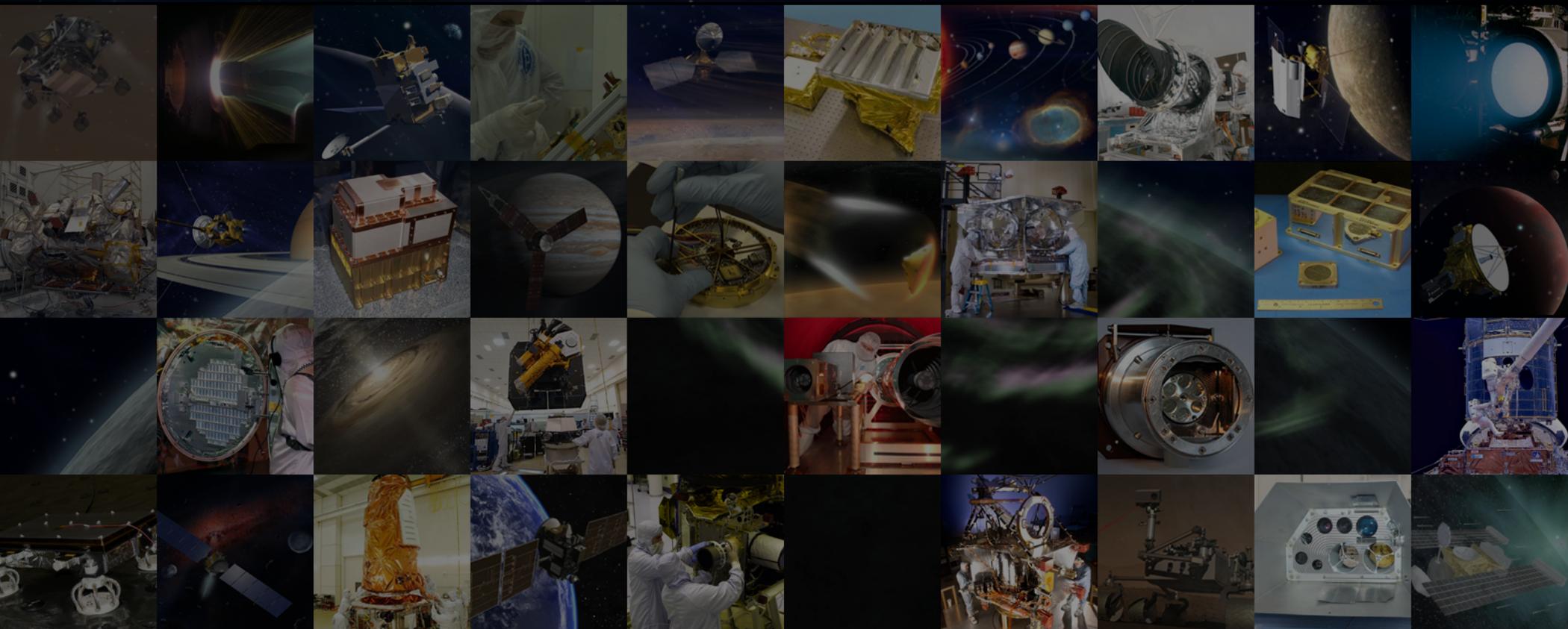




Update on the Planetary Science Technology Review (PSTR) Panel



Outline

- Panel Purpose
- Team
- Activities and Planned Products
- Assessment Approach and Methodology
- Major Issues and Observations
- Draft Set of Recommendations
- Next Steps
- Back up

Purpose

- The primary purpose of the Planetary Science Technology Review (PSTR) panel and its advisors is:
 - 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 will suggest process and policy changes
 - Help answer the how questions
- The panel will rely on the planetary decadal survey to identify what technologies PSD should invest in

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

Team

- Panel members are:

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

- NASA HQ POC is:

- Gordon Johnston

- Advisors are:

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

- Technical Support by:

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

PSTR Activities and Products

- There are three phases to the PSTR charter
 - Assessment of current content and performance
 - Formulation of ideas and recommendations
 - Report and Communicate
- Products will be
 - Interim report for the assessment phase
 - A final report detailing the work for all three phases
 - Two high-level notional technology roadmaps
 - One budget driven, the other need-based

Assessment Phase Summary

- The primary objective of the assessment phase was to understand current content, missing content, and identify issues/barriers as well as what works well
- A second objective was to look for best practices and possible lessons that could be applied to PSD from other organizations within and outside NASA

Assessment Methodology

- Hold briefings with HQ program executives and officers to understand current content and solicit observations
- Hold briefings (mostly via teleconference) between the panel and selected or recommended technology development stakeholders. Look for patterns of issues of differing views. Contact representatives from all stakeholders

- HQ'PE/PO

- Technologists

- Scientists

- Government

- Flight Missions

- Industry

- Academia

<u>Briefing List</u>		Flight Programs					Technology Management				Technology Tasks/Projects					Notes & Comments	
Topic	HQ PE/PO	Flagship	Discovery	New Frontiers	Mars	Other	Industry	NASA	Gov	University	Instruments	Bench Marking	Other	Comm / DSN			
ARMD	x					x		x									
AMMOS	x																
ESTO								x			x	x	x				
PSD Overview/Manangement								x									
Suborbital Investigations under Planetary Astronomy	x					x					x						
Planetary Protection	x					x							x				
AIST	x							x			x	x	x				
ASTID/ASTED	x							x			x		x				
Technology Investments																Budget overview	
ESMD						x		x				x					
ISP/Mars	x							x			x		x				
PIDDIP	x										x						
Lunar Lander	x					x		x					x				
Outer Planets	x	x											x				
Samples, Curation, Planetary Major Equip.	x							x					x			Facility and ground systems	
RPS	x							x					x				
New Millennium Program						x		JPL					x				
Aerocapture/EDL								x					x			Agency EDL activities	
Mars Technology Program					x			JPL			x	x	x			Tech progrm with multi-mission view	
MSL		x			x			JPL			x		x				
Flight Missions					x	x		JPL				x				Broad expereince and lessons learned	
GSFC Instruments								x			x					Broad expereince and	
SAM		x			x			x			x						
MESSENGER				x							x		x				
Decadal white papers							x	x	x	x							
AFRL						x											
Dawn			x														
ESMD technology update & gnrI lessons learned								x				x				Many new activities intitiated under ETDD	
Explorers & Helio Program Insights						x											
NASA SOMD communication plans and insight	x							x						x		Similar issues as PSD technology development	
NASA Chief Technology Office gnrI lessons learned								x								CTO impacts to technology development	
Technology management lessons learned								x	x		x						
New Frontiers/Discover/Lunar Quest Program Insights			x	x		x		x					x			Lunar program has technology development. Other programs feel impacts	
SBIR/STTR process and options	x							x								Low TRL	
Technology development at APL			x	x			x	APL									
Scientist view of NMP						x			x								
SMD POC to OCT role	x							x								Interfaces to OCT	
LASP (Academic views / Suborbital roles)			x	x	x	x			x	x			x				
Academic views /Technology						x			x				x			Spacecraft usbsystem technologies	
Technology management						x	x			x	x	x	x				
New Horizons				x			x	APL			x		x				
Honeybee Robotics		x				x	x						x			Small business experiences	
Aerospace Corp						x	x		x				x	x			

Major Observations of Current Programs

- Observations/Issues can be 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	Issue
Strategy	
S-1	Need overall manager responsible for strategy
S-2	Need clear path from TRL 0-9
S-3	Actively engage OCT, ESMD
S-4	Have strategy for all technology, not just hardware
S-5	Leverage external stakeholders
Process/Structure	
P-1	Programs need to be more consistent with clearly defined processes
P-2	Management spread across busy PO's
P-3	Need more accurate & consistent heritage and TRL assessments
P-4	Need processes to strongly encourage interaction
Resources	
R-1	Technology budgets unstable
R-2	Technology budgets insufficient
R-3	Leverage other's investments
Culture/Communication	
C-1	Investments have not yielded all the benefits they could have
C-2	Need more communication (in & out)
C-3	Projects too risk averse
C-4	Need more top level commitment
C-5	Need to better sustain capabilities

Major Observations of Current Programs

Strategic

*S-1) A comprehensive technology development strategy and an accountable owner is needed to set priorities and increase performance and coordination

S-2) There is no clear path for technologies through the existing programs to mature from TRL-0 to TRL-9. Specifically there is an issue with funding at mid-TRLs (valley of death) and there is no mechanism within PSD for sub-orbital test flights or technology demonstration missions

* S-1 is the top priority issue in the strategy category, S-2 is the second priority in the category and so on

Major Observations of Current Programs

Strategic

S-3) PSD should be proactive and engage the OCT and ESMD as appropriate to ensure coordination and effective leveraging of plans and activities

S-4) Technologies that address integration, ease of use, and system level issues need to be considered. Technology is more than just hardware and a qualified system is more than a set of qualified components

S-5) Universities and other external organizations are not adequately and consistently engaged and supported in technology development

Major Observations of Current Programs

Process/Structure

- P-1) The technology related decision making, planning, implementing, and review processes are not well defined and often inconsistent among programs
- P-2) Technology management is scattered across busy headquarters program executives and officers that also have other competing responsibilities
- P-3) The heritage and TRL assessment processes need to be more accurate and consistent
- P-4) A structure is needed that links technologists to missions and promotes early interaction with scientists.

Major Observations of Current Programs

Resources

R-1) Technology budgets are unstable and unpredictable. This makes technology maturation as well as sustaining skills and capability challenging and adds risk to overall mission success

R-2) Previously identified technology priorities have not been adequately funded to make progress

- » E.g. the gap to infusion, extreme environments, planetary protection, sample return, and more
- » 2008 CASSE report (solar system decadal mid-term)

R-3) Technology investments made by other agencies and the SBIR/STTR processes need to be better leveraged

Major Observations of Current Programs

Culture / Communication

C-1) Technology investments do not always realize all the benefits possible

- » Better documentation and accessibility to technology is critical to ensure broader use and to maximize investment potential
- » There is no easy way to comprehensively search and learn about technologies NASA is developing or has made available

C-2) Increased communication and exposure among all stakeholders (scientists, technologists, mission teams, other SMD divisions like the Earth Science Divisions, Centers,...) is needed for better technology planning, development, and infusion

Major Observations of Current Programs

Culture / Communication

C-3) Projects are too risk averse to new technologies

C-4) Tenuous top-level sustained commitment for technology

C-5) Technology capability and heritage is lost during gaps in flights or lapses in funding for technology programs

Draft Recommendations

- The Panel is currently collecting and developing recommendations
 - Solicited inputs through a web survey
 - Solicited inputs at various AG's and DPS
 - Generated ideas within the panel/advisor team
- Currently have 10 draft recommendations we consider as “major” inputs with 4 being the most critical and impactful
- We are awaiting the decadal survey comments on technology needs and technology resources before finalizing our recommendations
 - Our next face-to-face meeting is scheduled for Mar 14-15

List of Major Draft Recommendations

Draft Recommendations
Management
Establish a dedicated Technology Director position with overall responsibility for PSD technology
Establish a small supporting program office
Consolidate oversight responsibilities to the Director as much as possible
Strategy
Develop a comprehensive strategy for PSD technology
Actively pursue leveraging opportunities within and outside NASA
Process
Develop a more consistent and accurate TRL assessment process
Develop clear, transparent, and consistent decision and review processes
Develop a more structured and rigorous process to create interactions between technologists, scientists and missions
Culture and Communication
Develop a communication and documentation plan. Conduct periodic workshops targeting specific stakeholders with specific partnership and communication goals
Foster a culture advocating for and defending technology
Resources
TBD

Note: Recommendations in **Red** will be elaborated upon further in coming slides. Other draft recommendations are on the back up charts.

Draft Recommendations - Management

- 1) Establish a Technology Program Director (TPD), who reports directly to PSD Director. TPD responsibilities are grouped into two areas >>
 - a) Strategy and Leadership and b) Implementation

The responsibilities for strategy and leadership include:

- 1) Developing and maintaining a technology strategy and priorities to achieve PSD science goals
- 2) Formulating technology budgets and planning
- 3) Strategic communication with internal & external stakeholders in coordination with SMD policies. PSD POC for external stakeholders
- 4) Integrate the various PSD technology efforts and goals into a coordinated roadmap and development plan
- 5) Program Executive (PE) to the supporting program office

Draft Recommendations - Management

Implementation responsibilities include:

- 1) Overseeing decision processes for priority setting, gate definition and keeping, and program reviews of technology efforts—ensure integrity of selection process
- 2) Ensuring proper documentation and availability of technology data and development progress. Ensure scientists, technologists, and mission planners have understandable and easily accessible information
- 3) Oversight of processes to proactively influence and better leverage ESD, OCT, ESMD, SoMD, DoD and other potential technology partners and sources in according to SMD policies and procedures
- 4) Ensuring that technology developments are directly traceable to PSD science goals
- 5) Moving each technology along a path to infusion or termination depending upon performance at decision gates

Draft Recommendations - Management

- 2) Establish a 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 support systems, and in d) planning, documenting and communications.
 - The program office will assist in
 - implementing the overall strategy
 - developing and maintaining roadmaps
 - developing tools for capturing, communicating and maintaining technology data
 - implementing reviews and workshops
 - a host of other duties on behalf of the TPD.

Draft Recommendations - Strategy

3) Develop a comprehensive overall technology strategy

- All the important elements of a strategy will not be elaborated upon however a simple table is offered to suggest a notional approach to capturing scope and resource balancing. This could guide relative investment strategy, address identified issues with gaps and support long term success

Technology Area	Critical Capabilities /Facilities, etc	TRL 0-1	TRL 2-3	TRL 4-6	TRL 8+
Instruments					
Spacecraft Systems					
		System Level Maturity			
		Low	→ High		
Mission Support					
Planning/Documentation/Communication					

- Note that mission support systems are inclusive of non-hardware technologies, such as astrodynamics, mission design and planning tools, unique facilities, etc.

Draft Recommendations - Process

4) Develop a more consistent and accurate TRL assessment process

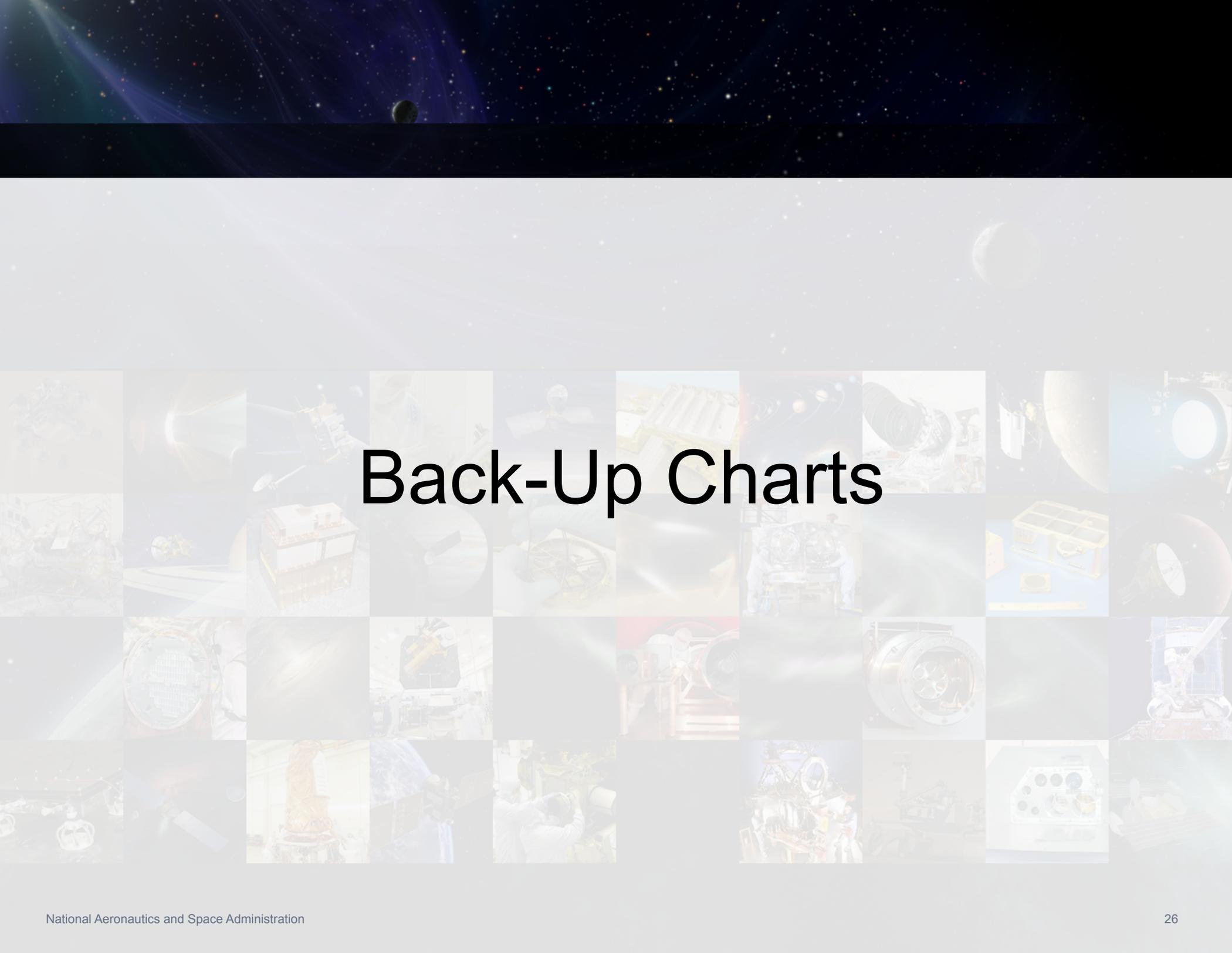
- The process needs to standardize and increase rigor while considering the application(s).
 - Difficult challenge due to the variety of planetary environments and the mission selection processes
 - Perhaps this implies a standard set of reference of missions with an enveloping set of requirements to work TRL assessments against
- The PSTR panel continues to investigate the potential use of tools, review boards, and other possible approaches
 - Assess other new efforts to work this issue
- Ownership of the PSD TRL assessment will be the PSD/TPD but we expect detailed interactions with missions and technologists

List of Major Draft Recommendations

Draft Recommendations
Management
Establish a dedicated Technology Director position with overall responsibility for PSD technology
Establish a small supporting program office
Consolidate oversight responsibilities to the Technology Director as much as possible
Strategy
Develop a comprehensive strategy for PSD technology
Actively pursue leveraging opportunities within and outside NASA
Process
Develop a more consistent and accurate TRL assessment process
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Culture and Communication
Develop a communication and documentation plan. Conduct periodic workshops targeting specific stakeholders with specific partnership and communication goals
Foster a culture advocating for and defending technology
Resources
TBD

Next Steps

- Further develop and refine recommendations
 - Particularly the TRL assessment focus
- Review Decadal Survey and complete recommendations
- Create final report and products
- Continue to communicate



Back-Up Charts

Draft Recommendations – Management

Technology management should, in general, be consolidated under the TPD.

- 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.

Draft Recommendations – Leveraging / Collaborating – With NASA

- Implement periodic meetings (e.g. quarterly) timed to impact PPBE or key technology solicitations with the other SMD Divisions and coordinated discussions with others such as SCAN and OCT.
 - Review technology plans, portfolios, and implementation progress to coordinate effective and efficient leveraging
- The TPD should proactively pursue collaborations and leverage technology development opportunities with OCT & SBIR, ESD, ESMD, SOMD, etc. in coordination and compliance with SMD policies and procedures

Draft Recommendations – Leveraging / Collaborating - University

- Strengthen university participation by creating opportunities for consortia, institutes and such to address planetary technology priorities (could be a broad range of mechanisms like team formation, specialized workshops, sharing of lab facilities, etc.)
- Initiate a workshop, inviting universities in particular, where general PSD needs and opportunities are outlined and attendees have an opportunity to exchange ideas, network, and engage students in projects
- Timescales for technology awards should be long enough to accommodate needs of graduate students

Draft Recommendations – Leveraging / Collaborating – Industry & Agencies

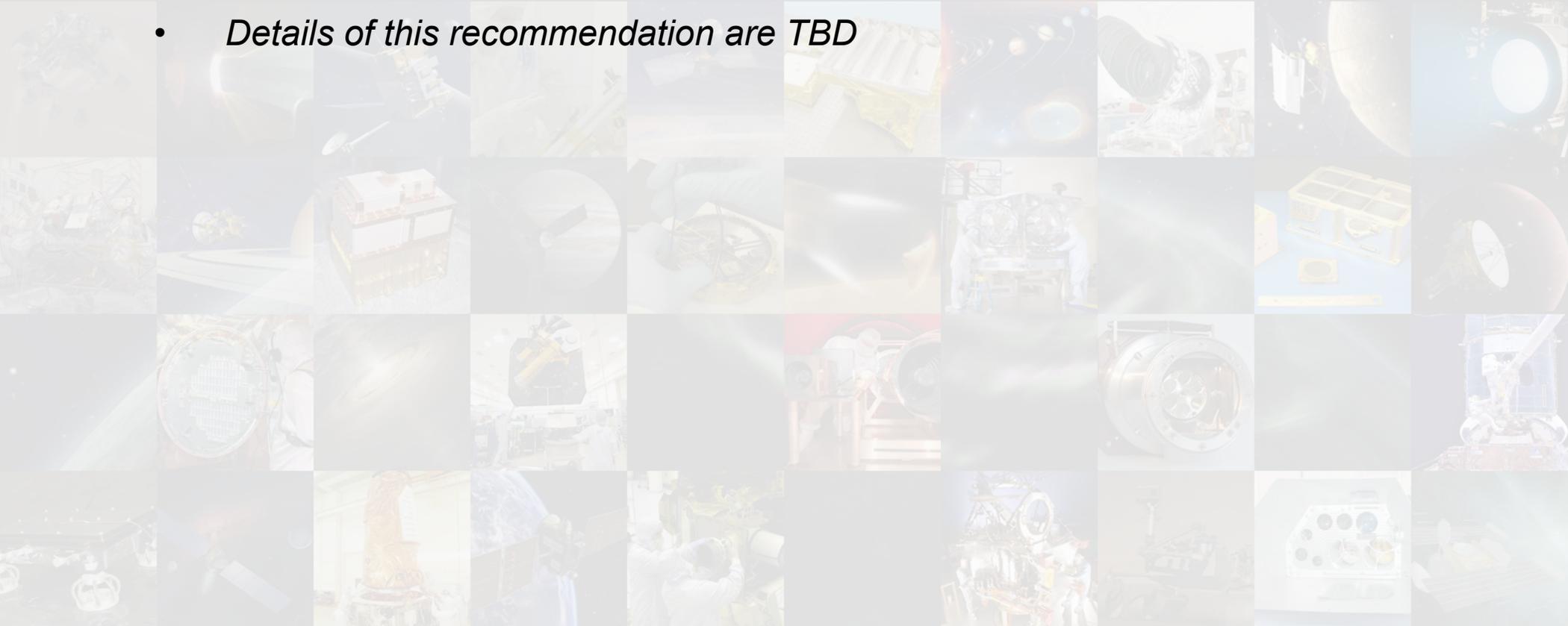
- External stakeholders (e.g. industry, other agencies) should be identified and engaged to address joint needs and create synergistic efforts
- Knowledge of contacts and synergistic activities can be consolidated and documented and made available to any technology program across PSD and NASA

Draft Recommendations - Processes

- Define and implement a transparent decision making process across all PSD technology programs, which includes
 - Discriminating and well-advertised decision factors
 - Well-defined planning, review, and selection processes
 - Decisions clearly traceable to strategic objectives and the related technology needs.
 - Processes should be consistent with NASA guidelines such as 7120.8

Draft Recommendations - Processes

- Develop a more structured and rigorous process to create interactions between technologists, scientists, and missions
 - *Details of this recommendation are TBD*



Draft Recommendations – Documenting/ Communicating

- Develop an overall communication plan. Part of that plan should be technology (e.g., instruments) or mission-application focused (e.g., MSR, outer planets) workshops featuring PSD technologies where interested parties and stakeholders are invited.
- Encourage exchanges and inter-center meetings and perhaps offer a catalogue of who's who in various technical fields
- Develop a comprehensive technology database
- Require recipients of technology funds to present their work at relevant workshops and in literature

Draft Recommendations – Documenting/ Communicating

- Technology projects should be provided with funding for documenting the work and then be required to deliver a final report that is comprehensive enough that a potential user can evaluate technology characteristics, readiness and applicability to needs.
 - Project should document a list of key contributors, their roles and responsibilities, and last known contact information
- These final reports should be available on an open PSD website.
 - If ITAR issues prevent public access, the final report should document open information publically but house controlled information on a secure site for use within NASA or other approved US entities.

Draft Recommendations – Documenting/ Communicating

- A PSD Technology website should be developed and maintained.
 - Include all the basic information on all PSD technologies being developed also including contact information and links to the other relevant websites
 - Structure the site so a search engine could be used by a potential users to locate relevant technologies.
- In addition to technologies, important test facilities should also be collected and made available
- Documenting and communicating tools should be tailored to a variety of users.
 - E.g an easy to search tool for non-technical users and a more detailed sections for referencing and technologists.

Draft Recommendations – Culture Risk Aversion

- Take steps to reduce the aversion to new technology
 - The TRL assessment improvements and better estimating and planning will help provide more confidence in adopting new technologies
 - Continue providing incentives but also strengthen them so more projects consider adopting new technologies.
 - Offer more opportunities to fly new technologies such as tech demos and sub-orbital missions.
 - Explore making changes to the mission acquisition approaches, offering a longer and better funded phase A for technology maturation and mission concept refinement.

Draft Recommendations – Culture Advocacy

- The TPD, reporting directly to the PSD division, should advocate technology needs.
- Include technology advocacy in PSD leadership Employee Performance Plans and evaluations.
- PSD leadership should advocate technology needs to SMD AA
- Encourage NASA assessment and advisory groups to support technology funding and infusion.

Draft Recommendations – Resources

Waiting for decadal survey before suggesting technology funding levels, balancing or other resource related recommendations

Some initial ideas include:

- Commit to and defend a stable budget. Provide funding for up to 4-5 years for all successfully reviewed technology programs and tasks. Apply the agency mission reserve policy to higher TRL level technology projects
- Maintain healthier reserves at the division level to avoid raiding technology programs
- Develop a prioritized de-scope plan a priori for technology programs and a minimum funding floor for key/strategic areas.

Other Draft Recommendations – Strategy, Critical Skills and Resources

- The PSD strategy needs to prioritize technology, capability, and key partnerships and ensure a minimum funding floor where appropriate
- Minimize loss of capability by maintaining consistent funding in the critical areas. Where technologies are discontinued ensure that comprehensive documentation is available and key personnel are identified
- Technologies that are not actively in use should be identified and their reactivation cost and schedule tracked
- PSD should work with Centers and other technology providers to understand and preserve the core capabilities needed to achieve PSD science goals
- Plan so that technology development, improvement, and sustainability may go beyond first flight.