposed implementation.
  - Mission requirements are missing, unclear, or not traceable to science objectives.

Notes: Most common issues are those highlighted in red above. Examples of performance areas: Signal to Noise Ratio, spectral resolution, pointing, alignment, coverage, altitudes, field of view, swath width, etc.

EVI-2 PEA M Requirement M-25 supersedes Requirement B-15 (SALMON-2 AO).

EVI-1 TMC: C1 Major Weaknesses

- Design (SALMON-2 AO: Requirements B-23, B-24, B-26)
  - Performance predictions are not supported
  - Projected performance has no margins or insufficient margins
  - Inadequate support for claimed performance margins
  - Inadequate discussion of analysis to support the design
  - Instrument design description is inadequate
  - Insufficient discussion of heritage relevance
  - Unclear or undefined development effort in maturing the instrument

Notes: Most common issues are those related to performance, highlighted in red above. Many issues were related to the thermal system.

EVI-2 PEA M Requirements M-26 and M-27 supersede Requirements B-23 and B-24 (SALMON-2 AO), respectively.

EVI-1 TMC: C4 Major Weaknesses

- Letters of Commitment (SALMON-2 AO Requirement 84)
  - Unclear commitment by major partner

- Management Approach (SALMON-2 AO Requirement B-45)
  - Conflicting lines of authority

- Schedule (SALMON-2 AO: Requirements 26, 47, B-27, B-29, B-30)
  - Technology development is not supported by the schedule
  - Explanation for compressed development phases is incomplete
  - Explanation for unusual sequencing is incomplete
  - Significant events are missing

- Systems Engineering (SALMON-2 AO: Requirements 27, 28, B-45)
  - Lack of detail in processes described
  - Unclear/insufficient systems engineering management description

EVI-1 TMC: C5 Major Weaknesses

- Basis of Estimate (SALMON-2 AO: Requirements 55, 60, B-51, B-69)
  - Insufficient level of detail
  - Missing items in Master Equipment List

- Funding Profile (SALMON-2 AO: Requirement B-53)
  - Unjustified front loaded funding profile

Concluding Remarks

- The Common Causes of Major Weaknesses have been identified with the applicable SALMON-2 and PEA J requirements.
- A significant number of Major Weaknesses were identified under the Instruments TMC Evaluation Factor C-1. Factor C-1 major weaknesses largely involved technology development, design, and performance requirements.
- The Investigation Design and Operations TMC Evaluation Factor C-2 had no identified Major Weaknesses.
- NASA intends to add to the database as the solicitations continue and to present results to the community prior to each solicitation. NASA is providing this service to assist the community in continually improving the quality of proposals.