# Factors Contributing to Unsuccessful Re-Proposed Missions

Gillian R. Anteau
Jet Propulsion Laboratory
California Institute of Technology

Mentor: Dr. Lynne P. Cooper, Office 152
JPL Student Intern Program

Final Report
August 24, 2012

## 1.0 Introduction

JPL often re-proposes unselected missions after technology advancement and mission concept development. Feedback given as major and minor weaknesses and strengths in prior rounds are addressed in later versions of proposals. This feedback provides insight into the factors that affect perceptions of risk and value. My research involved an in-depth case study of an original mission, Mission-A, and the re-proposed mission, Mission-B, after a multi-year technology development effort.

In 2002, Mission-A was rated as Category III, with above average science merit (top score) and High Risk. To reduce risk, NASA invested technology development funds. In 2006 the re-formulated Mission-A mission, renamed Mission-B, was rated Category IV, good to very good science, and Medium Risk. While the risk rating improved from Mission-A to Mission-B, the overall results were worse, as shown in Table 1 below:

| | Mission-A | Mission-B | Change |
|---|---|---|---|
| Category | III | IV | Worse |
| Science Merit | Above Average | Good- Very Good | Worse |
| Science Implementation | Average | Good | Same |
| TMC | High Risk | Medium Risk | Better |
| Result | Received technology development funding | N/A | Worse |

Table 1. Comparison of Results for Mission-A and Mission-B Proposals

## 2.0 Background

My research project was undertaken because unselected missions are often re-proposed following technology advancement or concept development, but for various reasons are still not chosen to be implemented. I am examining how the potentially positive advances in technology and concept maturity affect the evaluation of a re-proposed mission.

A successful re-proposal would properly determine what factors were or were not addressed in the original mission after receiving de-brief comments from the prior proposal. A successful re-proposed mission should therefore lower risk by fixing the problems identified in the prior-proposed mission and raise the science merit score.

## 3.0 Objectives

1. Determine what problems led to the non-selection of the original mission using de-brief comments

2. Identify issues that led to the unsuccessfully re-proposed mission using de-brief comments
3. Compare the issues to determine if the re-proposed mission mitigated the problems with the original mission
4. Determine the components of the re-proposed mission that made it unsuccessful based on comparisons to the original mission de-brief comments and the new technology and concepts it presents

**4.0 Approach**

I conducted an in-depth study of Mission-A and Mission-B. I analyzed and assessed mission concepts relative to sponsor feedback to determine factors that affected perceptions of risk and value. In 2002 when Mission-A was proposed, it received funding for technology development. I started my analysis by making detailed, in-depth comparisons of the content in the Mission-A and Mission-B proposals in eight specific areas: science goals, science objectives, technology maturity, mission design, experiment design, instrumentation, cost, and mission schedule. My research answers the following question: Are there any insights we can gain as JPL is making its decisions for the next round of Discovery and New Frontiers re-proposals?

**5.0 Results**

After comparing the information collected from both proposals, I evaluated similarities and differences. Both missions had similarities relating to destination, landing site characteristics, cruise phases, EDL (Entry Decent Landing), and the lander system. These areas were similar enough that they did not impact my analysis.

Significant changes occurred, however, in three areas: science goals, instrumentation, and [operations], as shown in Table 2.

| **Area** | **Change** | **Rationale** | **Impact** |
|---|---|---|---|
| Science Goals | • Mission-B added goal […] | Opportunity | Mixed |
| Instrumentation | • Mission-B added [instrument] | | |
| | • Mission-B added [new system] | Redundancy Threshold Mission | Positive |
| | • Mission-B moved [location of instrument] | Simplify instruments and [special system] design | Negative |
| Thermal Drilling Operations | • Operations Method – A vs. Operations Method – B | | |

Table 2: Key Concept Differences between Mission-A and Mission-B

Mission-A and Mission-B addressed the same MEPAG science goals except that Mission-B added [one new goal]. Mission-B included [one new instrument], considered as a strength by

the NASA review board. The addition of the [Instrument] took advantage of the landing site and where the instrument would be directly inserted into the ice. The [Instrument] also received a weakness because reviewers were concerned [about meeting the science goal].

A [new system] introduced redundancy and guaranteed that the performance floor could be met if the [primary system] could not be deployed. The [new system] also provided a higher [scientific] analysis due to a decrease in the chance of [potential astrobiological contamination]. Table 3 below contains information unique to both mission [special systems]:

[Deleted due to Competition Sensitive Information]

Table 3. Comparison of Mission-A and Mission-B drilling systems

The most significant change from Mission-A to Mission-B was the movement of [instruments to new location]. This resulted in a major change to [operations]. [Deleted due to Competition Sensitive Information].

The movement of [the instruments] introduced [new] issues that resulted in weaknesses given by the NASA review board. [Details deleted due to Competition Sensitive Information]

### 5.1 Science Objectives and Instrumentation

[Detailed discussion deleted due to Competition Sensitive Information]

| Mission | Science Objectives |
|---|---|
| Mission-A | 1.<br>2.<br>3.<br>4. |
| Mission-B | 1.<br>2.<br>3. |

Table 4. Comparison of Mission-A and Mission-B Science Objectives
[Details deleted due to Competition Sensitive Information]

The graphs below describe [key differences] in Mission-A and Mission-B:

Table 5. Comparison of Mission-A and Mission-B Instruments
[Details deleted due to Competition Sensitive Information]

Table 6. Comparison of Mission-A and Mission-B [systems]
[Details deleted due to Competition Sensitive Information]

## 6.0 Discussion

I had originally expected the reason for the Mission-B proposal being unsuccessfully re-proposed would be due to technology development issues, but the primary issue with Mission-B [related to science and contamination issues]. Mission-B mitigated the problems with the [key

technology] in the Mission-A mission through technology development, but introduced new problems involving science merit. Overall, the science was too risky because of a multitude of contamination issues. The technology weaknesses were reduced but there was a significant increase in science weaknesses due to contamination issues. [Details deleted due to Competition Sensitive Information]

**7.0 Conclusions**

The cause of Mission-B's reduction in risk rating, is the redundancy [details deleted due to Competition Sensitive Information]. A major strength of Mission-A was its well-focused science instrumentation. [Details deleted due to Competition Sensitive Information]

Based on the results of my research, the primary factor contributing to this unsuccessfully re-proposed mission was the high risk and probability [contamination issues]. This is the reason why the science merit of Mission-B received a lower rating than Mission-A. Mission-B did advance the technology of the [critical system], but also introduced more risk to […] overall science return. [A] reviewer statement […] raise[d] the question of how do you know what level of science is sufficient for the success of the mission? The reviewer comment indicates that it may have been better if Mission-B had not included [several instruments], rather than moving them [to a new location]. In this particular case, would this mission have been more successful if the [science] was entirely excluded rather than potentially simplified?

Science and technology are intertwined and cannot be focused on separately, but must be considered jointly. These research findings can be applied to other missions by appropriately addressing the de-brief comments and ensuring that the re-proposed mission reduces and discusses risk, includes redundancy, and is set to accomplish the primary science goals accurately and reduce the chance of sample contamination to ensure mission success. If a mission knows the boundaries of its science and how the technology can be appropriately integrated, it has a much higher chance of being chosen for flight.

**8.0 Acknowledgements**

This research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, and was sponsored by the JPL Student Intern Program and the National Aeronautics and Space Administration. I would like to thank Dr. Lynne P. Cooper for her help, support, and guidance throughout the duration of my internship. A special thank you also to Randii Wesson for providing me with knowledge about JPL and the universe and Mike Hecht's contribution to the proposals studied in my research. My final act of gratitude goes out to The Brick House for continual support, helpfulness, and comedy.

**9.0 Bibliography**

1. Mission-A Proposal
2. Mission-B Proposal
3. NASA De-Briefings