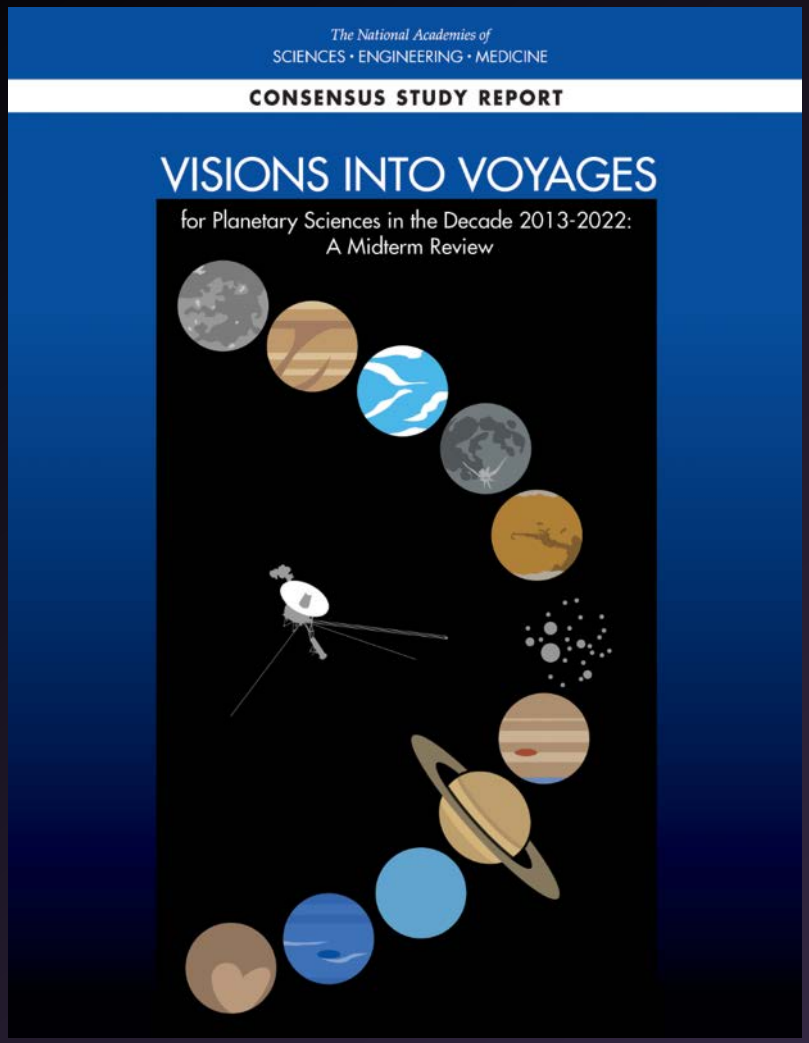


Committee on the Review of Progress toward Implementing the Decadal Survey Vision and Voyages for Planetary Sciences

(AKA **the Planetary Decadal Midterm Review**)

Louise M. Prockter

Co-Chair

NAS Planetary and Astrobiology Decadal Survey Steering Committee

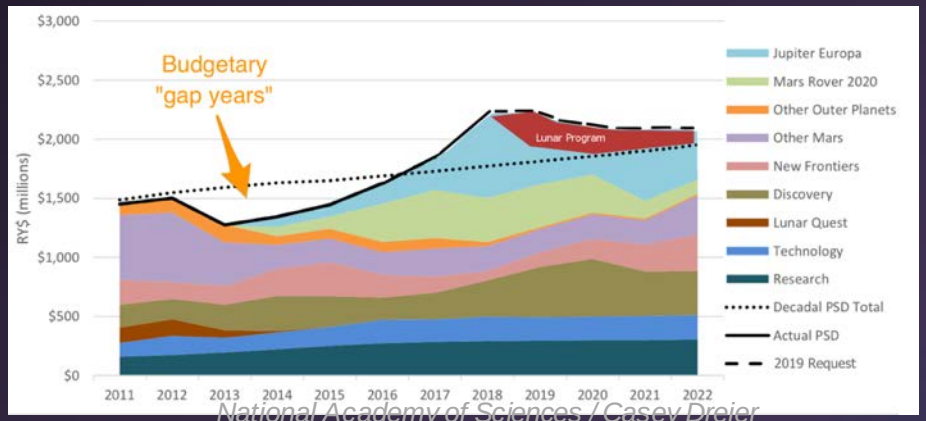
October 16, 2020

Outline

- Introduction
- Key issues
- Preparing for the next Decadal panel
- Other considerations

The 2013 Planetary Decadal Survey

- Vision and Voyages (V&V) recommended a balanced program of solar system exploration, across mission types and mission targets
- The main recommendations of the 2013 Planetary Decadal were:
  - Increase R&A at 5% above inflation at the beginning of the decade, and at the inflation rate every year beyond that
  - Invest 6-8% of the budget in technology development
  - Fly Discovery missions every 2 years if possible
  - Select two New Frontiers missions this decade, if possible
  - Initiate a Mars sample return mission this decade
  - Fly a Europa mission if certain conditions were met
- Several budget scenarios were envisaged; in reality, the budget at the start of the decade was lower than the worst-case scenario



Mid-term Review
Statement of Task summary

- Describe new science, technical advances, and relevant programmatic changes
- Assess how the current PSD program is responsive to the Visions and Voyages (V&V), and other related NAS reports
- Assess NASA's progress in realizing the program and in maintaining program balance
- For Mars, assess
  - Whether the Mars exploration architecture is responsive to the V&V and related reports
  - Whether the long-term program goals and science return can be optimized under the current budget
  - The Mars exploration architecture with respect to efforts by international partners
  - Whether the Mars exploration architecture represents a balanced mission portfolio
- Recommend actions to optimize science value, taking into account new discoveries
- Provide guidance on the mission portfolio and decision rules for the remaining half decade
- Recommend actions that will prepare for the next decadal survey, including community discussion, potential missions, programmatic balance, and potential mission concept studies

Committee

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Study Director

Committee Meetings

Meeting # 1: May 4-5, 2017
Keck Center, Washington, D.C.

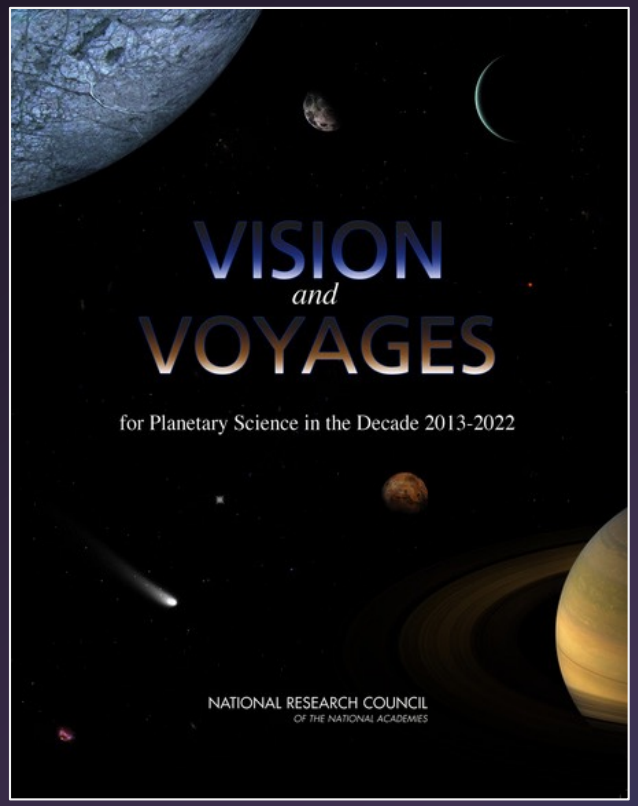
Meeting # 2: July 11-13, 2017
California Institute of Technology, Pasadena, CA

Meeting # 3: August 28-30, 2017
Woods Hole, MA

Meeting # 4: November 29-Dec 1, 2017
Beckman Center, Irvine, CA

Meeting # 5: February 26-28, 2018
Washington, DC

***Delivered**: July 2018*
***Release:** August 2018*



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Key Issues

- R&A and Technology spending
- Cadence of competed missions
- Adding Ocean Worlds to New Frontiers
- Mars 2020 – does it meet the decadal guidance?
- Europa Clipper – does it meet the decadal guidance?
- Are the above programs on budget/schedule, or do they pose a risk to programmatic balance?
- Europa Lander
- What is the status of the Mars Exploration Program?
- The “focused and rapid Mars sample return” proposal

Key Issue:
R&A and Technology Spending

Research and Analysis

Recommendation: NASA is largely following or exceeding the V&V-recommended levels of R&A and technology spending. It should continue to make these critical investments

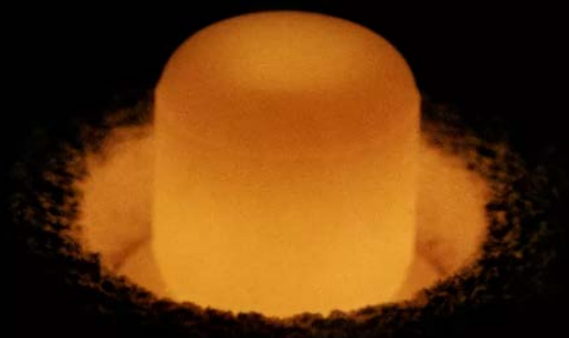
Recommendation: The next decadal survey committee should work with NASA to better understand the categorization and tracking of the budget for each of the R&A program elements, specifically providing insight into the budget for (1) Principal Investigator (PI)-led, competed, basic research and data analysis; (2) ground-based observations; (3) infrastructure and management; and (4) institutional or field center support

Also, the next decadal survey should be unambiguous when stipulating programs and recommended levels of spending

Technology Research and Development

Recommendation: NASA should continue to work closely with the DoE to ensure that the schedules for Pu-238 and clad production and the development of the MMRTG are maintained. It is also important that NASA continue the longer term developments of advanced energy conversion techniques

Recommendation: NASA should continue investment in development of the mission-enabling technologies at the 6-8 percent level



Key Issue:
Cadence of competed missions

Discovery

Finding: NASA's decision to eliminate phase E funding and launch vehicle cost from the Discovery AO has been enabling for missions to the outer solar system

Finding (abbreviated): NASA will not have met the V&V goal of a Discovery AO release every 24 months unless three missions are selected from the two potential future AOs

Recommendation: NASA should issue Discovery AOs at the V&V-recommended cadence of ≤24 months, recognizing that an AO that selects two missions would count as two AOs for the purpose of meeting the V&V recommendation. To approach meeting the recommendation, NASA should select three missions from AOs issued in 2019 and 2021

New Frontiers

Finding: The pace of New Frontiers class missions is behind the recommended cadence of 2 per decade, with only 1 mission likely this decade

Recommendation: NASA should issue the New Frontiers 5 announcement of opportunity as soon as possible, but at a minimum no later than five years after the issuance of the New Frontiers 4 announcement of opportunity (i.e., December 2021)

Key Issue:
Adding Ocean Worlds to New Frontiers List

New Frontiers list additions

Finding summary: New Ocean Worlds targets were introduced into the New Frontiers 4 call, outside the decadal survey process. Such a process could undermine the scientific priorities of the decadal survey and community support for them

Recommendation: If scientific discoveries or external factors compel NASA to reassess decadal survey priorities, such as the list of New Frontiers missions, NASA should vet these changes via CAPS, and allow for input from the community via assessment and analysis groups as time permits

Key Issue: Flagship missions

- Do Mars 2020 and Europa Clipper meet the Decadal guidance?
- Are these programs on budget and schedule or do they pose a risk to programmatic balance?

Mars 2020

Findings (abbreviated):

- Mars 2020 will fulfill the mandate of Vision and Voyages to take the first step in Mars Sample Return
- NASA is making substantial progress on technology development that will be required for MSR

Recommendation: NASA should continue planning and begin implementation of its proposed "focused and rapid" architecture to return samples from the Mars 2020 mission to achieve the highest-priority decadal survey large strategic (flagship)-class science for consideration for the next decadal survey

Europa Clipper

Finding (abbreviated): This committee finds that the Europa Clipper mission addresses most of the recommendations laid out by Vision and Voyages

Recommendation: NASA should continue to closely monitor the cost and schedule associated with the Europa Clipper to ensure that it remains executable within the approved life cycle cost (LCC) range approved at Key Decision Point-B (KDP-B) without impacting other missions and priorities as defined by the decision rules in Vision and Voyages.

If the LCC exceeds this range, NASA should de-scope the mission in order to remain consistent with the Vision and Voyages decision rules

Large Strategic (Flagship) Missions

Recommendation: NASA's Planetary Science Division should implement an Independent Cost and Risk Review Process at Mission Definition/System Definition Review (Key Decision Point-B, or KDP-B) specifically for large planetary strategic (flagship) missions to ensure that potential mission costs and cost risks are understood

Balance Across the Program

Finding (abbreviated): The recommended balance across the solar system and among mission classes has not been fully achieved. This lack of balance undermines the compelling comparative planetology investigations recommended by the decadal survey, particularly for the terrestrial planets

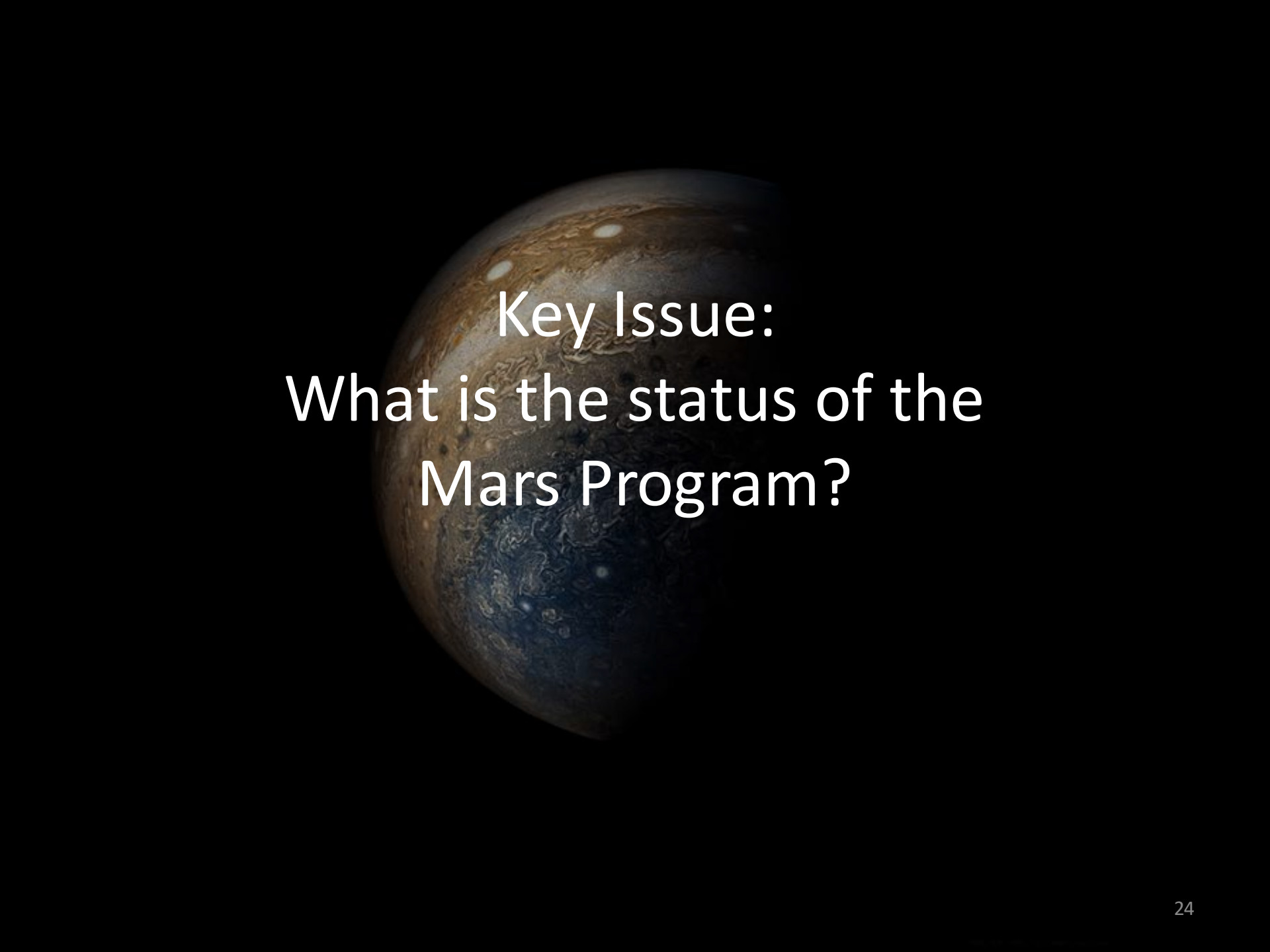
(V&V provided clear guidance about desired balance among mission classes; however, it was less clear what was intended by balance among targets. Target balance is to some extent tied to mission class.)

Key Issue:
Europa Lander

Europa Lander

Finding: A lander was not prioritized within the previous decadal survey (Vision and Voyages)

Recommendation: As a prospective large strategic (flagship) mission, the results of the NASA Europa lander studies should be evaluated and prioritized within the overall PSD program balance in the next decadal survey



Key Issue:
What is the status of the Mars Program?

NASA's Mars Exploration Program (MEP)

Recommendation: NASA should ensure the longevity of the telecommunications infrastructure at Mars to support the science return from current and planned landed assets, to mitigate the risks associated with the existing aging assets

This should not be accomplished by sacrificing the science being conducted by existing orbiters

Recommendation: NASA should immediately work to reinvigorate international cooperation to help implement Mars exploration more effectively and affordably

NASA's Mars Exploration Program (MEP)

Recommendation (abbreviated): NASA should develop a comprehensive MEP architecture, strategic plan, management structure, partnerships (including commercial partnerships), and budget that address the science goals for Mars exploration outlined in Visions and Voyages

This approach of managing the MEP as a program, rather than just as a series of missions, enables science optimization at the architectural level

This activity should include assurance that appropriate NASA/MEP management structure and international partnerships are in place to enable Mars Sample Return

Other recommendations
(abbreviated)

- Ensure CAPTEM is involved in planning for Mars 2020
- Consider curation activities in Discovery and New Frontiers as a Phase E cost to level playing field and discourage unrealistically low proposal budgets
- Regularly and formerly review the Virtual Institutes (SSERVI, NAI)
- Before the next decadal is significantly underway, NASA should conduct an assessment of the role and value of space-based astronomy, including newly emerging facilities, for planetary science

Ice Giants study

Finding: Exoplanet discoveries further enhance the importance of an ice giants mission, already recognized as a high priority in Vision and Voyages

Finding (abbreviated): The objectives of the mission concept described in the 2017 ice giants predecadal study have been changed significantly from the original Vision and Voyages science objectives

Recommendation: NASA should perform a new mission study based on the original ice giants science objectives identified in Vision and Voyages to determine if a more broad-based set of science objectives can be met within a $2 billion cost cap

Education and Public Outreach

Recommendation (abbreviated): The STEM Activation program should work with all NASA planetary missions to define science content and program implementation. NASA's Planetary Science Division should link education and outreach activities directly to the missions that are providing the science content for them

NASA had previously provided funds equal to 1 percent of the overall project budget to support these activities. New funding at this level would provide robust support for project engagement in these education and outreach activities

Infrastructure: DSN

Recommendation:
The committee endorses the Vision and Voyages recommendation that all three DSN complexes should maintain high-power uplink capability in the X- and Ka-band, and downlink capability in the S-, X-, and Ka-bands

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Preparing for the Next Decadal Survey

Recommendation: NASA should sponsor 8 to 10 mission concept studies based on the list produced by the Committee on Astrobiology and Planetary Sciences, prioritized with input from the assessment and analysis groups, prior to the next decadal survey

Preparing for the Next Decadal Survey

Recommendation: In preparation for the next decadal survey, NASA should consider priorities and pathways for advancing the state of the art of CubeSats and SmallSat technology, and how science-driven planetary small mission concepts that leverage emerging capabilities are identified and possibly implemented for flight

Preparing for the Next Decadal Survey

Recommendation: The next decadal survey committee should assess NASA's ability to respond to new needs for data archiving and interoperability from spacecraft, laboratories, and publications

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Other considerations for the Decadal panel

- Overall funding guidelines for R&A and Technology were explicit in V&V, but more data and metrics were needed to determine whether they had been met
  - Challenging to ascertain what programs fit where
  - e.g., SSERVI (then NLSI), NAI were not discussed in V&V
- Aim for greater clarity regarding how the Mars Exploration Program ties to the Decadal Survey
- Consider how to handle new discoveries that occur during the decade

Other considerations for the Decadal panel

- Decision rules in V&V were useful, but some recommendations may have been optimistic
  (e.g., three flagships? Four?)
- Clarify language with respect to funding expectations and development for large long-term projects
- If recommending a descope, clarify the goal
  - Guidance in V&V was clear regarding the circumstances under which a Europa Flagship mission could be flown, but no target numbers were given
  - Challenging to assess how well Europa Clipper met the charge

Summary

The main recommendations of the Planetary Decadal were:

- R&A be increased at 5% above inflation at the beginning of the decade, and at the inflation rate every year beyond that ✓
- 6-8% of the budget should be invested in technology development ✓
- Discovery missions should be selected every 2 years if possible ✗
- Two New Frontiers missions should be selected this decade, if possible ✗
- A Mars sample return mission should be initiated this decade ✓
- If certain conditions could be met, a Europa mission should be flown ✓

Nasa has followed **most** of the decadal survey recommendations, despite an unfavorable budget at the start of the decade

Questions?