

NASA ADVISORY COUNCIL

SCIENCE COMMITTEE

November 9-10, 2021

Virtual Meeting

MEETING REPORT



February 7, 2022

Meenakshi Wadhwa, Chair



February 8, 2022

Jason Callahan, Designated Federal Officer

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Tuesday, November 9, 2021

Opening Remarks / Introduction of Members

Mr. Jason Callahan, Designated Federal Officer (DFO) for the NASA Advisory Council (NAC) Science Committee (SC), opened the meeting by greeting the participants. He then reviewed the Federal Advisory Committee Act (FACA) rules for the participants. Under FACA, the meeting was open to the public and minutes were being taken to be posted to the NASA website. All presentations and statements would be part of the public record. Each SC member has been appointed on the basis of individual subject matter expertise and all have been designated as Special Government Employees (SGEs). As such, they are subject to federal ethics laws and must recuse themselves in the event of a personal or institutional conflict of interest (COI). Members with questions or concerns about possible COIs should discuss the matter with Mr. Callahan.

He then introduced Dr. Meenakshi Wadhwa, Chair of the SC. Dr. Wadhwa welcomed the SC members and had them introduce themselves. She noted that there were two new members present, Dr. Linda Godwin of the University of Missouri and Dr. Willie E. May of Morgan State University. Dr. Wadhwa noted that this was the first SC meeting since Mr. Bill Nelson had become NASA Administrator and wished him the best; she noted that the SC was looking forward to working with Administrator Nelson and his team towards advancing NASA's mission. She then reviewed the meeting agenda and goals.

NASA Science Update

Dr. Michael New, NASA Science Mission Directorate (SMD) Deputy Associate Administrator (AA) for Research, gave the SMD update, which focused on news, policy updates, and the Fiscal Year 2022 (FY22) budget status. Dr. New noted some of the new leaders at NASA, who have come on board at a time of unprecedented science activity. Recent and upcoming launches include Landsat-9, a joint mission between NASA and the U.S. Geological Survey (USGS); the Planetary Science Division (PSD) Lucy mission to Jupiter's Trojan asteroids; and the James Webb Space Telescope (JWST, or Webb) from the Astrophysics Division (APD). The Lucy team is currently addressing an issue with the mission's solar arrays, while the Webb telescope has arrived in French Guiana and is being prepared for a December launch. In addition, the Double Asteroid Redirection Test (DART) mission, the Imaging X-ray Polarimetry Explorer (IXPE), and the next Geostationary Operational Environmental Satellite, GOES-T, will launch in early 2022.

NASA recently divided the Human Exploration and Operations Mission Directorate (HEOMD) into the Exploration Systems Development Mission Directorate (ESDMD) and the Space Operations Mission Directorate (SOMD). Dr. New explained that SMD works most closely with services from within SOMD. The Human Research Program, which had been part of SMD's Division of Biological and Physical Sciences (BPS), has been moved out of BPS and into SOMD.

NASA now has three policy priorities:

1. Address the climate crisis;
2. Promote diversity and equity in science; and
3. Restore America's global standing in science.

To respond to the first priority, the Agency is assembling the Earth System Observatory (ESO), a network of interconnected satellites and observatories that will provide unprecedented 3D holistic views of Earth's systems. To address the second priority, NASA is instituting a suite of Inclusion, Diversity, Equity, and Accessibility (IDEA) initiatives, including Bridge Programs to link Minority Serving Institutions (MSIs) to major research institutions and NASA centers with the goal of diversifying the national Science,

Technology, Engineering, and Mathematics (STEM) workforce, including at NASA. The Agency will also implement IDEA requirements, such as the Dual Anonymous (Dual Anon) review system that has been used for over 20 research solicitations to date and is expanding to additional programs. Feedback has been positive thus far, and the review system has resulted in more women in leadership positions and more new institutions submitting proposals.

Dr. Sara Tucker asked if IDEA requirements will focus on mission level Announcements of Opportunity (AOs) or if will they extend to smaller levels such as Research Opportunities in Space and Earth Sciences (ROSES). Dr. New replied that SMD is focusing on AOs at the moment. The draft language will require responses to include both a description of how the science and engineering teams were put together and a plan to maintain the diversity of team going forward. This has not yet become part of ROSES, though there have been experiments with the Astrophysics Data Analysis Program (ADAP) and the Payloads and Research Investigations on the Surface of the Moon (PRISM) proposals for the Commercial Lunar Payload Services (CLPS) landers for the moon, both through ROSES. These pilot initiatives asked proposers to present diversity and inclusion plans; the data are still being analyzed. There will be something similar for Earth Venture 6 (EV-6). At this point, SMD is avoiding highly prescriptive direction, preferring to see what the community comes up with.

SMD is attempting to determine why it is not receiving proposals from MSIs or Primarily Undergraduate Institutions (PUIs) and hopes to learn how to make it more attractive and easier for investigators from such institutions to apply. The Bridge Programs are meant to address this issue. Globally, NASA is a strong tool for soft power through the leveraging of international partnerships. NASA is engaged in more than 400 such alliances, and the Agency tries to model how open and transparent science benefits everyone.

Turning to the budget, Dr. New said that the President's Budget Request (PBR) for SMD reflects the three NASA policy priorities, as well as leading Artemis science. The Senate and House have released their budget mark-ups, and the Build Back Better campaign includes funds for climate research and development (R&D). The budget request supports SMD's ongoing work and some new work. Dr. New presented the recent cost performance versus baseline budget estimates for a long list of NASA science missions, reflecting the 70 percent joint cost and schedule confidence level (JCL) set for Phase C/D. Collectively, 256 missions underran their budget commitments by 2.3 percent, though individual missions differ. SMD is proud of gaining control of mission costs.

Discussion

Dr. Vinton Cerf asked if the mission cost improvements reflect better tools for estimating or if there was some other cause. Dr. New did not believe the cost improvements resulted from better tools so much as improved rigor in estimating at each step, with basic reviews and more developed processes. The Agency also holds significant funds in reserve for each mission, which can be released but not easily. For large strategic missions, NASA has found that cost growth often results from instrument development, so that is an area of focus.

Dr. Wadhwa asked what positive or negative impacts the reorganization of HEOMD might have on SMD. Dr. New said that the impact should be neutral for the most part. SMD deals with individuals and groups in both new directorates. Dr. New said the split makes sense because the functions of the two new directorates are very different and the new organizational structure allows more focus. He noted that the split is actually a reversion to the way NASA previously organized human spaceflight. Citing the example of NASA's Launch Services Program, he explained that the two new directorates now constitute larger parts of a smaller portfolio and might receive more attention. SMD has always had excellent relationships with those groups; representatives sit in SMD's senior staff meetings and are part of the teams.

Dr. Amy Mainzer said that the work on climate is heartening. She asked about NASA's position on projects to mitigate climate change. Dr. New replied that there is a mission in development that will enable identification of CO² emission sources, and there is talk of expanding that capability. The Agency has a long-term relationship with the National Oceanic and Atmospheric Administration (NOAA) and is ready to provide NASA's unique capabilities to this problem. It is not explicitly part of NASA's mandate to identify greenhouse gas emissions, but the Agency helps determine them in conjunction with partners.

Dr. Wadhwa praised the ongoing emphasis on IDEA and asked if the Bridge Program and outreach workshops came from the summer Request for Information (RFI). Dr. New said that that was not the case; the RFI responses were still being analyzed and he did not know when that information would be available. The Bridge Program was developed as a natural means of growing a more diverse workforce.

Dr. Mainzer asked for more information on COVID-19 supply chain issues. Dr. New explained that the pandemic has caused some schedule slippage due to delays in acquiring some products that were once more readily available. While a few missions have had delays in development, it has been manageable thus far. The 70 percent JCL provides NASA adequate margins for cost and schedule. Nothing catastrophic has happened, but the supply chain delays are affecting missions in development. Dr. Wadhwa asked about personnel issues, especially postdocs and other early-career individuals. Dr. New said that SMD put out a call for proposals for research award augmentations and funded a couple of million dollars for early career scientists. There are currently discussions on whether there is a need for another such call, but the Agency does not collect data that would reveal an exodus of people from relevant fields. However, there have certainly been negative impacts.

SMD Transform to Open Science (TOPS)

Dr. Steven Crawford, SMD Senior Program Executive for Scientific Data and Computing, Mr. Kevin Murphy, SMD Chief Science Data Officer, and Dr. Chelle Gentemann, open science lead for NASA's Earth Science Data Systems (ESDS) Program, discussed the TOPS program, which was developed through a series of meetings with academia, industry, and NASA to determine how to enable greater open science in the future. Mr. Murphy, who is embedded within the Earth Science Division (ESD), identified the three goals that will enhance the ability to do open science across SMD:

1. Develop and implement capabilities to enable open science.
2. Continuous evolution of data and computing systems.
3. Harness community and strategic partnerships for innovation.

Open source science is transparent, inclusive, accessible, and reproducible. The focus is on software, documentation, and data services. Open source science addresses how open science is implemented, building on tools and techniques for software. This will change how scientists interact with missions. The SMD divisions have invested significant funds into their data archives, and discussions are occurring about the alignment and coordination of these archives. Cloud computing is a consideration. Mr. Murphy delineated the key steps involved, starting with the creation of TOPS and the designation of 2023 as the Year of Open Science. Investments will be ongoing, and there will be a prototype data catalogue in late FY22, along with an expansion of the Astrophysics Data System (ADS). There are also plans for cross-divisional investment in cloud environments.

Dr. Crawford described SPD-41, a scientific information policy document that consolidates existing policies that apply to SMD; the document also elucidates NASA and federal guidance. SPD-41 applies to all SMD-funded activities with the exclusion of restricted information. NASA will be releasing an RFI on SPD-41. Dr. Crawford presented a timeline and plan for public engagement, noting that SPD-41 is an early step in a long process.

Dr. Tucker expressed concern about leakage of technology development through publication despite International Traffic in Arms Regulations (ITAR) restrictions. Dr. Crawford said that the team is aware of this concern but has not yet come to the point of outreach to the many groups on their contact list. He noted that NASA is gaining substantial momentum on open source science, which calls for a mosaic of voices, as exemplified by the team.

Dr. Gentemann described TOPS, which addresses the broken system of closed environments and minimal communication of knowledge and codes by moving to a system of sharing to enable better execution of the scientific process resulting in greater impacts. The organization of science has a gender and diversity issue that can only be managed by changing the cultural norms. It is not enough to strengthen policies, which has been done, the power dynamics must also change. While aspects of the scientific process may be closed to support national and cyber security concerns, it is possible to be both open and safe. Open science creates new pathways for participation and makes science more equitable. However, it is not obvious to everyone how to participate in open science.

TOPS aims to accelerate scientific discovery through support for NASA SMD initiatives on IDEA and environmental justice work. It is a 5-year initiative to jump-start coordinated activities that will transform science through visibility, capacity sharing, incentives, and pathways. Through TOPS, SMD hopes to reach at least 20,000 scientists, double participation by members of historically excluded communities, and accelerate major scientific discoveries via ROSES.

To achieve TOPS goals such as visibility, SMD will need to provide top-level support that promotes the sharing of knowledge. To achieve greater capacity sharing, TOPS will provide an interactive open science platform with curated content that builds on existing resources and is flexible enough to be used at a wide range of events. The effort will target undergraduate and graduate students as well as scientists in both early and late career states. In addition, managers need to understand open science concepts and how to enact them. To reward and recognize the work enabling a more open scientific process in SMD, TOPS will offer incentives and awards. Pathways expansion will make science accessible to everyone regardless of their institutional affiliations. Dr. Gentemann explained that this work has begun and presented the next steps. She asked for SC feedback and thoughts about what the initiative is doing and anything that might be missing.

Discussion

Dr. Cerf stated that open source software can be buggy, which creates concerns about how to ensure data quality and integrity. Dr. Gentemann explained that there is a spectrum of quality and an element of educating people. She has dealt with buggy software situations and believes they are inherent in software. An active community can consistently contribute, support, and help improve software. Part of this involves identifying the valuable libraries of software. Regarding data, Dr. Crawford explained that TOPS will initially work with ESO missions. The expectation is that the algorithms will to be developed in an open manner while continuing NASA's rigor in product evaluation and calibration. There are examples of researchers adapting lower-level products and self-correcting. The TOPS initiative seeks to accelerate such peer review. If some of the community contributions meet quality requirements, those contributions can be added.

Dr. Cerf pointed out that publications in peer-reviewed journals have been polluted in some cases, which is an issue of maintaining data quality. Dr. Crawford said that the SMD divisions each handle such situations differently, but NASA is not lowering the quality requirements on missions or major projects. The Agency will work with its partners and provide guidance about data sharing and correction of bad data. Dr. Wadhwa asked whether the requirements would affect past work. Dr. Crawford said that the emphasis is on missions going forward, with ongoing missions adopting TOPS as time and resources allow. Dr. Godwin asked if she was correct in assuming that this is a two-way street with international

partners. Mr. Murphy gave an ESD example of articulating these principles along with the need for validation of data with international partners. There has been no pushback thus far.

Dr. Charles Woodward asked how support for under-utilized communities will be provided through TOPS. He also had questions regarding emerging artificial intelligence (AI) and machine learning (ML), which have been shown to be very insular to the benefit of certain communities and the detriment of others. Mr. Murphy replied that they know AI can be inherently biased, which is an ethical issue, and they are talking to affected communities about it. In addition, a NASA report on many of these issues is imminent. It will address many of Dr. Woodward's concerns. Dr. Crawford said that regarding TOPS support for under-utilized communities, the program currently has two approaches. One is through ROSES, with projects to support maintenance and upkeep, among other things. Secondly, the missions directly support open source projects. Dr. Mainzer pointed out that someone must pay for code development; it is not free and cannot be done without providing support. It is one thing to require code development at the mission level where it can be built into the budget. However, this could create substantial impacts if the requirements are within ROSES, especially for the many programs that are stretched thin, and it could exacerbate already low selection rates. Dr. Crawford explained that requirements on code sharing are being kept at a low level. The program is not requiring researchers to maintain their code. There is significant value in the reproducibility of scientific papers, though, which spills over into access to usable code. TOPS intends to make such a burden very low. They still need to examine how to best support people who are developing libraries and software packages. Dr. Gentemann added that it is not just NASA moving in this direction. Publications are also asking PIs to share their code as part of doing science and producing results in a paper. Dr. Mainzer noted that this is a lot of work and can be hard on the community, so the burden needs to be considered, especially regarding the impact on selection rates. Mr. Murphy said that there is a need to discriminate the larger pieces from the individual code snippets, and there are open source libraries that need support. There is a program intended to accomplish this goal and NASA would like to grow it over time.

Dr. Tucker explained that as a member of the weather community, she advocates sharing due to the need for global data. But she had concerns about industry investment and sales of data that NASA will buy. A similar situation exists with NOAA. She likes anonymity but also appreciates that TOPS could lead to a sense of community. She wondered how to balance promotion of open data with NASA's desire for more industry investment in science. Mr. Murphy said that making data available in scalable ways is one model that has potential to reduce the friction Dr. Tucker described. In talks with commercial data providers, TOPS has observed that they want to understand what types of science analysis NASA can do, and it circles back into their value equation. It is a multi-pronged approach.

Mr. Marc Weiser said that there have been great gains in NASA's productivity with industry partnerships, but it is critical that industry partners keep the data clean, which may be addressed in the future. Mr. Murphy agreed. One area of success with commercial data was the Covid dashboard to get the information aggregated and shared for study. Dr. Wadhwa said that she applauds the overall SMD goal here, but she was just at an astromaterials data management workshop that found, operationally, analysis of samples could require a more nuanced approach. Mr. Murphy said that the policy allows variances and did address samples. There will be timeline issues and technology problems that inhibit turnaround.

Division Advisory Committee (DAC) Chair Reports

Heliophysics Advisory Committee

Dr. Michael Liemohn gave the update from the Heliophysics Advisory Committee (HPAC). A recent teleconference was the only meeting of 2021, as there were issues with appointments and approvals. The teleconference included a Heliophysics Division (HPD) update and Government Performance and Results Modernization Act (GPRAMA) review. Both GPRAMA performance goals received unanimous green

ratings. HPAC hopes to have a larger meeting in early 2022. Dr. Liemohn presented one science highlight about the first solar energetic particle of the new solar cycle. The Parker Solar Probe (PSP) flies progressively closer to the sun and has been involved with other HPD missions in taking coordinated measurements of a blast of energetic particles. HPD has a small but mighty fleet of missions around the solar system.

Earth Science Advisory Committee

Dr. Tucker said that the Earth Science Advisory Committee (ESAC) had also had few meetings. A recent teleconference focused on the GPRAMA review. ESAC voted green on both of its performance goals. There was a lot of material to cover across six focus areas with a lot of cross-cutting work. Highlights from the meeting include:

- Satellite observations have led to advancements in understanding the Earth system.
- The availability and continuity of data sets enable improved prediction.
- Movement of NASA data to the cloud has led to increased availability and use.
- Despite COVID-19 restrictions, NASA Earth scientists participated in several field campaigns.
- Science teams advanced data simulation and retrieval for upcoming missions.

Dr. Woodward asked if the movement of data to the cloud encompassed any broader discussion of also moving the processing algorithms. Dr. Tucker said that she was aware of the activity but did not have enough information at hand to provide an update. Dr. Cerf observed that the use of large-scale computing resources could be applied to clouds. Dr. Tucker said that NASA is doing a lot of work in that area. Dr. Liemohn asked about the extent to which the Earth science community is embracing CubeSats and NanoSats. Dr. Tucker replied that a lot is being done. She is from the technology and weather communities, where there is much emphasis on getting data for atmospheric and surface observations. NOAA is looking at SmallSats as well. Dr. Wadhwa asked if ESAC discussed NASA's initiatives for climate change and resilience. Dr. Tucker said that the meeting was focused on the GPRAMA review but ESAC hopes to discuss these topics soon.

Planetary Science Advisory Committee

Dr. Mainzer provided the update on the Planetary Science Advisory Committee (PAC). The last full meeting was in June, there was a telecon in October for GPRAMA, and a full meeting was scheduled for the week after this SC meeting. PAC has nine Assessment Groups (AGs), reflecting the great breadth of planetary science; they reported in June. The GPRAMA ratings were all green.

Science highlights include the upcoming Decade of Venus, with two new NASA missions to that planet in development. Venus Emissivity, Radio Science, InSAR, Topography, and Spectroscopy (VERITAS) will look at how Venus reached its current state. It will launch in mid-2025 and provide data by the end of that year. The Deep Atmosphere Venus Investigation of Noble gases, Chemistry and Imaging (DAVINCI) mission will land on Venus to measure atmospheric and surface properties. There is also a European Space Agency (ESA) mission for Venus. The Double Asteroid Redirection Test (DART) is about to launch, heading to the Didymos asteroid system to test a method for changing an asteroid's orbit. As noted previously, the Lucy team is still assessing the impact of the solar panel issues.

The Here to Observe (H2O) pilot program will bring students into science team meetings to encourage young people from under-represented groups to pursue careers in science.

The June PAC meeting generated the following findings:

- Planetary Data Ecosystem Independent Review Board

Recognition and praise for the efforts of the Planetary Data Ecosystem (PDE) Independent Review Board (IRB) and PSD in initiating and formalizing the PDE. PAC noted that full implementation and support will require additional resources and funding.

- Research and Analysis (R&A) Funding
The additional funding available for R&A funding this year is excellent news, but it is a one-time increase in the budget. PAC encourages NASA to request additional support for R&A in future budget requests.
- Mars missions' community involvement
*PAC was happy to hear about the appointment of Dr. Meenakshi Wadhwa as the Mars Sample Return (MSR) Program Scientist. PAC looks forward to hearing more about the formation of an International Recon/Science Measurement Definition Team for MIM and a Campaign Science Group for MSR.
The PAC recommends that the process for deciding which samples to return and assessing whether a particular sample meets Decadal science objectives should be open to the scientific community.*
- Apophis
PAC recommends that NASA set up a study team to investigate how to maximize the scientific return of this close approaching asteroid without disturbing the object or perturbing its orbit.
- Closed captioning
*PAC was pleased to have closed captioning at the June meeting as it increased the accessibility of the meeting.
PAC encourages NASA to make closed captioning available for all public, virtual NASA meetings, and to help standardize this practice within the science community.*

Dr. Woodward asked if Apophis is an issue for planetary defense. Dr. Mainzer replied that while there is no chance it will strike Earth it could produce impacts such as landslides. Dr. Woodward suggested that there might be an opportunity to tag along as it makes its approach. Dr. Mainzer agreed that that is possible. It will be quite bright in the night sky but will create no hazard whatsoever. NASA does not want to perturb its orbit.

There was discussion about whether other divisions have anything like the H2O pilot program. Dr. New said that there are multiple programs in each division, such as HPD's Mentoring 365, and SMD wants to see which work best. (The Launchpads are managed out of his office and are not specific to APD as was said in the WebEx chat.) Dr. Woodward said that the Astrophysics Advisory Committee (APAC) had a long conversation about other activities across SMD. Launchpad and Bridge Programs kept coming up. H2O could be a structural model for the SMD requirements for missions to show how they incorporate IDEA. Dr. New said that he is very committed to IDEA but does not want to commit too soon. Rather, he wants to try some things and see what works best.

Wrap-up Discussion

Dr. Wadhwa wanted to return to the open source discussion. Dr. Cerf wondered about the role of the Open Archival Information System (OAIS). A statement in the chat said that open architecture for an OAIS is part of the consideration for the open data initiative, which includes software as well. He also had a question about Jupyterhub and Jupyter Notebooks, which a lot of researchers are using like an online lab book. It allows them to capture both data and software, then allow third parties to have access as either editable or readable. It is an interesting and powerful tool for sharing lab work. Dr. New said that JupyterHub and Jupyter Notebooks have been under discussion, but NASA prefers to describe capabilities rather than specify products. NASA might recommend using a tool with the Jupyter capabilities. Dr. Cerf cited the importance of interoperability. Dr. Woodward agreed. APAC has discussed how NASA

manages data archives on commercial sources that could disappear, while the science community generates enormous amounts of data that are beyond the Agency's ability to store itself. The divisions are not at the same point on the strategic thinking. Dr. New said that this is an ongoing conversation. One of Mr. Murphy's roles is developing this kind of strategic thinking. Mr. Murphy elaborated that there is an activity related to looking at how SMD manages cloud computing and enables open access safely. There are tools needed to stay current, and they are not things that NASA has developed. There are also questions about how NASA divisions other than ESD can migrate to cloud environments. This initiative is at the early stages. The only way NASA can manage some of the upcoming data flows is through the cloud, but quality assurance and control work are necessary to ensure that the cloud vendors provide the right services. Dr. Cerf noted that a peculiar shift is occurring with a new diversity of underlying hardware, and this creates issues of platforms and computation.

Dr. Wadhwa then asked the Committee members for their thoughts. Dr. Mainzer said that PAC is always concerned about R&A funding. The planetary disciplines depend on that and the community is very sensitive to changes and unfunded mandates for more work, especially for the smaller institutions that have less capacity to absorb them. This perspective is not new. Dr. New said that SMD is not at the point of analyzing added costs. More funds will be needed, and he does not want to give requirements without funds. But it is early in the process and there are questions: Do you send funds to the PI or set up a support organization for them? And how does that money get split? It is too early to discuss specifics. NASA planetary researchers are typically on "soft money" and are widely spread throughout the academic community. The National Science Foundation (NSF) does not have a similar program. Dr. Tucker said that from her Earth science perspective, she has always so impressed by the diversity of the planetary field. But while it is great to have a supportive community, things can go badly and bullies can rise up. She wondered if there is a way to keep the collaboration and support when it is so open that anyone can come in with biases and issues. Dr. Wadhwa agreed. The astromaterials data management community is discussing this and the need for a cultural shift while ensuring that the quality standards are maintained. Dr. Tucker said they need to make sure there is a strong sense of trust to maintain collaboration.

Dr. Liemohn said that he liked the presentation on open science, citing his experience as editor-in-chief of a journal where there was a push to enforce open data policies. The journal had a strong library staff, which is not the case at smaller institutions. He asked what NASA might do to help bridge that transition for the smaller organizations and if it would be possible for the Agency to sponsor help for researchers' code for analysis and tools. Mr. Murphy said that that discussion is occurring in NASA. Dr. Godwin said that she enjoyed the presentations and could see the H2O program scaling.

Dr. Woodward was most struck by the call for data fidelity, which needs to be studied to make sure it is accomplished correctly. If NASA cannot guarantee data fidelity, the Agency has done a disservice. The TOPS conversation was fascinating and necessary. The Astrophysics Decadal Survey (DS) was recently released and recommends how to maintain integrity and trust in an open community, noting the metrics and elements to consider. He agreed that the SPD-41 document is a source of struggle. Dr. Cerf concurred, asking how NASA can earn trust and allow people to earn and demonstrate trust for cooperating researchers. They need to think about those mechanisms. He called out NSF's Research Data Alliance experience and suggested looking at ema.org, which allows people to describe the shape and form of their data.

Dr. Wadhwa observed that there was a lot of commonality in this discussion, possibly worth a recommendation. She also wanted to think about Covid impacts and a recommendation for ongoing support for early career scientists who are still feeling the impact of the pandemic. In addition, SC normally has a joint meeting with HEOMD's advisory committee in the spring. She asked the SC members for topics to share at that time. Dr. Woodward pointed out that the lunar campaign is ramping up

and the commercial presence could outpace that of NASA. He added the astrophysics DS says nothing about this, which he personally found odd.

Dr. Mainzer wanted to know what worked with the first round of Covid augmentations. Dr. New said that there has been no formal feedback from the community but SMD can obtain some data. The Directorate funded close to 90 percent of the augmentation requests, though this was only for early career, soft money researchers. Dr. Wadhwa suggested an RFI to assess further need, which Dr. New agreed was possible. He asked that the DAC members try to get a more qualitative sense from their communities. Dr. Liemohn observed that the need is strongest among people with younger children rather than strictly the career stage. The burden on parents is disruptive and having a negative impact on their work lives. Dr. Wadhwa was concerned about how to assess the needs of caregivers. Dr. New did not think that would go away, even as Covid impacts dissipate over time. They should be asking what aspects of the systems they can alter to better support caregiving. SMD has done some things in this area when PIs have sought relief. It was not clear if SMD should go beyond that. He wondered if the SC, DACs, or AGs should solicit information from the community.

Dr. Tucker said that the American Meteorological Society assists those who need caregiving support to attend meetings, both in person and virtually, noting some groups ask for scholarship money rather than meeting funds. She said that NASA may have to be creative in its efforts to aid researchers. Dr. Wadhwa would like the DACs to address the ongoing, systemic issue with caregivers by discussing how SMD could initiate programs to help. She remained concerned about individuals who were disproportionately affected by COVID-19. She hears about this issue anecdotally and thought it would be worthwhile to have a fast-track RFI to gauge whether there is an ongoing need. Dr. New said this course of action was possible; he requested that SC make it a recommendation.

The meeting adjourned for the day at 4:57 p.m.

Wednesday, November 10, 2021

Re-open Meeting

Mr. Callahan reopened the meeting. He reminded participants of the FACA regulations and all that they entail. He then introduced Dr. Wadhwa. She thanked the participants and introduced the first speaker.

Associate Administrator for Office of Diversity and Equal Opportunity (ODEO)

Dr. Stephen Shih, NASA's AA for ODEO, thanked the SC members and invited their input and questions. His primary responsibility at NASA is for internal Diversity, Equity, Inclusion, and Accessibility (DEIA) policies and procedures, with promotion of DEIA to the external community being a secondary responsibility. The Office of Personnel Management (OPM) conducts an annual survey that consistently finds NASA to be highly regarded within the federal government workforce for its support of diversity, as a place to work, and for inclusiveness and employee engagement. The survey supports these assertions with data. Dr. Shih said that NASA is just beginning its efforts in DEIA. He listed President Joseph Biden's DEIA priorities, all of which are unfunded but require significant work to be accomplished on similar timelines. He gave special attention to four Executive Orders (EOs):

- EO 13985: EO on Advancing Racial Equity and Support for Underserved Communities Through the Federal Government
- EO 13988: EO on Preventing and Combating Discrimination on the Basis of Gender Identity or Sexual Orientation
- EO 14020: EO on Establishment of the White House Gender Policy Council
- EO 14035: EO on Diversity, Equity, Inclusion, and Accessibility in the Federal Workforce

For NASA, EOs 13988 and 14035 are internal, while 13985 and 14020 are external. EO 13985 addresses the entire government's approach to providing more access and opportunity across the country, especially among under-represented and under-served communities. EO 14020 concerns a White House effort to develop a national government strategy on gender policy.

Dr. Shih provided the status of what NASA has done to address EO 13988:

- Guidance on Gender Transition and Identity – pending internal clearance.
- Policy for Restroom Inclusivity – implementation underway.
- Policy for Use of Gender-Inclusive Language – under development.
- Review of Badging and Security Procedures to Remove Barriers to EEO and Accessibility for LGBTQ+ Employees – implementation underway.
- Review and Updating of NASA's Astronaut Selection and Retention Standards – implementation underway.

Some older buildings present architectural issues with restroom inclusivity, but the Agency is finding ways to work around this problem. A question in the WebEx chat asked how the Agency is handling situations in which these federal policies conflict with state-level policies. Dr. Shih said this is an unsettled issue and compared it to federal masking requirements that conflict with local proscriptions on masking.

Dr. Shih provided NASA's status for EO 14035:

- DEIA Best Practices Submission – completed on Aug. 31, 2021.
- DEIA Assessment – completed on Oct. 4, 2021.
- DEIA Strategic Plan – drafted, awaiting White House issuance of Governmentwide DEIA
- Strategic Plan for alignment; due March 22, 2022

Dr. Shih also noted the response to EO 14020:

- NASA provided input and practices to inform the White House's development of a Government-wide strategy for advancing gender equity and equality, issued on Oct. 22, 2021. NASA will also contribute to the amplification and implementation of this strategy.

Dr. Cerf asked if there is a feedback loop for implementing these strategic plans. Dr. Shih described his philosophy for the foundation of the strategic vision. He said the challenge with many strategies across the federal government arises from the fact that they are often additional, compliance-oriented requirements that were not developed as part of an Agency's mission. Such strategies tend to be stand-alone and unfunded and are usually not developed inclusively. This leads to a compliance approach that leaves the strategy to fall by the wayside as just one of several of priorities, not central to the mission and diverting resources and time. The result is that people do not see their needs, ideas, and feedback reflected, eliminating any extrinsic motivator. There is also usually a lack of assessment to see if implementation has made a difference.

With this cautionary perspective in mind, Dr. Shih wants to think of DEIA as the health of the NASA workforce. He said NASA needs to conduct an evaluation to understand where the Agency stands and to diagnose conditions, problems, needs, and solutions. NASA will then apply solutions and follow with further assessment. Senior management needs to receive this data, then engage and lead on DEIA initiatives. NASA wants to elevate DEIA to the Administrator's office and to include the principal leaders of each NASA organization, cascading down to the management councils at each center as a means of ensuring horizontal and vertical alignment. Dr. Shih will be responsible for integrating the implementation plan, obtaining feedback, and promoting buy-in at all levels of the NASA workforce.

There will be DEIA councils at every NASA center and at Headquarters. Dr. Shih described employee resource groups that address various identities and interests, from race to gender identity to caregiving to career stage and more. These resource groups will provide the DEIA councils with data, ideas, and support. He continues to consider how to broaden inclusion and engagement of the workforce. NASA will have to ensure mission alignment to enable success, and the Agency needs the engagement of employees at all levels to achieve sustained support and cultural integration.

Dr. Shih presented NASA's implementation of EO 13985, Advancing Racial Equity and Support for Underserved Communities through the Federal Government:

- 90-Day Equity Assessment of agency programs and policies to assess whether underserved communities and their members face systemic barriers in accessing benefits and opportunities available pursuant to those policies and programs – completed on April 19, 2021.
- 200-Day Equity Assessment – completed Aug. 9, 2021.
- NASA Equity Plan to address any barriers to full and equal participation in agency programs and agency procurement and contracting opportunities – under development; due Jan. 20, 2022.
- NASA RFI and Public Meeting
 - On June 15, 2021, NASA issued an RFI, seeking public input on advancing equity and support for under-represented and underserved communities in NASA programs, contracts, and grants.
 - On July 13, 2021, NASA hosted a public meeting to discuss the RFI and further engage the public for input on implementing EO 13985.
 - Public input from the RFI and meeting are currently being reviewed to inform the development of the upcoming new NASA Equity Plan.

Recent DEIA initiatives and actions at NASA include the following:

- NASA Core Value of Inclusion; Symbolic Emphasis on DEIA in NASA Facilities and Missions
- Administrator's Policy Statement on DEIA.
- Anti-Harassment Campaign, Unity Campaign.
- Disability/Accessibility Summit
- DEIA Performance Requirement
- Diversity Dialogue Sessions
- Agency-wide Engagement

Dr. Shih noted that the anti-harassment program NASA established in 2018 promotes safety and mission success by helping employees feel they can speak out on issues or incidents involving harassment. It is an example of how NASA's DEIA campaigns align with the Agency's safety and mission assurance culture, which is a fundamental aspect in the thinking of many Agency employees. DEIA is branded not just as a compliance effort, but rather as an opportunity to reinforce the lessons learned from the pivotal tragedies that have shaped NASA. Past accidents were not just technical mishaps, they also revealed a lack of inclusion and cognitive diversity while uncovering complacency, optimism bias, and more. The results were damaging to the Agency's risk management and decision-making processes. By contrast, the anti-harassment program seeks to make employees feel secure in sharing unconventional thinking, which is key to both innovation and safety. The result is a reporting culture that is reinforced by actions taken due to the reports. Data from the campaign are limited to date but indicate progress and reduced processing times.

Dr. Shih described a Unity Campaign launched by NASA in 2019. NASA's external equity approach focuses on outreach and engagement in scientific competitions, grants and cooperative agreements with MSIs, procurement strategies, and STEM engagement. SMD has expanded its use of Dual-Anonymous Peer Review (DAPR) in grant reviews, a system that increases fairness and reduces unconscious bias in awarding research grants and is being used for the first research projects related to the Webb mission.

NASA is updating a code of conduct (SPD-22) for peer review panels while taking steps to ensure that these panels better reflect science community demographics.

Dr. Woodward posted a question in the WebEx chat noting that the strategies discussed align with NASA's fifth core value of inclusion. He asked how this change in direction will influence actions in the federally supported workforce that many of the Program Analysis Groups (PAGs) deal within their communities. Dr. Shih replied that the core value applies to the Agency's mission and operations broadly. SMD, as well as the rest of NASA, is committed to inclusion in all the Agency's work. The vision is to benefit all humanity. Dr. Wadhwa posed a question about the process and timeline for evaluating inputs from the RFI on advancing racial equity/support for under-served communities and implementing a selection of the strategies. Dr. Shih said that the equity plan is due in January. The internal plan is due in March. He then answered a question about data evaluation, which will be discussed in the monthly council meetings. Centers gather their own data and there is centralized data collection at the enterprise level. The focus on data generates healthy competition, as a science and engineering workforce finds data motivating. Dr. Woodward asked about the assessment and integration of division pilot programs with solicitations that include DEIA requirements. Dr. Shih said that these will be addressed by the individual offices.

Dr. Shih described the new Civil Rights Assurance Form, which reinforces existing requirements and now requires grant recipient institutions to promptly report information relating to new findings of discrimination at their institutions. There is a new requirement for those seeking financial assistance to certify that they have policies and procedures aligned with EO 13985. Dr. Shih's office does regular compliance reviews and finds grantees to be well aligned.

For procurement, NASA is developing new requirements that promote the acquisition of goods and services from small and minority-owned businesses. These include provisions to set aside resources for such businesses. Other procurement activities are being enacted as well. The Minority University Research and Education Project (MUREP) offers grants and cooperative agreements to MSIs, HBCUs, Hispanic-Serving Institutions (HSIs), and other organizations supporting under-represented groups. Dr. Shih then described a program with the Girl Scouts as an example of external equity in STEM engagement. This is just one of many such programs. He thanked the SC for their input and questions.

Discussion

Dr. Wadhwa thanked Dr. Shih and asked for further SC member questions. Dr. Woodward found the concept of DEIA as a means of engaging NASA's risk management culture to be striking and a novel approach. This is a new way of framing the conversation, he said. Dr. Shih said that it aligns with the NASA culture of risk management and mission success and presents a clear line to the importance, priority, and value of inclusion work. Casting DEIA as a risk mitigation strategy helps everyone understand why they should focus on enabling all people and elevates the confidence of those in under-represented groups to be visible.

Dr. Wadhwa asked about coordination with the open science initiatives. Some of the open science mandates could adversely affect institutions with fewer resources. Dr. Shih replied that enhanced engagement will lead to better situational awareness and approaches to these issues.

Dr. May said he applauds tying these initiatives to achievement of the mission, which provides initiative and makes the effort sustainable. He remarked on the coupling of MSIs, which are distinct from HBCUs and institutions that serve under-represented groups. He said there is a fair degree of cynicism about MSIs within the community, as the term has been appropriated by large institutions. He asked how NASA is addressing this issue. Dr. Shih said he was still thinking about this. His initial focus is on reaching

children to see the possibility of their contributions to science. He would like to think more broadly on how to best reach the community, rather than considering MSIs versus HBCUs.

SCaN Commercialization and Lunar Science/Artemis

Dr. Jeffrey Volosin, Deputy Director for Astrophysics, Mr. Gregory Heckler, Acting Director of the Commercial Services Office in Space Communications and Navigation (SCaN), and Mr. Andrew Petro, Lunar Communications and Navigation Architecture & Implementation Lead, provided an update on SCaN activities regarding commercial operators and Artemis. Mr. Heckler explained that commercialization has been a big topic for many years at NASA and presented some history. He stated the overall emphasis is on moving away from reliance on some government technology by leveraging commercial capabilities. Artemis is a pivot point and has led the Agency to think in terms of a network and lunar relay services. The driving requirements come from both SMD and human exploration, and SCaN continues to define these. Along with the lunar relay network, SCaN has identified a need for antenna upgrades and development, specifically upgrades to the 34-meter antennae and development of 18-meter antennae. The first step, which began in 2021, is upgrading the Deep Space Network (DSN) by retrograding two antennae at each of the three stations. This will not be sufficient, however, so NASA is establishing Lunar Exploration Ground Sites (LEGS), the 18-meter antennae, to enable near-space communications and free up DSN for more remote communications. There will be at least three LEGS stations for thorough coverage.

Mr. Petro explained that the lunar relay capability, which is new to SCaN, has been driven by the difficulty of communications with certain lunar regions such as the south pole. Any missions to the far side of the Moon will also require relay capabilities. SMD plans a robotic mission to the far side as early as 2024, and a range of other lunar missions could benefit from relay services that will provide better timing and precision. He described the needs and implementation plans for three timelines: current to 2024; 2024 to 2028; and 2028 and beyond. The goal in 2024 is to have the initial relay capability established. Compatibility and interoperability are core considerations. The second phase, 2024-2028, will involve more global coverage and more complexity in the missions covered and capabilities offered. The third phase will center on a sustainable presence on and around the Moon, with the incorporation of new technologies. A series of graphics depicted the communications architectures for both the early phase and the 2030 plan. He said there has been a great response from industry and international partners regarding interest in providing lunar relay services.

Mr. Heckler said that SCaN put out a draft interoperability standards document for lunar communications and navigation services and is seeking feedback from the commercial sector. Interoperability standards will be important as NASA procures services from a variety of sources. He noted that NOKIA won a Tipping Point award from NASA's Space Technology Mission Directorate (STMD) to demonstrate cell phone service technology on the lunar surface. NASA will use commercial capabilities and standards wherever possible instead of reinventing them. Vendors already have the needed capabilities for LEGS and the lunar relay. This new focus requires continuous market research and outreach, which is being conducted through a new office at Goddard Space Flight Center (GSFC), the Commercialization, Innovation, and Synergies (CIS) Office. The CIS charge is to identify new providers through a series of engagement initiatives, conduct market research, and facilitate RFIs to enable collaboration with SCaN on acquisitions. Mr. Heckler then gave a timeline of the industry engagement progress to date. Response has been strong, with about 35 responses to the RFIs.

Mr. Heckler summarized the presentation by noting that Artemis is a huge challenge for NASA that will require SCaN to leverage commercial capabilities for lunar communications in order to help preserve DSN capacity for communication with other missions further out in the solar system and even beyond. Regarding a question on robotics and humans in the loop versus autonomous vehicle travel, Mr. Heckler said the needs of the Volatiles Investigating Polar Exploration Rover (VIPER) are similar, as even

vehicles with humans will need to be able to be operated remotely. The combination of direct-to-Earth and lunar relay capabilities will provide that opportunity.

Discussion

Dr. Wadhwa thanked the team and asked if there were any SC members with questions. Dr. Cerf praised SCA_N's efforts and noted an international network focused on interplanetary work and multiple suppliers. He confirmed that the SCA_N team is in touch with that group and suggested that the SC might want a presentation on the international network in the future. Mr. Marc Weiser said that redundancy is important as NASA makes these investments. The dependence on the network goes up when there are humans in the loop as opposed to autonomous robotic operations. Mr. Heckler said they expect to have lunar capable DSN capacity and resiliency to make sure the preventive maintenance program does not result in unintended down time. It is important to have high reliability on unique assets. SCA_N has worked with NASA's exploration units and CLPS to position SCA_N's assets as a provider of last resort and to not have their missions locked into 34-meter antennae. This will help drive demand for commercial spacecraft services and international sources. This will provide a good solution to meet the lunar domain needs and move away from reliance on ground assets. On VIPER, SCA_N pushed for more autonomous operations and fewer humans in the operations and communications loop. The microwave spectrum presents another challenge. NASA leads the space frequency coordination group. The Agency understands the need for spectrum management and how it affects science missions on the moon and elsewhere.

Public Comment

The meeting was opened for comments from the public.

Dr. Alexa Halford asked what precautions will be put in place to make sure data from commercial entities will be made publicly available in support of open science best practices as well as IDEA principles. She also asked how research science and applied science payloads will be integrated into LunaNet, and how they will be funded.

Mr. Petro said that data still belong to the people who generate them, not those who convey them. Dr. Wadhwa said that this is something to watch as the open science policy is implemented, and it could result in a recommendation or finding. Because the data in question are in support of Agency missions and lunar applications, she thought this would still fall under the open science area. Mr. Heckler said that he agreed with Mr. Petro, that SMD requirements would apply. SCA_N reliably moves data from mission spacecraft to those behind the missions but does not own the data.

Mr. Petro said that for the second question, he thinks of communications and navigation assets as infrastructure, with the science and applications users separate from that. He does not see a conflict. Dr. Woodward noted that missions in development can encounter challenges with launch service providers, which could become an issue. Mr. Heckler said that SCA_N enables payloads and tries to identify the needs and capabilities.

Large Strategic Missions Study and Implementation Plan

Dr. Wanda Peters, SMD Deputy Associate Administrator for Programs, and Mr. John Gagosian, Deputy Director of the Joint Agency Satellite Division (JASD), discussed the SMD Large Mission Study (LMS) results and implementation plan. Mr. Gagosian began by describing the study that grew from SMD identifying the need for greater success in the delivery of large strategic missions. He mentioned that there were several LMS phases. NASA has begun applying the implementation plan to the MSR campaign and will apply it to missions resulting from the new astrophysics DS. The study and the implementation plan used two separate teams with some crossover to ensure that the study intent was

understood. Both teams emphasized diversity in membership. Mr. Gagosian showed the study methodology. The public report has been issued.

Principles for the study team included:

- Focus implementation on the most important problems/issues
- Don't attempt to change things that cannot be changed
- Seek input from the diverse spaceflight community
- Direct recommendations specifically to SMD leadership
- Ensure recommendations are limited, specific, actionable, and impactful
- Share final findings and recommendations broadly and openly

To keep things manageable, the teams decided to cap the number of recommendations at ten. The Study Team also defined large strategic missions for the Implementation Team as a framework. Dr. Peters noted that they talked to several projects dealing with lessons learned, including MSR project teams and the Webb team. Mr. Gagosian explained that the Study Team characterized the recommendations according to both their impact on project performance and the ability of NASA to implement them. Dr. Peters said that the Implementation Team accepted seven of the ten recommendations in their entirety, with three partial acceptances. The presenters then went through each recommendation.

Recommendation 1 addressed ***Pre-Phase A Team Composition***. Mr. Gagosian explained that large missions do a lot of work at this stage, as they tend to have long development cycles. The teams spend a lot of time defining measurements. NASA needs to emphasize this phase more and ensure the pre-project teams have the right skills and experience to translate decadal survey recommendations into viable mission architectures. Dr. Peters said that the Implementation Team accepted this recommendation, as there is a need to ensure these missions are implementable and executable. Her team did note the need to look within the Agency as part of the nationwide search for people with the necessary skill sets. There is also a need to do succession planning for consistency on these longer missions. The program offices are another factor, and large missions need a program director who can provide good insight and oversight.

The second recommendation centered on ***Pre-Phase A Architecture Trades and Descope Options***. Mr. Gagosian explained that it is important to avoid overly ambitious mission concepts that lead to unrealistic expectations and costly re-conceptualizations. Mission teams should develop architectures that avoid going beyond what is necessary to accomplish the goals. There is a corresponding need to have descope options as well. Dr. Peters said that the Implementation Team accepted this recommendation with its emphasis on requirement analysis and trades. It is important to develop plausible descopes and identify when options are no longer viable. Mission concept teams should push their projects to determine these by Mission Concept Review (MCR). It is important to make sure the descopes are seriously discussed and not just added to check a box on the list.

Recommendation 3 on ***System Maturity Assessment*** was based on a finding that NASA underestimates the impact that large mission complexity has on design and development timelines. Therefore, the Study Team advised the Agency to develop better evaluation tools for assessing the maturity of design concepts. The Implementation Team gave this recommendation a provisional acceptance, seeking follow-up in the form of four specific action items. The Implementation Team also pointed out that this recommendation essentially calls for a change in NASA's policies and practices.

Mr. Gagosian described the fourth recommendation about ***Technology Integration into Complex Systems*** as calling for technologies to be matured earlier in the project lifecycle. The complexity of large missions requires some flight elements to begin development before all the mission technologies have been demonstrated in a lab environment. This introduces a significant risk of not meeting system level

performance budgets. The Study Team advised achieving Technology Readiness Level (TRL) 6 earlier and having a new, system-level engineering demonstration standard. Dr. Peters said that this was a partial acceptance because the Implementation Team disagreed about the change in the TRL standard; it should be a goal, not a requirement, and a lot of these items should be settled by Phase B. The Team did agree that there should be increased scrutiny in the reviews. The team included an action item to engage the SMD Chief Technologist to leverage technologies and the community.

Recommendation 5, *Analytical Tools*, was also partially accepted by the Implementation Team. Mr. Gagosian explained that--driven largely by NASA's experience on Webb--the study team recommended that NASA fund development of engineering tools to reduce analysis cycle timelines. He also noted that disparity in margin philosophies among partners has been shown to cause issues. Dr. Peters said that the Implementation Team agreed that there should be a margin and risk philosophy and common tool sets, especially on large missions with multiple partners. What the team did not accept was defining what the common tools should be and who should determine that solution. This issue goes beyond engineering tools and encompasses programmatic tools. NASA needs to determine how the tool set is developed, who will fund it, and how it will be mandated. While this is outside the purview of SMD, the Directorate is a key stakeholder.

In the Webex chat, a process question arose regarding which prior missions were considered for purposes of determining “lessons learned.” Mr. Gagosian explained that the Study Team studied previous assessments of all large NASA missions from the last 20-30 years and talked to people who worked on missions as far back as Viking. More recent missions included Curiosity, Parker Solar Probe, Spitzer, and others that are mentioned in the report. Another question enquired about universal design considerations, which he took to mean connectors and fasteners and the like, and which the team did not discuss.

The sixth recommendation addressed *Cost and Schedule Estimation to External Stakeholders*, which Mr. Gagosian described as addressing openness regarding the level of uncertainty. Early in a mission life cycle, teams do not have an accurate sense of what a mission will cost. The Study Team asserted that NASA should portray its level of uncertainty by talking about cost bins, not costs. The Agency also needs to estimate the pre-formulation and formulation costs with as much precision and detail as possible to enable sufficient budgets for the early phases in which technologies are matured and designs are defined. Dr. Peters said that the Implementation Team thought the cost bins were an excellent idea. Missions have greater uncertainty early and it is not possible to plan for every contingency even with reserve postures. However, the Implementation Team did not want to be prescriptive and preferred a case-by-case determination. SMD has a lot of history showing the 70 percent JCL to be more successful than prior methods, and it may be worthwhile to look at 80-90 percent JCL levels. Mr. Gagosian added that in the mid-1990s, no one had any idea what Webb would cost and NASA would not know what a similar mission would cost if they started it today. Dr. Peters agreed. Experience with large missions has helped refine the Agency’s ability to gauge estimates and be more transparent and realistic.

The Implementation Team fully accepted Recommendation 7 on *Standing Review Boards* (SRBs) being established earlier in the process, especially so the Chair and Deputy Chair can begin work early. Mr. Gagosian explained that one of the issues for large missions is understanding how to integrate the many elements of very complex projects with multiple partners. Dr. Peters said that selecting the Chair and Deputy Chair earlier will help them understand mission complexity. The Implementation Team also noted issues with natural turnover and different focuses in the lifecycle stages. It is important to keep membership and skill sets up to date.

The eighth recommendation on the *Instrument Selection Process* was driven primarily by lessons learned from planetary science missions. The current process does not do a good job of evaluating how a collection of candidate instruments will operate together as an integrated payload. The Study Team

sought to ensure more interaction between the project and potential instrument providers early in the formulation process. Dr. Peters said that the Implementation Team agreed but noted that the SMD Deputy AA for Research is looking at this issue and needs more time. There also must be a mechanism to establish firewalls at NASA centers/labs so that they can contribute to the evaluation without prohibiting them from bidding. This leads to consideration of the procurement and legal aspects of the selection process. Overall, however, the Implementation Team agreed with the need for systems engineering support up front.

In the Webex chat, Dr. Liemohn pointed out that pre-proposal interactions could lead to established partners gaining an advantage. NASA should be proactive in ensuring that instrument proposers have fair access to this information. He asked if this was in the implementation plan. Mr. Gagosian replied that this is a reason the Study Team considered Recommendation 8 to be “difficult to implement.” However, Phase A and Pre-Phase A studies have been conducted while ensuring the integrity of the process. He gave the example of the Roman Space Telescope; the Phase A instrument studies greatly improved the overall system architecture. There are current studies for other missions, and he believes that NASA can do this while preserving procurement integrity. However, this does require the Agency to take care in the process.

The ninth recommendation focused on ***SMD Capabilities***. Mr. Gagosian said that NASA has a lot of oversight burden and must ensure that the program offices are as strong as possible. These are highly critical positions and NASA should take steps to bring in the best people. Dr. Peters agreed, noting that the Implementation Team emphasized the programmatic areas. These are executive leadership positions.

The final recommendation focused on ***Center Capabilities***. Mr. Gagosian said that while SMD does not run the NASA centers, the Directorate needs them and relies on each having the necessary capabilities for these long-term investments. The Study Team recommended more communication and dialogue to ensure the capabilities will be in place when needed. Dr. Peters said that the Implementation Team agreed. Large strategic missions work on a partnership model that requires communication and engagement. The dialogues need to continue once contractors are in place.

The conversation moved to the issue of separate budget lines for large missions. While Agency flagship missions like Webb may spend time operating as their own divisions, they will ultimately be divisional flagships. Dr. Peters thanked the SC and Mr. Gagosian. The two LMS teams are attempting to disseminate information regarding SMD’s activity on this topic, and to that end have been asked to brief the other NASA mission directorates to leverage lessons learned. The SMD AA is committed to this implementation plan.

Dr. Mainzer thanked the LMS teams for acknowledging the need for succession planning on missions with long timelines. Developing the workforce is a huge and necessary undertaking. Dr. Peters said that the workforce largely comes from the implementing centers and the contractors. As part of a plan to bring people in for the long-term missions, one thought was to have the SRB Chair, usually a senior person, followed by a mid-career Deputy Chair. In some cases, development time is shorter than flight time to the destination, and that is a consideration as well.

Division Advisory Committee (DAC) Chair Report

Astrophysics Advisory Committee

Dr. Woodward reported that APAC had a virtual teleconference in October focused on GPRAMA and an APD update, along with several presentations. Both GPRAMA performance goals were rated green. The APD update noted that Webb and IXPE will launch soon. APD will also have a Senior Review in spring of 2022, which will report to APAC in May. The Committee discussed the PBR as it reflects astrophysics,

specifically the House markup. There are notable differences between the House and Senate budgets, but the overall budget is healthy in both cases.

APAC has concerns about the science return from Webb, specifically that the R&A funding wedge is insufficient to support the level of research appropriate for such a complex and expensive mission. This led to a recommendation:

APAC strongly advises the APD work aggressively to more fully fund investigators' research and analysis requirements for the JWST Cycle 1 work efforts and to manage resources to accelerate meeting the full funding of these efforts to maximize timely and impactful return on the \$10B national investment in the flagship mission.

There is also concern about the Webb name. APAC had made multiple requests for an address on this, and the NASA historian spoke at the October meeting. The current assessment is that there is no proof of culpability. However, APAC was dismayed to learn that there is no report thus far, nor is there a plan for a report. This led to a couple of recommendations:

Critically review whether naming of flagship missions that has traditionally occurred within APD over the past few decades is appropriate, or whether APD should follow a tact more aligned with other SMD divisions in their naming of NASA flight assets;

and,

Work with the NASA Historian to fully and completely document the current status of investigation of archival materials, conversations, and other sources that culminated in the Administrator's decision of record in a written report.

The NASA historian said that if new information becomes available, the conversation could be reopened. This is a highly contentious issue. Nonetheless, the astrophysics community does look forward to the launch of this platform.

Other meeting highlights included the Senior Review process; Hubble Fellowships and a path for improvement; the possibility that ESA's Athena mission, in which NASA is a partner, might not be able to meet its key science objectives; the impact of supply chain issues on the Roman mission; how best to coordinate the Euclid, Roman, and Rubin assets; and Keck access. APAC also seeks continual updates on the information policy implementation.

Dr. Wadhwa thanked Dr. Woodward and asked if there had been any surprises in the recently released astrophysics DS. Dr. Woodward explained that APAC met prior to the release and has not yet had an opportunity to discuss it. Speaking strictly as a private citizen, he found a few surprises. The creation of a technology development office is an interesting sort of recommendation but with puzzling implementation. There were suggestions of missions that are on a 20-year timeline or more, and while many flagships do take more than a decade, that surprised him. There was good discussion of probes and Explorers, yet he was very surprised to find no mention of Artemis or CLPS. He views that as an opportunity lost.

Discussion, Recommendations, and Findings

Dr. Cerf said that captioning is increasingly common and should be available in keeping with IDEA and accessibility. Mr. Callahan said that NASA has considered this and ran a pilot with a DAC meeting. He expects captioning at the next SC meeting but was still unsure about signing. Dr. Cerf said that Google provides signing services for employees and visitors who need them; he would assume NASA would do the same. This would be an observation if not a recommendation. Dr. Mainzer said that PAC had a finding on that.

Dr. Wadhwa said that it was not clear if they needed a Covid recommendation. Dr. New had mentioned the RFI. Dr. Liemohn thought it would be useful because the impact of Covid is continuing. Dr. Wadhwa also thought the concerns about the open science policy and the impact of unintended consequences might be worth reporting. Some SC members had advised caution regarding unfunded mandates that could affect R&A. Dr. Woodward said that SPD-41 creates a large unfunded wedge of effort that is unconstrained in requiring long-term maintenance of software. Dr. Liemohn suggested that the policy provide a timeline rather than infinite maintenance. It is difficult to estimate the cost. Dr. Wadhwa noted that there were concerns about the validation of data in addition to software. Dr. Cerf wondered if they should be thinking about a federal capability for this, which could be cross-cutting. Dr. Wadhwa replied that the issue was a policy already up for comment, and his idea was beyond the SC purview.

Dr. May observed that among the unintended consequences of open science is the possible sharing of unfiltered information with other nations that do not share with the United States. He asked how this was being handled as a nation. Dr. Godwin added that there are ITAR exceptions, but she was also thinking about the cooperating nations. Nonetheless, she would think that China would be excluded by SPD-41. Dr. Cerf pointed out that it is hard to hide public data. When Dr. Woodward mentioned the need to scrub some dual-use software codes, Dr. Cerf said that there are classes of data NASA wants to control. Dr. Tucker added that China provides data in the weather field, but many U.S. organizations are prohibited from using it because it is risky.

Dr. Wadhwa listed possible future discussion topics. She wanted to follow up with closed captioning and signing. Dr. Woodward endorsed Dr. Cerf's comment about SCaN and the need for an integrated system. Dr. Cerf elaborated, stating his concern that the presentation emphasized links and ground stations. The SC could ask for clarification on their architectural model, since it involves a mix of government and commercial assets. Dr. Wadhwa agreed.

Outbrief to SMD AA

Dr. Thomas Zurbuchen, SMD AA, joined the meeting. Dr. Wadhwa reviewed the discussion about Covid impacts and a possible recommendation to put out another RFI to determine if there is a need for another augmentation. She reported that the SC engaged in a robust discussion about the open science initiative and SPD-41. The SC generally supported the effort but also expressed some caution about unfunded mandates, especially for institutions that have fewer resources. This issue has nuances to be considered. The SC expressed additional concerns about how to validate data and software. Finally, the SC recognized that the community will require a cultural shift to implement this initiative.

The SC was impressed with the Agency commitment to IDEA. Some questions arose about the pilot programs, specifically how they will be pulled together and assessed to move forward into the longer term with the best ideas. This was from Dr. Shih's presentation. Dr. Zurbuchen replied that there has been a lot of learning in this arena, some of which goes beyond NASA. He is not going to tell people to stop their effort in this area but he also does not want to create a lot of smaller, uncoordinated programs that may not achieve desired results. NASA needs to identify what does and does not work. He appreciated the feedback. He asked Mr. Callahan to pursue captioning of meetings.

Dr. Woodward praised the strategy that Dr. Shih articulated of DEI as risk management. That perspective integrates it into the fabric of the entire Agency. Dr. Tucker thought it was great that the policies focus first on the internal and then the external, but she would like to hear about that interface, such as interactions between NASA program managers and grantees. Dr. New explained that the majority of NASA research dollars are spent outside of the Agency. SMD has been evaluating training programs for everyone and has a contract with a proposal writing presentation group. Such events have occurred since 2004. SMD also talked about PI Launchpads, which are open, and there are other programs and presentations. A web page offers resources for new PIs, and there is information on how to report

harassment. All missions have public-facing websites. Dr. Tucker said that she was interested in how program managers treat their grantees. Dr. New replied that SMD has been developing codes of conduct for those interactions, with training that included bystander intervention.

Dr. Liemohn asked about the sustainability of the Launchpads. Dr. New explained that SMD intends to continue offering the Launchpad every 12-18 months. The first was in-person and the second was completely online, so they have both taken a lot of work. Sustainability is something SMD is considering, especially since there have been outside funding and organizational contributions. Dr. May commended NASA on the IDEA initiatives. He pointed out the need to address the ambiguity in the term “MSI,” which has become diluted as major universities consider themselves to fall under that category. More precision in the outreach would be helpful.

Dr. Wadhwa said that another issue related to the division of HEOMD and the structure of the SC’s annual joint meeting. Dr. Zurbuchen said that NASA still wants the advisory committees to come together. Dr. Liemohn asked about the LMS recommendations; Dr. Zurbuchen said that they are still under review.

Adjourn

The meeting was adjourned at 4:58 p.m.

Appendix A
Participants

NAC Science Committee Members

Dr. Meenakshi Wadhwa, Arizona State University, *Chair*
Dr. Vinton G. Cerf, Google
Dr. Linda Godwin, University of Missouri
Dr. Michael W. Liemohn, University of Michigan
Dr. Amy Mainzer, University of Arizona
Dr. Willie E. May, Morgan State University
Dr. Sara Tucker, Ball Aerospace
Dr. Charles E. Woodward, University of Minnesota, Astrophysics Advisory Committee
Mr. Jason Callahan, NASA Headquarters, *Designated Federal Officer*

Other Participants

Lorella Angelini
Alexandra Antoine
Louis Barbier
Peter Bender
John Bergstresser
Lora Bleacher
Jan Joris Brüggmann
Kevin Burke
Claude Canizares
Sun Chan
David Cheney
Steven Crawford
Etienne Dauvergne
Laura Delgado Lopez
Brett Denevi
David Eisenman
Sylvie Espinasse
Jeff Foust
Galen Fowler
John Gagosian
Chelle Gentemann
Tyler Green
Ben Greenhagen
Richard Griffiths
Alexa Halford
Diane Hammons
Brian Harvey
Hashima Hasan
Gregory Heckler
Saki Hirama
Douglas Isbell
Linda Karanian
Jennifer Kearns
Charles Lillie
James Lochner

Robert Lock
Bonnie Meinke
Glenn Morris
Kevin Murphy
Asal Naseri
Michael New
Rachel O'Connor
Roopesh Ojha
Masami Onoda
Peter Orel
Lucas Paganini
Wanda Peters
Andrea Peterson
Andrew Petro
Ursula Rick
Michael Robinson
Richard Rogers
John Rummel
Mark Schattenburg
Andrew Schurr
Joel Scott
Elizabeth Sheley
Stephen Shih
Mary Sladek
Marcia Smith
Harvey Tananbaum
David Traore
Lucia Tsaoussi
Kota Umeda
Jeffrey Volosin
Keith Warfield
Shoshana Weider
Marc Weiser
Eboni Whitfield-Miles
Ashlee Wilkins
Thomas Zurbuchen

Appendix B
NAC Science Committee
Membership

Dr. Meenakshi Wadhwa (Chair)
Arizona State University

Mr. Jason Callahan (Designated Federal Officer)
NASA SMD

Dr. Noel Bakhtian
Lawrence Berkeley National Laboratory

Dr. Vinton G. Cerf
Google

Dr. Linda Godwin
University of Missouri

Dr. Michael W. Liemohn
University of Michigan

Dr. Amy Mainzer
University of Arizona

Dr. Willie May
Morgan State University

Dr. Sara Tucker
Ball Aerospace

Dr. Charles E. Woodward
University of Minnesota

Appendix C
Presentations

1. NASA Science Update; *Michael New*
2. SMD Transform to Open Science (TOPS); *Steven Crawford, Kevin Murphy, Chelle Gentemann*
3. HPAC: Heliophysics Advisory Committee Report to the NASA Science Committee; *Michael Liemohn*
4. ESAC: Earth Science Advisory Committee Report to the NASA Science Committee; *Sara Tucker*
5. PAC: Planetary Science Advisory Committee Report to the NASA Science Committee; *Amy Mainzer*
6. Associate Administrator for Office of Diversity and Equal Opportunity (ODEO); *Dr. Stephen Shih*
7. SCaN Commercialization and Lunar Science/Artemis; *Jeffrey Volosin, Gregory Heckler, Andrew Petro*
8. Large Strategic Missions Study and Implementation Plan; *Wanda Peters, John Gagosian*
9. APAC: Astrophysics Advisory Committee Report to the NASA Science Committee; *Charles Woodward*

Appendix D

Agenda

**NASA Advisory Council
Science Committee
Virtual Meeting
November 9-10, 2021**

Tuesday, November 9, 2021

1:00 – 1:05	Opening Remarks / Introduction of Members	Mr. Jason Callahan Dr. Meenakshi Wadhwa
1:05 – 1:10	Goals of the Meeting	Dr. Meenakshi Wadhwa
1:10 – 2:00	NASA Science Update	Dr. Michael New
2:00 – 3:00	SMD Transform to Open Science (TOPS)	Dr. Steven Crawford Mr. Kevin Murphy Dr. Chelle Gentemann
3:00 - 3:15	Break	
3:15 – 4:00	Division Advisory Committee (DAC) Chair Reports Heliophysics Advisory Committee Earth Science Advisory Committee Planetary Science Advisory Committee	Dr. Michael Liemohn Dr. Sara Tucker Dr. Amy Mainzer
4:00 – 5:00	Wrap-Up Discussion	All

Wednesday, November 10, 2021

1:00 – 1:10	Re-open Meeting	Mr. Jason Callahan Dr. Meenakshi Wadhwa
1:10 – 1:55	Associate Administrator for Office of Diversity and Equal Opportunity (ODEO)	Dr. Stephen Shih
1:55 – 2:40	SCaN Commercialization and Lunar Science/Artemis	Dr. Jeffrey Volosin Mr. Gregory Heckler Mr. Andrew Petro
2:40 – 2:45	Public Comment	
2:45 – 2:55	Break	

NAC Science Committee Meeting, November 9-10, 2021

2:55 - 3:40	Large Strategic Missions Study and Implementation Plan	Dr. Wanda Peters Mr. John Gagosian
3:40 – 3:55	Division Advisory Committee (DAC) Chair Report Astrophysics Advisory Committee	Dr. Charles Woodward
3:55 – 4:30	Discussion, Recommendations, and Findings	All
4:30 – 4:45	Outbrief to SMD AA	Dr. Meenakshi Wadhwa Dr. Thomas Zurbuchen
4:45	<i>ADJOURN</i>	

Appendix E

WebEx Chat Transcripts

DAY 1

from Meenakshi Wadhwa (Ext) to everyone: 1:16 PM

SC members: Please feel free to add your comments or questions to the chat here. I will try to track and will call on you after the presentation.

from Michael Liemohn (Ext) to everyone: 1:17 PM

Ocean cargo insurance is more fascinating than the name might suggest.

from Amy Mainzer (Ext) to everyone: 1:18 PM

Michael can you give you a quick overview of the timetable for JWST's in orbit checkout?

from Amy Mainzer (Ext) to everyone: 1:19 PM

Thanks, Michael.

from Sara Tucker (Ext) to everyone: 1:28 PM

Michael - will the IDEA requirements be focused on mission level AOs or will they expand down to smaller levels such as ROSES?

from Sara Tucker (Ext) to everyone: 1:32 PM

Yes!

from vinton cerf (Ext) to everyone: 1:44 PM

Is this a consequence of better cost estimating tools

from Laura Delgado Lopez (Int) to everyone: 1:56 PM

To respond to the Chair's question about the RFI, NASA has a cross-agency team in place reviewing all of the responses we received through the end of the year. Steve Shih may indeed have more details to add.

from Richard Griffiths (Ext) to all panelists: 2:00 PM

NASA at COP26:<https://www.nasa.gov/feature/nasa-at-the-un-climate-change-conference/>

from Amy Mainzer (Ext) to everyone: 2:01 PM

Thanks for the link, Richard.

from Steve Crawford (Int) to all panelists: 2:14 PM

<https://science.nasa.gov/researchers/science-data/science-information-policy>

from Sara Tucker (Ext) to everyone: 2:19 PM

Great to hear you are working with organizations like AMS, AGU, AAS, etc. to promote these ideas. Have you had discussions with organizations like OSA and SPIE?

from vinton cerf (Ext) to everyone: 2:20 PM
i have questions about Open Science when that is timely

from Meenakshi Wadhwa (Ext) to everyone: 2:25 PM
Will come back to you on this at the end of Chelle's presentation, Vint.

from Marc Weiser (Ext) to everyone: 2:35 PM
How do you think about lookback at past & ongoing work vs future work?

from Linda Godwin (Ext) to everyone: 2:37 PM
Are our international partners also moving in this direction?

from Amy Mainzer (Ext) to everyone: 2:42 PM
Are researchers going to be expected to provide ongoing support for software that is delivered? This sounds like it could put a substantial burden for maintaining code on researchers without providing funding for them to do so.

from Chick Woodward (Ext) to everyone: 2:42 PM
'd be interested to here how to support the open software community, who contribute efforts that are not well supported... also the question revolving around AI and machine-learning codes re: ITRAR/EARS/CUI to be managed?

from vinton cerf (Ext) to everyone: 2:43 PM
I have other questions to cover later

from Sara Tucker (Ext) to everyone: 2:43 PM
I have a question about NASA expectations for industry investments vs. open source. data.

from Marc Weiser (Ext) to everyone: 2:50 PM
Given the increasing commercial partnerships, do you have expectations of how they participate on a broader scale? Or, is this going to be primarily non-commercial participants?

from Kevin Murphy (Int) to all panelists: 2:50 PM
With respect to data quality, we fund science teams and QA/QC teams to constantly evaluate products generated by NASA instruments. We also fund reprocessing efforts to improve data quality over time

from vinton cerf (Ext) to everyone: 2:50 PM
Amy's question is very relevant. Some software widely used doesn't get adequate support such as Network Time Protocol software support that has a part-time volunteer.

from vinton cerf (Ext) to everyone: 2:53 PM
Just having raw code may be insufficient - it typically runs in some context so that has to be available for someone to reproduce experiments for example.

from Chick Woodward (Ext) to everyone: 2:53 PM
agreed with Amy ... its a large burden, and software sometimes is not easily scoped...

from vinton cerf (Ext) to everyone: 2:54 PM
Does Open Archival Information System standard have a role for data/software sharing initiative?

from vinton cerf (Ext) to everyone: 2:54 PM
Are Jupyter Notebooks contributing to open sharing?

from vinton cerf (Ext) to everyone: 2:55 PM
Would use of containers improve the ability of researchers to use each other's code?

from Chick Woodward (Ext) to everyone: 2:55 PM
also was it missing is the issue in interoperability of platforms, codes, and archives to advance community science access

from Michael Liemohn (Ext) to everyone: 2:56 PM
My institution has a data repository that mints DOIs for your code brick or software set (accompanying a study, for instance). It's managed through the library, with staff to help you. This is great...for people like me at a major research university. Does NASA have a plan to help those at smaller institutions make this transition to archived data and code?

from vinton cerf (Ext) to everyone: 2:57 PM
how about dropping the shared slides so we can see more of the panel?

from Chick Woodward (Ext) to everyone: 2:57 PM
but can those value added activities be commercially monetized and hence get taken out the public domain as a result?

from Amy Mainzer (Ext) to everyone: 2:58 PM
Great question, Michael. My fear is that the burden of paying for this is not equitably distributed among institutions.

from Jason Callahan (Int) to Andrew Schurr (Int) (privately): 2:58 PM
Got a request from a member to turn slides off during discussion

from Michael New (Int) to everyone: 3:03 PM
Mini: Can I respond to this question, too?

from Steve Crawford (Int) to all panelists: 3:03 PM
Jupyterhub, containers, different DOI services, existing standards, and community best practices are all part of the guidance and training we will be developing to provide to the community

from Meenakshi Wadhwa (Ext) to everyone: 3:05 PM
Apologies, Michael - just saw your note. Are you around for the discussion period?

from Meenakshi Wadhwa (Ext) to everyone: 3:07 PM

SC committee members: There are some important points/comments in the chat that I would like us to revisit in our wrap up discussion. Please make note of those points that you want to come back to.

from Kevin Murphy (Int) to all panelists: 3:16 PM

@Vint - OASIS definitely informs how we build archives. One example of OASIS for search is available from <https://cmr.earthdata.nasa.gov/opensearch/home/docs>.

Jupyter is a big part of how we are supporting collaboration. It is a critical component of the NASA-ESA Multi-Mission Algorithm and Analysis Platform (MAAP) - <https://scimaap.net/>

from Sara Tucker (Ext) (privately): 3:18 PM

Hi Jason, did my slides get integrated? I have them ready in case they did not.

from vinton cerf (Ext) to everyone: 3:26 PM

@kevin OASIS not OASIS ?

from vinton cerf (Ext) to everyone: 3:30 PM

@Michael - does the rotation of the sun result in twisting of magnetic field lines around the sun resulting in delivery of particles from a solar ejection traveling around the sun along the twisted field lines?

from Michael Liemohn (Ext) to everyone: 3:36 PM

@Vint: yes. The energetic particles both follow the spiraling magnetic field lines as well as drift across them.

from vinton cerf (Ext) to everyone: 3:39 PM

@michael - thanks

from Michael Liemohn (Ext) to everyone: 3:40 PM

I have a quick question for Sarah, too.

from vinton cerf (Ext) to everyone: 3:41 PM

this discussion introduces a while new definition of Cloud Computing!

from Chick Woodward (Ext) to everyone: 3:50 PM

Amy yes there are PAGS and SIGS that are doing some of these special assessment topics

from Chick Woodward (Ext) to everyone: 3:50 PM

in the APAC

from vinton cerf (Ext) to everyone: 3:52 PM

VERITAS - to get solid historical data do we need real samples from a lander?

from vinton cerf (Ext) to everyone: 3:54 PM

"to hell and back" ...

from Chick Woodward (Ext) to everyone: 3:55 PM

Is progress being made in understanding the power impact of the non-latched solar panel in LUCY, and any impacts on mission profiles determined?

from Michael New (Int) to everyone: 3:56 PM
Yes, that's correct.

from Chick Woodward (Ext) to everyone: 3:56 PM
thanks

from Chick Woodward (Ext) to everyone: 3:57 PM
APD runs a LuanchPad initiative and is contemplating a deeper bridge program activity (similar to what Michael New described this morning)

from vinton cerf (Ext) to everyone: 4:00 PM
YAY, Meeni!!!!!!

from Chick Woodward (Ext) to everyone: 4:01 PM
Apophis in LEO?

from Chick Woodward (Ext) to everyone: 4:04 PM
correct with the H2O program, as it is an embedding mentorship

from David Traore (Ext) to all panelists: 4:08 PM
A Spacecraft mission to Apophis should be an interesting approach.

from Chick Woodward (Ext) to everyone: 4:15 PM
How will NASA manage repositories (for code) vs infrastructure for data archives

from vinton cerf (Ext) to everyone: 4:19 PM
keep in mind sustainable support of internally developed software or open source software

from Chick Woodward (Ext) to everyone: 4:21 PM
What are the NASA Centers who develop mission etc, being folding into this conversation and also impacts with SDP-41

from Willie E. May (Ext) to everyone: 4:28 PM
Have to run at 4:30 for another meeting that I am leading. See everyone tomorrow

from vinton cerf (Ext) to everyone: 4:28 PM
bye Willie - great to see you again!

from Jason Callahan (Int) to everyone: 4:29 PM
Thank you, Dr. May. See you tomorrow.

from vinton cerf (Ext) to everyone: 4:32 PM
collaboration only works if there is a strong sense of trust of the participants and their intent and motivations

from Chick Woodward (Ext) to everyone: 4:32 PM
bingo Vint

from Chick Woodward (Ext) to everyone: 4:45 PM
yes we definitely have some long-Covid impacts to science folks ...

from Marc Weiser (Ext) to everyone: 4:46 PM
I believe we had a recommendation COVID-19 impact, including on early career researchers from last year. Might be helpful to understand what worked vs didn't meet expectations in terms of support.

from Chick Woodward (Ext) to everyone: 4:46 PM
Mini .. yes the lunar environment is right now

from Amy Mainzer (Ext) to everyone: 4:47 PM
Great idea, Mark, and Mini thanks for raising this.

from Chick Woodward (Ext) to everyone: 4:49 PM
has anyone said "thanks?"

from Chick Woodward (Ext) to everyone: 4:50 PM
that would be a good "charge" to the various PAG here on the line ...

from vinton cerf (Ext) to everyone: 5:00 PM
what about public comment or questions?

from Michael Liemohn (Ext) to everyone: 5:00 PM
Tomorrow.

from vinton cerf (Ext) to everyone: 5:00 PM
ok

from Chick Woodward (Ext) to everyone: 5:01 PM
bye

DAY 2

from Meenakshi Wadhwa (Ext) to everyone: 1:21 PM
SC members: Please feel free to add your comments or questions in the chat. I'll try to keep track to address either during or after the presentations.

from Chick Woodward (Ext) to everyone: 1:27 PM
Do implementation of these policies at the federal level supersede those of certain States that are at variance?

from Chick Woodward (Ext) to everyone: 1:27 PM
Does

from Chick Woodward (Ext) to everyone: 1:40 PM

The strategies discussed are aligned with NASA 5th core value of inclusion, so the culture is key to the pivot internally. How will this change in direction influence actions in the federally supported workforce (that many of the PAGES deal with their communities)?

from Meenakshi Wadhwa (Ext) to everyone: 1:45 PM

Steve, I was wondering about the process & timeline for evaluating inputs from the RFI on Advancing Racial Equity/support for underserved communities to implementing a selection of the strategies?

from Linda Godwin (Ext) to everyone: 1:46 PM

data is compiled from NASA centers and dependent on their processes?

from Vint Cerf (Ext) to everyone: 1:49 PM

does this mean reviewers need to take their shoes off when evaluating proposals to NASA :-)

from Chick Woodward (Ext) to everyone: 1:51 PM

some divisions running pilot experiments with DEIA requirements in their solicitation, how will these experiments be integrated and assessed?

from Chick Woodward (Ext) to everyone: 1:51 PM

are running

from Marc Weiser (Ext) to everyone: 1:53 PM

Are you coordinating with the Open-Science initiative? How so?

from Chick Woodward (Ext) to everyone: 1:54 PM

I find it extremely interesting that DEIA is being also framed as a means to address risk management in terms of philosophy ...can you comment on this perhaps novel and different "justification"

from Willie E. May (Ext) to host (privately): 1:58 PM

Would like to make a comment

from sara tucker (Ext) to host (privately): 1:59 PM

Building on Chick's earlier comment regarding actions in the federally supported workforce - does the policy address avoiding harassment in the relationship between NASA grant program managers and the external community (grantees)?

from Willie E. May (Ext) to host (privately): 2:00 PM

Aligning these initiatives to execution of mission is a very good idea

from Michael Liemohn (Ext) to everyone: 2:01 PM

One of the 4 efforts within Open Science was "open=inclusive" science. Is this what you meant Marc?

from Chick Woodward (Ext) to everyone: 2:04 PM

on point Willie

from Chick Woodward (Ext) to everyone: 2:13 PM

is there any discussion about maintaining some internal competence and capabilities for both ground-station and LEO for mission critical redundancy and guaranteed bandwidth, etc.?

from Vint Cerf (Ext) to everyone: 2:15 PM

Chick - there is a significant complement of NASA people from most of the Centers working on the DTN network design, standardization and implementation.

from Chick Woodward (Ext) to everyone: 2:16 PM

yes, maybe i misunderstood the strategy of 100 percent reliance on commercial looking forward...

from Marc Weiser (Ext) to everyone: 2:16 PM

How are you thinking about redundancy in the system for the future? For example, when Australian DSN went offline for upgrade, there wasn't ability to send signal to Voyager 2.

from Chick Woodward (Ext) to everyone: 2:17 PM

@marc ... good example

from Vint Cerf (Ext) to everyone: 2:17 PM

I think the idea is to accommodate substantial commercialized service but I believe a strong technical capability should be inboard of NASA.

from Marc Weiser (Ext) to everyone: 2:17 PM

@chick, didn't see your question. Yes, what Chick asked.

from Vint Cerf (Ext) to everyone: 2:18 PM

Marc, likely we should design the Solar System Internet to incorporate substantial resilience, multi-path options as we have with the terrestrial Internet.

from Vint Cerf (Ext) to everyone: 2:21 PM

Most of the information to/from Mars since 2004 has used store/forward relay.

from sara tucker (Ext) to host (privately): 2:21 PM

Is the SCA_N program keeping the spectrum needs of Earth observation systems in mind in terms of avoiding adding noise to weather observations (i.e., microwave bands) as well as low-latency communication needs?

from Vint Cerf (Ext) to everyone: 2:22 PM

This is not the same as "bent pipe" relay but more like Internet.

from Chick Woodward (Ext) to everyone: 2:23 PM

Are the LunaNet communication protocols compatible with those in the commercial sector, whose presence will grow in the trans-lunar and surface environment?

from Marc Weiser (Ext) to everyone: 2:23 PM

As you look at the overall system design for Artemis/Moon, how do you take into account some of the science mission specs that require human in the loop for certain robotic missions, like VIPER (thus again redundancy, even on the far side of the moon)?

from Vint Cerf (Ext) to everyone: 2:24 PM

CCSDS "solar system internet" is relevant to this discussion. see also IPNSIG.ORG

from Vint Cerf (Ext) to everyone: 2:26 PM

Marc - we did real-time robotic control from ISS to Earth using the DTN protocol suite several years ago.

from Vint Cerf (Ext) to everyone: 2:30 PM
IETF and CCSDS standards are in sync for referencing

from Chick Woodward (Ext) to everyone: 2:36 PM
is anyone tracking the cumulative effect of rely and other satellite transmission capabilities on the overall impact to the power, noise and frequency utilizations as ground-based observatories are now under increasing challenges with ESM contamination?

from sara tucker (Ext) to everyone: 2:39 PM
Is the SCaN program keeping the spectrum needs of Earth observation systems in mind in terms of avoiding adding noise to weather observations (i.e., microwave bands) as well as low-latency communication needs?

from Vint Cerf (Ext) to everyone: 2:44 PM
It's really important to develop a multi-network operation to achieve more redundancy.

from Vint Cerf (Ext) to everyone: 2:45 PM
We have to get past focus on antennas and focus on network architecture, multi-provider systems.

from Meenakshi Wadhwa (Ext) to everyone: 2:46 PM
I think we will need to move on to the next part of agenda after Greg addresses this last question.

from Vint Cerf (Ext) to everyone: 2:46 PM
OK

from Alexa (She/Her) Halford (Int) to all panelists: 2:47 PM
What precautions will be put in place to make sure data from commercial entities will be made publicly available in support of open science best practices as well as IDEA principals?

from Alexa (She/Her) Halford (Int) to all panelists: 2:47 PM
How will science and applied science payloads be integrated into LunaNet, and how will they be funded? Through ROSES or HEO?

from Brian Harvey (Ext) to host (privately): 2:48 PM
Who benefits most from SCaN?

from Alexa (She/Her) Halford (Int) to all panelists: 2:50 PM
Yes - We often have to pay for data from commercial entities like SPIRE - or from AMPERE or WOLLEN or REACH and this can inhibit the ability of people to participate.

from Wanda Peters (Int) (privately): 2:58 PM
Hello Jason, I am online as an attendee. I cannot unmute or start my video

from Marc Weiser (Ext) to everyone: 3:28 PM
As you looked at the technology recommendations, did you get as specific as universal design considerations? For example, with in situ repair capability?

from Meenakshi Wadhwa (Ext) to everyone: 3:30 PM

A process question: for this study, which specific SMD prior missions were considered from a "lessons learned" perspective (I am assuming JWST, but which others?)?

from Chick Woodward (Ext) to everyone: 3:34 PM

But JWST blew through various cost bins, and external stakeholders could not understand how to budget for outyear obligations ... so does 6 have an implicit admission that costs cannot be accurately estimated even parametrically?

from Chick Woodward (Ext) to everyone: 3:37 PM

thanks

from Michael Liemohn (Ext) to everyone: 3:44 PM

On #8: the pre-proposal interaction could lead to established partners having a preference. NASA should be proactive in ensuring a fair access of instrument proposers to this information. Does the implementation plan address this?

from Chick Woodward (Ext) to everyone: 3:46 PM

if these [program offices are stood up, would they carry separate budget lines independent from the divisions (like the Webb model)?

from sara tucker (Ext) to everyone: 3:50 PM

These are great findings and implementation plan approaches for the NASA mission – I'm curious how these ideas apply to NOAA missions run by NASA?

from Amy Mainzer (Ext) to host (privately): 3:51 PM

Would you be able to comment on the need for succession planning for these long developments?

from Vint Cerf (Ext) to everyone: 4:03 PM

is "colling" a typo for "cooling"

from Vint Cerf (Ext) to everyone: 4:22 PM

Vint has a question about preservation of data and software.

from Chick Woodward (Ext) to everyone: 4:26 PM

Mini it is very important that we continue to ask that SMD talk with universities, NASA centers, industrial partners etc. about the implications requirements and impacts of SDP-41

from Amy Mainzer (Ext) to host (privately): 4:27 PM

Agreed, Chick.

from Chick Woodward (Ext) to everyone: 4:27 PM

Willie -- reciprocity aka open=skies interesting point!

from Vint Cerf (Ext) to everyone: 4:27 PM

Vint has a comment on information sharing

NAC Science Committee Meeting, November 9-10, 2021

from Louis Barbier (Int) to host (privately): 4:29 PM

Open data (and open science in general) refer to the published scientific literature. It excludes ITAR, patents, proprietary information, personal information, etc.

from Chick Woodward (Ext) to everyone: 4:37 PM

Jason sent out a revised agenda this morning :-)

from Michael Liemohn (Ext) to everyone: 4:51 PM

I have a follow-on question regarding the PI Launchpad Workshop.

from Jason Callahan (Int) to Meenakshi Wadhwa (Ext) (privately): 5:03 PM

We're clear, can start closed session.

from Chick Woodward (Ext) to everyone: 5:42 PM

thanks all stay well