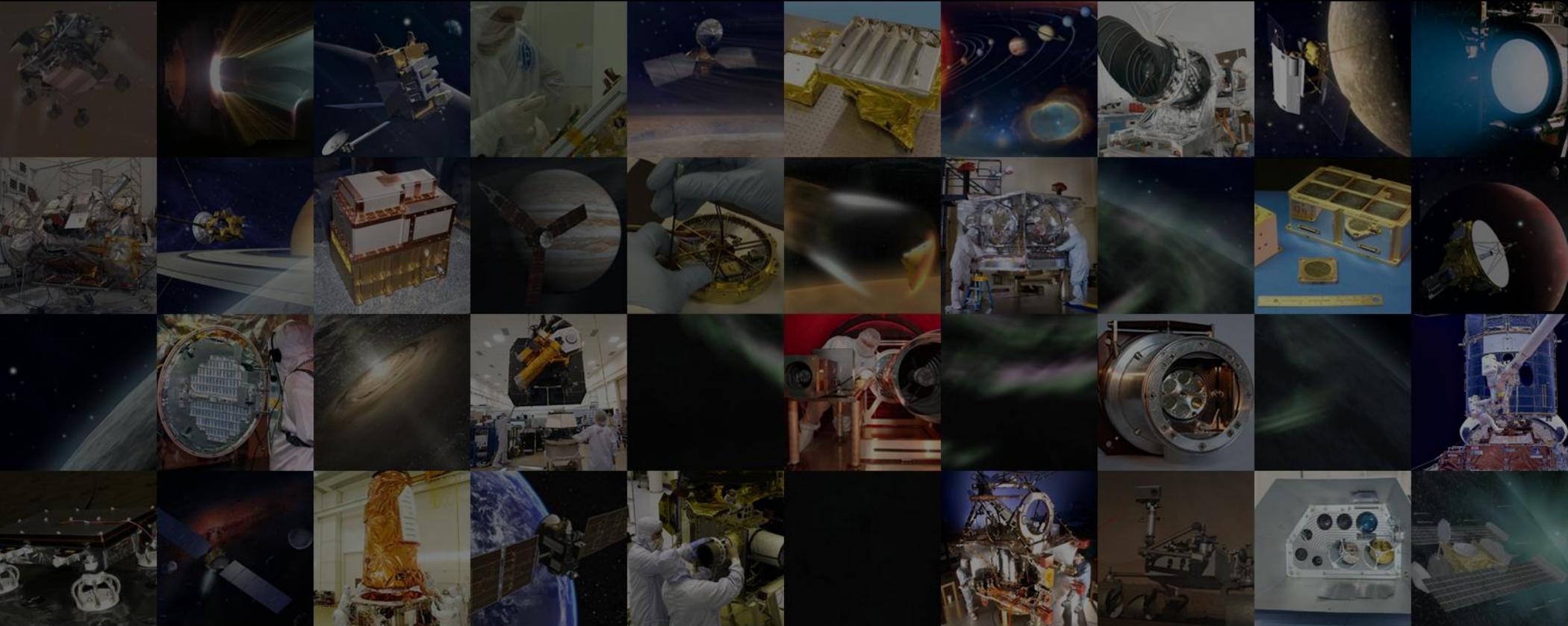




# The Planetary Science Technology Review Panel Final Report Summary



# Outline

- Panel Purpose
- Team
- Activities and Planned Products
- Assessment Approach and Methodology
- Major Issues and Observations
- Major Recommendations
- High-level Metrics

# Purpose

- The primary purpose of the Planetary Science Technology Review (PSTR) panel and its advisors was to:
  - Assist the Planetary Science Division (PSD) of NASA Headquarters in developing a coordinated and integrated technology development plan that will better utilize technology resources
- The panel recommends process, policy, and structure changes
  - Helps answer the how questions
- The panel relied on the Planetary Decadal Survey to identify what technologies PSD should invest in
- The panel coordinated with the PSS SR&T review team

The full charter of PSTR can be viewed online <http://spaceflight systems.grc.nasa.gov/PlanetaryScience/>

# Team

- Panel members were:

- Peter Hughes, NASA GSFC
- Tibor Kremic (chair), NASA GRC
- Brad Perry, NASA HQ
- James Singleton, AFRL

- Advisors were:

- Pat Beauchamp, JPL,
- John Clarke, Boston University
- Ralph Lorenz, APL

- NASA HQ POC was:

- Gordon Johnston

- Technical Support by:

- Waldo Rodriguez, NASA LaRC
- Linda Nero, NASA GRC

# PSTR Activities and Products

- There were three phases to the PSTR charter
  - Assessment of current content and performance
  - Formulation of ideas, recommendations, and high-level metrics
  - Reporting and Communicating
- Products were
  - Interim report for the assessment phase
  - A final report discussing the work for all three phases
  - Notional Roadmaps were de-scoped from Charter

# Major Issues / Observations

- Observations/Issues were grouped into four categories
  - Strategic - Issues that relate to an overall Planetary technology strategy
  - Process/Structure – Issues that relate to technology program processes and supporting institutional structures
  - Resource - Issues that relate to resources made available for technology development activities
  - Culture/Communication – Issues that relate to the cultures and communication among space projects teams, the supporting technologists, their respective institutions, and external stakeholders

# List of Major Observations and Issues

Issue Number	Observation/Issue
<b>Strategy</b>	
S-1	No overall strategy or accountable manager
S-2	No clear path for technology maturation from TRL 0-9
S-3	Limited engagement of other NASA OCT, ESMD, and ESD technologists
S-4	Technology should be perceived as more than just hardware development
S-5	Efforts by external stakeholders are not worked into PSD strategy
<b>Process/Structure</b>	
P-1	Programs are not consistent and do not have clearly defined processes
P-2	Technology managers are overloaded and often oversee flight projects
P-3	Inconsistent and inaccurate TRL and heritage assessments
P-4	Limited processes that encourage interaction between stakeholders
<b>Resources</b>	
R-1	Technology budgets are unpredictable
R-2	Technology budgets are insufficient
R-3	Inadequate leveraging of others' investments
<b>Culture/Communication</b>	
C-1	Technology investments have not yielded all the benefits they could have
C-2	Inadequate communication (in & out)
C-3	Projects are too risk averse to new technology
C-4	Tenuous commitment by top management
C-5	Need to better sustain capabilities

# Summary of Major Recommendations

Major Recommendation
Management
MR-1) Establish a dedicated Director position with overall responsibility for PSD technology
MR-2) Establish a small supporting program office
Strategy
MR-3) Develop a comprehensive strategy for PSD technology
MR-4) Strategically allocate resources (guidelines are provided by PSTR)
MR-5) Actively pursue a strategy of leveraging opportunities within and outside NASA
Process
MR-6) Develop a more consistent and accurate TRL assessment process
MR-7) Develop clear, transparent, and consistent decision and review processes
MR-8) Develop a more structured and rigorous process to create interactions between technologists, scientists, and missions
Culture and Communication
MR-9) Develop an overall communication plan and technology database
MR-10) Foster a culture that advocates for and defends technology
Resources
MR-11) Dedicate stable funding at the higher end of the decadal suggested range - 8%

# Recommendations - Management

**MR-1)** Establish a Technology Program Director (TPD) position who reports directly to PSD Director. Consolidate technology management under the TPD as much as practical\*. TPD responsibilities include:

<b>Responsibilities of the Technology Program Director</b>
<b>Strategy /Leadership</b>
Develop and maintain an overall PSD technology strategy with clear priorities
Formulate technology budgets and plans
Develop a strategic technology communication plan and act as POC for PSD technologies
Integrate PSD technology needs and efforts into a coordinated roadmap
Serve as the Program Executive of the supporting program office
Advocate for technology needs and communicate accomplishments and highlights
<b>Implementation</b>
Develop and oversee decision processes for priority setting, gate keeping, and program reviews
Ensure the integrity of the selection processes
Ensure all technologies are either making steady progress toward maturation, being infused, or getting terminated
Ensure that the proper technology related data and status is easily available to the right person, at the right time, and at the level of detail needed.
Oversee the processes that leverage and/or influence stakeholders within, or outside, NASA
Ensure all PSD technology efforts are traceable to PSD science goals

\* In special cases where a *dedicated* program executive and program office already exists it may be more appropriate to keep the existing structure. In that case the TPD can provide higher level guidance and coordination.

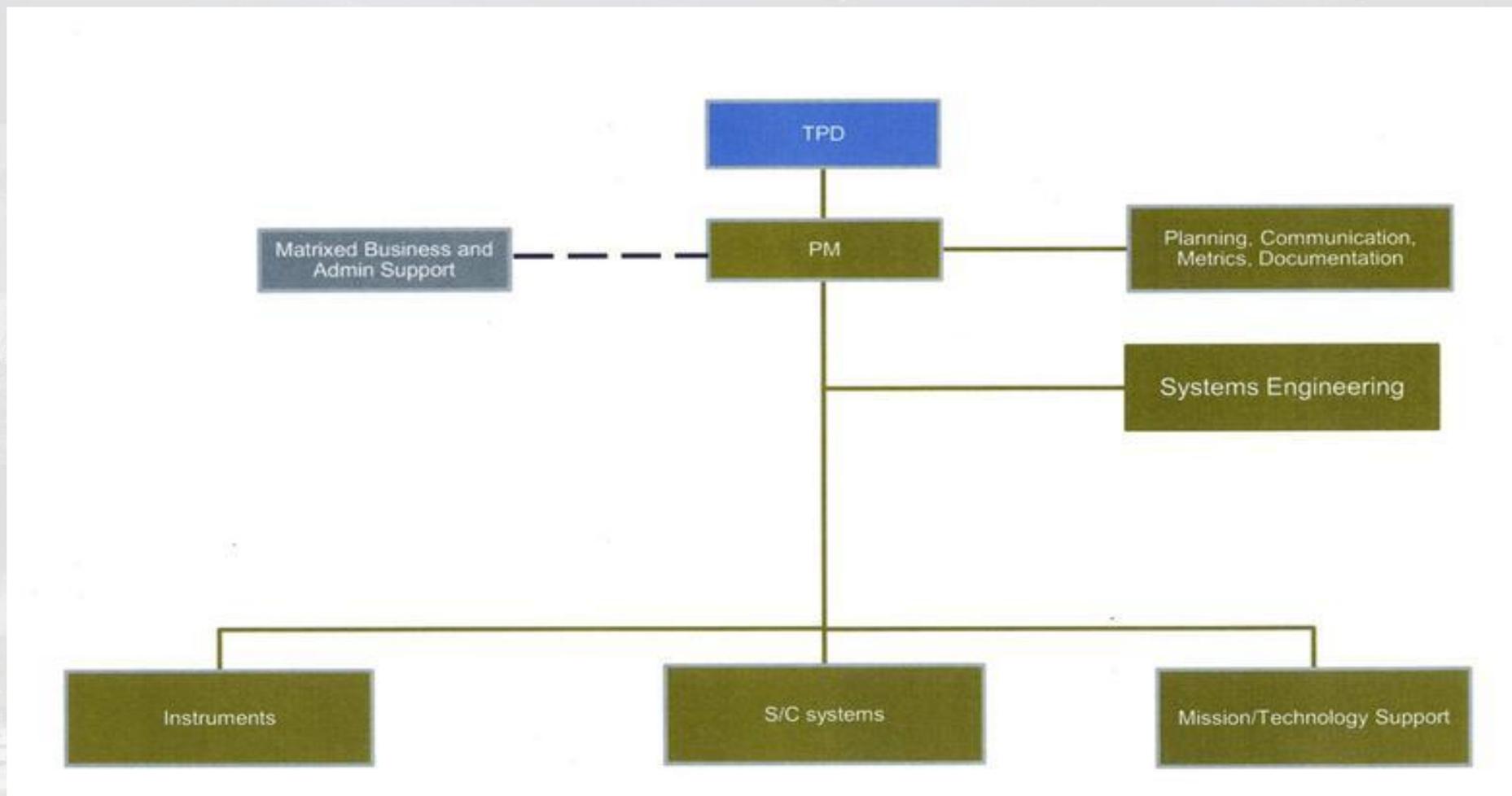
# Recommendations - Management

**MR-2)** Establish a small Planetary Technology Program Office to assist the TPD and PSD in implementing and managing technology efforts

- The program office should coordinate the expertise and leadership in the areas of a) instruments, b) spacecraft systems, c) mission / technology support systems, and in d) planning, documenting and communications. Include a strong system engineering position with mission experience
- The program office will assist the TPD in
  - » implementing the overall strategy
  - » developing roadmaps
  - » developing tools for capturing, communicating, and maintaining technology data
  - » implementing reviews and workshops
  - » a host of other duties on behalf of the TPD

# Recommendations - Management

## Notional Program Organization Chart



# Recommendations - Strategy

## MR-3) Develop a comprehensive overall technology strategy

- All the needed elements of a strategy were not developed by the panel, but a simple tool was offered that captures PSD technology in dimensions of maturity and area. The tool can assist PSD in balancing and prioritizing resources and program content

Technology Area	Critical Capabilities/ Facilities, etc	TRL 0-1	TRL 2-3	TRL 4-6	TRL 7+	Recommended Total Percent
Instruments						
Spacecraft Systems						
		System Level Maturity Low to High				
Mission Support						
Planning/ Documentation/ Communication						

- Mission support is inclusive of non-hardware technologies, such as astrodynamics, mission design and planning tools, unique facilities, etc.
- PSD has unique environmental and technology needs and must step up to initiating unique, long-range, and/or high-risk technologies

# Recommendations – Strategy

MR-4) Suggested resource balance/allocation as a percentage of total PSD technology investments

Technology Area	Critical Capabilities/ Facilities, etc	TRL 0-1	TRL 2-3	TRL 4-6	TRL 7+	Recommended Total Percent
Instruments	----	7	8	12	8	35
Spacecraft	-----	5	10	12	8	35
		System Level Maturity Low—————> High				
Mission Support	5	2	5	8	NA	20
Planning/ Documentation/ Communication	----	2	2	3	3	10

# Recommendations – Resources

We acknowledge the decadal survey's recommendation that 6-8% of the total PSD budget be devoted to technology - However;

- Given the unique nature of PSD missions and the limited number of technology providers / sponsors for those technologies
  - Given the decadal did not include resources for low TRL PSD developments and mission studies
  - Given PSTR recommends a stronger investment in non-hardware technology development elements (e.g. testing and integration technologies, mission planning technologies, etc.)
- 
- **We therefore believe that 8% is needed to adequately fund PSD technology needs**

# Other Recommendations – Resources

- The resources that are book-kept in technology budget lines should not be used for non-technology needs
  - » Artificially reduces efficacy and increases cost perceptions
- *A priori* - Develop a prioritized de-scope plan
  - And a minimum funding floor for key/strategic technologies
- Maintain healthier protected reserves at the division level to avoid raiding technology programs
- Provide funding for up to 4-5 years, as appropriate, for successfully reviewed technology programs and tasks.
- Apply the agency mission reserve policy to higher TRL level technology projects where readiness may impact mission success

# High-Level Metrics

- PSTR developed high-level metrics (goals) for the overall technology program. The objective of the high-level metrics is to provide PSD a relatively simple way to assess overall program success
- PSTR did not attempt to create detailed performance metrics or specific metrics for specific technologies
  - » Will be developed by the TPD and supporting program
- Metrics address several areas including Technology Maturation and Infusion, Leveraging, Communicating, and Programmatic

# Summary of High-Level Metrics

Metric/Goal	Metric/Goal
<b>Technology Maturation and Infusion</b>	
G-1a	10-30% of TRL 1-2 technologies make it to TRL 3 (Adjust metrics over time)
G-1b	40-60% TRL 3-4 technologies make it to TRL 6 (adjust over time)
G-1c	Infusion to flight for technologies that achieve TRL 6 should be > 80%
G-2	Develop a maturation schedule for each technology and ensure the technology is making the progress it should. Review on an annual basis
G-3	Each technology should have specific technical requirements and maturation milestones to achieve. Review on an annual basis
<b>Leveraging</b>	
G-4	Attract leveraging support of technologies suitable to PSD and track it as a percentage of total PSD technology investment. Work towards developing a specific goal based on initial experiences
<b>Communication</b>	
G-5	Implement at least one PSD technology focused workshop annually
G-6	All technology development efforts are described in conference proceedings or peer reviewed publications and results are documented in a standard final report
<b>Programmatic</b>	
G-7a	Establish a responsible technology program director (TPD) by end of FY12 and the supporting office/structure by end of FY13
G-7b	Create, document, and communicate an overall technology strategy by middle of FY13
G-7c	Establish a TRL assessment process for PSD technology developments and identify representative environments that can become pseudo requirements for technology development projects by middle of FY13
G-7d	Roadmaps for all technology developments are developed and linked to the overall strategy, the decadal survey, and expected mission needs by end of FY13
G-8	Timely and adequate funds are provided in needed technology developments. The goal is to fund technology efforts at levels needed to achieve desired readiness as identified in the respective technology's roadmap.

# High-Level Metrics – Programmatic

- Programmatic metrics are intended to encourage timely implementation of technology program improvements. Whatever variant of the PSTR recommendations are implemented they should be done in a timely manner. The goals are:
  - The TPD function fully implemented by end of FY12
  - Complete development of a comprehensive and detailed technology strategy by mid FY13. Technology roadmaps completed by end of FY13
  - Establish the PSD TRL assessment process by mid FY13
  - Program office function being fully implemented by end of FY13. Some support is needed sooner to develop and communicate the strategy, technology roadmaps, and TRL assessment process