The Space Science Decadal Surveys: Lessons Learned and Best Practices

A Summary for the ESAS Steering Committee

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About the Study

- Follow-on to the November 2012 Workshop "Lessons Learned in Decadal Planning in Space Science"
- Collects lessons learned from planetary, heliophysics, astronomy & astrophysics, and Earth science experiences with decadal surveys and mid-term assessments
- Written with future survey committees in mind
  - "Handbook" approach
  - Time-ordered discussion with collection of lessons learned and best practices as an appendix

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Chapter 1: *Introduction to Decadal Surveys*

A 'Short Course' in Decadal Surveys
Decadal Survey Structure and 'Moving Parts'
The Statement of Task of a Decadal Survey

Chapter 2: *Decadal Survey Process*

Mission Formulation
Science & Mission Prioritization
Suggested changes in the Prioritization Process
The "blackout problem"
The CATE process

Chapter 3: *The Decadal Survey Report*

The Existing Program
The Survey's Recommended Program
– Advice to Agencies
– High Profile Missions
Communication of the Decadal Program

Chapter 4: *Implementing the Decadal Survey*

Decision Rules
Stewardship – SSB & other tactical advice
International Activities
Interagency Issues

Near-term Considerations for Earth Science Decadal

- Budget
  - Historical vs. aspirational
- CATE
  - How many, how detailed, & why
- Mission Recommendations
  - Reference Missions vs. Implementation Recommendations
  - High-Profile Missions & need for clear communication of intent, decision rules
- Interagency Challenges

Budget

"Because budget uncertainties seem inevitable, a best practice might be to replace the extrapolations of a current or newly released budget with a baseline that reflects longer-term funding levels for NASA SMD and relevant partner agencies such as NSF and NOAA. Surveys could then build in budget scenarios that "trend-up" and "trend-down" over the decade, as alternatives to the nominal, "baseline" plan they have provided. Greater stability in agency budgets for science would be wonderful, but intentions of the executive branch and congressional priorities seem to guarantee fluctuations as large as 20 percent over a few-year timescale. It seems unwise to base a survey program on a budget run-out for a decade by primarily relying on what has happened only in recent years or on the latest projections of executive or congressional priorities. "

CATE

Lesson Learned: CATE involves assessment of a single point design to assess cost and technical risk. It is most useful as a reasonableness check on what is being recommended. Details used to support the CATE analysis are not necessarily indicative of how a mission will ultimately be implemented.

Best Practice: The survey committee can choose, and subsequently identify in its report, the role of the CATE in the survey. The CATE could provide, for example, a best-possible cost estimate for a point design or an independent, rough estimate for comparative purposes.

Best Practice: To prevent the CATE analysis from unnecessarily "driving" the decadal survey process, survey committees can consider implementation of a two-step CATE in which rough technical readiness and risk assessment feedback (accurate to a factor of two or three) would be provided for most, if not all, concepts early in the survey process. The more detailed and comprehensive CATE analysis (as used in recent surveys) would be reserved for those concepts that the committee identifies as worthy of further study.

Mission Recommendations

"In some communities, implementation is not separable from science goals, while in others the science goal takes precedence and might be implemented in a variety of ways."

Lesson Learned: The tendency to over-define mission concepts in pursuit of more accurate cost evaluation can stifle creative approaches to addressing survey goals.

Mission Recommendations: Lower Cost & Competed Missions

Best Practice: The practice within decadal surveys of not defining specific NASA mission concepts for lower cost and competed missions, yet recommending that such missions address priority decadal survey goals and objectives, allows flexibility to leverage innovative implementation approaches

Mission Recommendations: Reference Missions

Best Practice: Decadal surveys can present their implementation strategies as *reference missions*—that is, a credible hardware configuration that can achieve the science goals and is sufficiently defined for robust cost evaluation—instead of blueprints for detailed implementation.

Best Practice: It is desirable that the survey committee determine, as early in the process as possible, how robust a mission concept needs to be to provide sufficient cost certainty. An example is an ambitious mission where the survey committee needs to know—with reasonable confidence—that a mission team will be able to propose a credible design that meets science requirements and fits within the cost cap for the mission class.

Mission Recommendations: High-Profile Missions

- Facilities and missions with the potential to have large-scale impacts on the program due to their strategic importance, scope, and/or size; Tend to be performance-driven rather than cost-constrained

"A best practice for future surveys is to give greater attention and added care in assessing and recommending potentially "discipline-disrupting" programs. A thorough and rigorous CATE process can help, but too often the true cost of such a mission cannot be well established until the program is well underway. Surveys can provide clear decision rules and decision points that will effectively establish cost caps, with the intent of triggering reconsideration of the mission and the possibility, or necessity, of rescoping its science capability."

Best Practice: When recommending high-profile missions, survey committees are advised to explicitly state which aspects of the project are essential to retaining the mission's consensus priority and which can be further considered during design development to enable cost control.

Interagency Challenges

"…some agencies have considered the surveys to be aimed primarily at NASA's flight program, much like the congressional perspective. As such, some agencies have not been inclined to support the planning or funding of the decadal process, nor have they embraced the recommendations made to them as part of the decadal survey plan.

Decadal surveys are exercises in which the relevant scientific communities develop a consensus about what the United States should accomplish over the next 10 years. This is advice given on behalf of the entire community, not just a portion (i.e., the NASA-supported portion) of the discipline. This advice cannot be truly effective if agencies—whose participation is essential for implementation—are not consulted, do not participate, and do not feel the need to respond to a survey's recommendations…"

Best Practice: *Participation by all relevant agencies is optimized when decadal reports include specific descriptions of the types of interagency collaboration that the decadal survey committee finds desirable.*

Interagency Challenges: Earth Science

- Three sponsors
  - Uneven role/usage of survey in agency plans/priorities
  - Uneven language in statement of task reflecting this
- Communicating & managing expectations of sponsors *and* stakeholders is critical