National Aeronautics and Space Administration

Technology, Innovation, & Engineering Committee
of the
NASA Advisory Council

NASA's Goddard Space Flight Center
Greenbelt, MD
March 26, 2018

Meeting Minutes

G. Michael Green, Executive Secretary

William F. Ballhaus, Jr., Chair

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Meeting Report prepared by
Elizabeth Sheley

NAC Technology, Innovation and Engineering Committee Meeting
March 26, 2018
NASA's Goddard Space Flight Center (GSFC)
Greenbelt, MD

Open Meeting

Welcome and Overview of Agenda/Logistics
Mr. G. Michael Green, Executive Secretary of the NASA Advisory Council (NAC) Technology, Innovation, and Engineering (TI&E) Committee, welcomed the members and reviewed the meeting agenda.

Opening Remarks
Dr. William Ballhaus, TI&E Chair, welcomed the Committee members. He also introduced the first speaker, Mr. Chris Scolese, Director of the NASA Goddard Space Flight Center (GSFC).

Welcome to NASA GSFC
Mr. Scolese welcomed TI&E to GSFC, and introduced Dr. Crystyl Johnson, the Center's Deputy Director for Technology. He then presented a brief overview of GSFC activities. The Fiscal Year 2018 (FY18) budget is good for GSFC and for NASA overall. The budget restores some cancelled missions, such as the Wide Field InfraRed Space Telescope (WFIRST), Plankton, Aerosol, Cloud, ocean Ecosystem (PACE), and Restore-L, as well as some partnerships. GSFC collaborates on the Climate Absolute Radiance and Refractivity Observatory (CLARREO) mission, the Orbiting Carbon Observatory-3 (OCO-3), and the Deep Space Climate Observatory (DSCOVR), which are all continuing. The Neutron star Interior Composition Explorer (NICER) is an example of a partnership between NASA Headquarters and GSFC. This project also serves as an example of joint funding between STMD and Science Mission Directorate (SMD), while Restore-L is enabled by investments from STMD and the Human Exploration and Operations Mission Directorate (HEOMD). Mr. Scolese explained how a new ammonia sensor performs a difficult function formerly conducted by astronauts at some risk. The sensor is a harbinger of future in-space assembly practices that will be effective and more cost-efficient. A growing area is that of sample return technologies.

The Origins, Spectral Interpretation, Resource Identification, Security-Regolith Explorer (OSIRIS-REx) spacecraft will travel to Bennu, an asteroid, as a test. The Comet Astrobiology Exploration Sample Return (CAESAR) mission is a finalist for the Planetary Science Division's (PSD's) New Frontiers program and, if selected, will return samples from a comet. The FY19 budget is exciting and worrisome both at once, as it is not yet clear whether the missions that were cut and restored from the FY18 budget will also be restored for FY19. However, the overall NASA budget increases, which is good.

STMD Update and FY 2019 President's Budget Proposal
Mr. James Reuter, Acting Associate Administrator for STMD, explained that Mr. Stephen Jurczyk was now the Acting Associate Administrator for NASA. The current Acting Administrator, Mr. Robert Lightfoot, retires on April 30. By then, NASA is expected to have either a confirmed administrator or another acting administrator. Mr. Jurczyk planned to join the TI&E meeting remotely and address a proposed restructuring that would eliminate STMD as a separate mission directorate.

Overall, space technology funding for FY18 is at $760 million, about $74 million over FY17. However, Congress included a lot of directed funding, such as $130 million for Restore-L. The President's Budget

Request (PBR) was much lower. The plan is to take Restore-L to Key Decision Point C (KDP-C) in April. The report language also includes $75 million for nuclear thermal activities. Mr. Reuter noted that there are cryogenic activities that support the nuclear-thermal area. The Flight Opportunities Program received $20 million, a $5 million increase. STMD was directed to spend no less than $25 million for manufacturing research, which is a typical amount.

Nanomaterials is a new area for direction, at $5 million. However, STMD already has a Space Technology Research Institute (STRI) that receives $3 million for nanomaterials, and there is a Tipping Point project in the area as well. Mr. Gordon Eichhorst asked about collaborating to push the barriers in nanomaterials. Mr. Reuter replied that NASA selects specific areas of focus. For example, in on-orbit manufacturing, the NASA focus is on space applications. STMD sponsored a Centennial Challenge with Bradley University and Caterpillar, Inc., to build additive structures out of a range of regolith materials. The next round is for manufacturing a scale model. The Army Corps of Engineers is partnering on this challenge and a related project. STMD's budget increase is not sufficient to cover all of the directed spending, but it is close enough to be manageable. Game Changing Development (GCD) in particular is lower than anticipated, but NASA hopes to grow it back eventually. Overall, the budget is a good one.

Mr. Jurczyk joined the meeting and explained that there is a push for Congress to confirm Representative James Bridenstine as NASA Administrator before Mr. Lightfoot's retirement date. There was no firm plan in place should that not occur. Mr. Lightfoot has been an excellent Acting Administrator.

As Mr. Reuter noted, NASA's FY18 budget is good, $1.6 billion above the PBR. SMD received about $500 million above the request, including funds for WFIRST and Earth science missions that had been proposed to be cut. The budget also funds lunar robotic missions. Aeronautics received $20 million above the request, with no direction for the additional funds. HEOMD's budget is $800 million above the PBR and $400 million above the FY17 level, and includes funds for a second launch platform that will help provide more options. NASA Education had been zeroed out in the PBR but received $100 million. There was also an increase for environmental compliance and restoration to address the backlog of maintenance and repairs at the centers. A separate supplement helps address hurricane recovery costs.

The FY19 PBR restructures the budget to divide STMD and parts of HEOMD into three new areas: Deep Space Exploration Systems, which will cover human exploration; Low Earth Orbit (LEO) and Spaceflight Operations, which includes commercial cargo and crew; and Exploration Research and Technology (ER&T), which largely includes the STMD functions. ER&T also takes on the core Advanced Exploration Systems (AES) programs, which are currently within HEOMD. Another HEOMD function moving into ER&T is the Human Research Program (HRP). The FY19 PBR for ER&T comes to just over $1 billion. ER&T's program structure will be close to that of STMD and include investments for development of Technology Readiness Levels (TRLs) 1 through 7.

In conjunction with the other mission directorates, Mr. Jurczyk is leading the effort to create an organizational structure for the new arrangement. The team is looking at having two organizations, with one focused on LEO and spaceflight opportunities, and the other emphasizing deep space exploration activities. Another option is having a single organization to manage all of this, which would be challenging. The team is working out the pros and cons of the options, the challenges, what the options would look like, control, roles, integration, etc. The Congressional justification includes the exploration campaign, along with lunar and Mars programs, and some HEOMD efforts. There will have to be strong integration across the three mission directorates. Commercial and international partners will also be crucial to success. The timeline assumes having a proposal for the NASA Administrator in the late spring. Congressional approval is also necessary, and that type of thing normally occurs during the appropriations

process. Since the White House wants this done on or about the next fiscal year, NASA hopes to take the proposal to the Congressional committees by late summer in order to gauge support.

Dr. Ballhaus asked about the rationale for the change, including the advantages and disadvantages. Mr. Jurczyk replied that the two primary reasons are integration and focus. He thinks the integration has largely been done, while the ER&T programs will focus on exploration and commercial capabilities. The restructuring would shift the emphasis from STMD's focus on cross-cutting technologies to an exploration focus. Some of the current work will shift to SMD, as there are science efforts that do not feed into human exploration. Examples include the coronagraph, and Entry, Descent, and Landing (EDL) technologies for missions to Venus or Titan. Science-centric projects will have to be transitioned or completed. There is also the known risk of the development programs pulling funds from the Research and Technology (R&T) budget. The White House is aware of that risk, which will have to be addressed in the proposed restructuring and governance.

Dr. Ballhaus said that he saw some advantages, noting that the technology program has lacked an urgency argument. Integrating technologies that are baselined into projects is an advantage. However, NASA has previously had large cuts in applied research and Science and Technology (S&T), and that is a risk. He wanted to know what NASA will do to ensure that that does not happen again. In addition, there had been a gap in communications with universities, which supply both TRL development and the future workforce. Now that that gap is less of an issue, it is important to keep the communications and support going. Mr. Jurczyk said that a benefit of the reconfiguration is definitely in the focus and the technology pull. NASA still wants to invest in early stage development and TRLs. The lion's share of early stage funding does go to universities. He hopes for a positive outcome and will provide an update at the next TI&E meeting.

Dr. Matt Mountain asked about science in the exploration campaign. Mr. Jurczyk said that the focus is on lunar, with a robotic precursor mission to the moon. This is run by the Planetary Science Division of SMD and feeds into crewed work on the moon. Most Mars activities will be either ongoing missions to fill strategic knowledge gaps for human exploration of Mars. Mars Sample Return (MSR) is an ongoing area of focus that the SMD budget covers in order to contribute to achieving exploration goals and objectives. Mr. Eichhorst observed that the National Space Council advisory group seems to have only two technologists, which struck him as rather light. Mr. Jurczyk said that he will take that into account.

Dr. Ballhaus thanked Mr. Jurczyk, who said that he appreciated TI&E and its input.

Mr. Reuter explained that NASA will now focus less on Mars and more on the moon. He reviewed the proposed ER&T budget, which will include HRP. He then explained the funding shifts that will accompany the proposed reorganization. The draft roadmap for exploration includes four major initiatives: the Early Science and Technology Initiative; the Small Commercial Lander; the Mid-to-Large Lander, which will lead to a human-rated lander; and the Lunar Orbital Platform and Gateway. A graphic displayed which NASA mission directorates are involved in each initiative. It is likely that industry is far enough along that NASA could buy services for a small commercial lander. The mid-to-large lander would lead to a human descent lander; this will require testing of technologies and capabilities. A Request for Information (RFI) has been issued in order to gauge commercial interest. It is important to demonstrate capabilities and gain expertise before going to a full-size lander.

The Gateway currently involves studies for habitation leading to the potential for further exploration. An evaluation is going on with NASA's international partners to determine which partner will lead which area. The United States will lead propulsion. The plan is to have one SLS/Orion flight and two commercial flights per year. Technology infusion will go into that plan. Rovers would be led by SMD, but the related

technologies would be led by ER&T. STMD currently has an open Tipping Point competition for propulsion and EDL. This is all in the early planning stages. There will also be emphasis on lunar cubesats, missions to the dark areas of the moon, In Situ Resource Utilization (ISRU), and ground-penetrating radar. Long-term storage of cryogenics feeds into the propulsion area.

ER&T will emphasize growing exploration. Mr. Reuter showed the guiding principles, which address which current projects will continue to be funded and developed. The primary customer will be HEOMD. ER&T will fund across the TRL spectrum, including low TRLs, while working with SMD on some of the technology and research needed to meet science goals. Mr. Reuter noted that science currently accounts for only about five percent of the STMD budget. Ongoing science projects will continue, but ER&T will evaluate which new projects to start. In terms of how best to support industry, NASA looks at where the Agency is developing technologies that promote its interests, then asks public partners to propose projects that would benefit them. NASA will compete these projects, as it does with much of its work. Deep Space Optical Communications (DSOC) is an example of a science need, but it also applies to HEOMD, so ER&T will support it as a shared interest.

The key technology focus areas are largely unchanged. For now, development of the STMD strategic framework has been tabled. The only significant change to a strategic thrust area is in ST4, which had been "Enable the next generations of science discoveries" and is now "Expand capabilities through robotic exploration and discovery." Mr. Reuter said that this could be discussed further at a future TI&E meeting.

Mr. Reuter highlighted some recent STMD accomplishments. Two small spacecraft missions are now on orbit after being launched on Orbital ATK's Cygnus vehicle. Other accomplishments occurred in the areas of Solar Electric Power (SEP), kilopower, and the Station Explorer for X-ray Timing and Navigation Technology (SEXTANT), which is now on the International Space Station (ISS). For in-space robotics manufacturing assembly, three contractors have completed Phase 1 designs and moved on to Phase 2. The Laser Communication Relay Demonstration is on track for a 2019 launch. DSOC is moving into the demonstration phase. The Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) program industry day was successful; this activity will stay in ER&T. Since beginning the industry days, NASA has seen an increase in SBIR/STTR proposals. Mr. Eichhorst observed that a lot of multi-year work went to Game-Changing Development (GCD) projects, some of which were dropped due to relevancy concerns. He was concerned about their place in the reorganization. Mr. Reuter said that those programs were not affected. Flight Opportunities Testing for Precision Landing Technologies had a successful flight test, showing that there is a need for more computing power. The Centennial Challenges went well.

Mr. Reuter then presented FY19 milestones in key focus areas. Some lunar projects will come over from AES, and NASA will have an instrument on a Korean pathfinder mission. Risk mitigation testing in Nuclear Thermal Propulsion (NTP) will continue into FY19, as an indemnification issue with a contractor slowed things down. NASA will evaluate this investment in FY19. Two contractors are looking at Extreme Environment Solar Power. Lunar IceCube is a smallsat. eCryo work should be complete in July.

Another project area is composite technologies for exploration. The Mars Science Laboratory Entry, Descent, and Landing Instrument 2 (MEDLI2) will be on the Mars 2020 mission. NASA is partnering with ULA and Boeing on a hypersonic accelerator for Mars, though this is primarily a NASA project. Satellite servicing, which is part of Restore-L, is in Preliminary Design Review (PDR). There are two primary commercial interests, and NASA hopes to infuse it into a public/private partnership.

Mr. Douglas Terrier, NASA's Chief Technologist, said that the Office of the Chief Technologist (OCT) role will continue. Mr. Reuter said that OCT started an HRP pilot in the biomedical area. This was transferred to

STMD, and a call for white papers indicated strong commercial interest. NASA only runs the challenge, with venture capitalists providing the funds. The Department of Energy (DOE) and the Air Force are also interested. The multiplying effect for the companies is very large, and the NASA brand draws investment. There will be an evaluation of whether this benefits NASA. OCT will focus on whether NASA emphasizes the right technologies. He believes the new administrator will want TI&E input on that.

Dr. Ballhaus observed that competition is not always the best option, as it often favors the incumbent, and non-incumbents will often incur additional costs. It slows the process down. He asked how to best promote innovation in this case. Mr. Reuter agreed that this can be an issue. ULA had a Space Act Agreement (SAA) for logistics activities, and that has been a useful mechanism. NASA has also used SAAs with SpaceX and Orbital ATK. This will be an ongoing consideration. Mr. Terrier added that OCT knows where the expertise is and leverages it.

Mr. Reuter said that NASA plans to add more STRIs, and will announce a solicitation in May for at least two topics, and possibly a third. The Early Stage Initiatives are also growing, and he hoped to pull in more GSFC help to enable technologies that are stuck in the early stages. The GCD line for FY19 reflects the AES shift and some encumbrances, however. Finally, efforts are underway to add a kilopower demonstration by 2020. He noted the GCD areas of technology focus. The program will no longer work on space observatory systems, and will place less emphasis on robotics. All Technology Demonstration Missions (TDMs) map to key focus areas. Tipping Point Technology projects are fixed price, and require a business plan and infusion probability. STMD was about to make a downselection, and plans to have an annual solicitation.

Mr. Reuter next presented FY18 highlights in the area of technology maturation and showed the FY19 plan. The last test for the Kilopower Reactor Using Stirling Technology (KRUSTY) is complete. Precision landing and NTP efforts are progressing; stakeholders would like NTP to move faster, however. Cryogenic Fluid Management (CFM) now has a roadmap with critical technology elements. An RFI to industry did not get much response. Mr. James Oschmann observed that industry does not see a business case. Mr. Reuter agreed, noting that NASA would like to learn more about industry needs in this area. In the area of small spacecraft technology, there are some demonstration missions planned, with commercial flight partners. He described the two STRIs from 2016, the Center for the Utilization of Biological Engineering in Space (CUBES) and the Institute for Ultra-Strong Composites by Computational Design (US-COMP). He then noted the various prizes and challenges across NASA, including the Centennial Challenges. The NASA Innovative Advanced Concepts (NIAC) will now have an emphasis on exploration but will not be constrained. Technology transfer is strong.

Under the restructuring, ER&T will incorporate HRP activities. The Program has projects on ISS medical issues, space radiation, countermeasures, exploration medical capabilities, and human and behavioral performance. There are detailed risk mitigation roadmaps for what can be done on ISS and what must be done elsewhere. Regarding ISS funding, the plan is to get to the point where NASA is not a direct contributor. That will be a topic for HEOMD as well. HRP areas linked to furthering goals beyond ISS, such as life support, will stay in HEOMD.

Dr. Ballhaus observed that technology demonstrations tend to slide out of budgets, as they are expensive. He wondered whether industry sees that technology demonstrations will be able to stay in the budget. Mr. Oschmann said that a tradeoff will require a strong need. For some technologies, there will be less pull. He did not believe that green propellant and the Deep Space Atomic Clock (DSAC) would have happened had they depended on industry interest. These are examples of technologies that are more long-term. Commercial interest is small and insufficient to compel the work. Some technologies must be flown before there is pull.

Discussion and Recommendations

Dr. Ballhaus led the discussion on the draft TI&E presentation to NAC. He observed that in order to make great advances, NASA needs to have a system of checks and balances or protections to prevent the loss of the early TRL and technology push, which happened previously in NASA's technology development history. Mr. Eichhorst added that it took several years to even identify which among the many underfunded technologies should be emphasized. It seems like NASA just got there, and it would be tragic to go back. He was not sure what needed to happen for stakeholders to realize that, whether it was a programmatic or a NASA-wide communication responsibility. Dr. Ballhaus noted that a lot of funding had been shifted away and spent on projects in development, disrupting consistent technology development. Mr. Eichhorst pointed out that the emphasis on the shorter term is not less expensive than investing in a longer-term plan.

Dr. Mary Ellen Weber agreed. However, she thought there might be an opportunity with this structure to better protect some of the technology development, depending on the strength of the leadership of the effort. There could be more technology funding in this structure if the leadership holds the line for the less-defined purposes. Currently, the most-needed technologies are the responsibility of other mission directorates. Under the restructuring, those mission directorates might seek more technology funding by emphasizing the urgency. If leadership only goes with the obviously needed technologies, however, that would negate her argument.

Mr. Michael Johns said that a lot of NASA's technology progress has happened due to STMD being a standalone mission directorate. He found the ER&T structure to be worrisome, and he preferred a standalone organization. He was further concerned that technology funds will be consumed by other interests under the new structure. Dr. Ballhaus said that over the years, he has seen some good advocacy and recognition that NASA should fence off these funds. Other administrators have made different decisions. It is important for NAC to point out the risk, as well as the need for the checks and balances.

Mr. Eichhorst said that TI&E had several meetings in which they discussed how to get new technology flown. STMD had to engage with program directors in order to accomplish that. Mr. Oschmann identified the Laser Communications Relay Demonstration project as an example. Dr. Ballhaus observed that part of NASA's value is its R&D, so missions need to include a technology base. The Agency had been penalizing smaller missions for taking risk and, in doing so, disadvantaged the Principal Investigators (PIs) who were proposing innovations that carried risk. That led STMD to work with SMD to create incentives that make it worthwhile for scientists to propose innovation. Mr. Oschmann noted that the new structure will help the urgency argument where there is a good definition of the need, but it will hurt the broader and longer-term base for R&D. Too much of this scenario depended on the uncertainty of having the right people in place. Also, in some cases the business case is not convincing. He was concerned about the loss of needed NASA investments where industry is not yet interested.

Dr. Ballhaus said that he had had some of these discussions over the years, going back to the late 1980s. While NASA often knows what technologies are needed, the Agency does not always know when they are needed, or how to phase the investment. In that regard, the new structure could help. Dr. Mountain said that this could be a concern for the science side. He understood the rationale, but the messaging outside of NASA Headquarters is that the balance shifts to HEOMD. Mr. Oschmann noted that the Earth Science Technology Office (ESTO) funds some activities for longer-term missions; he was concerned about losing that. Dr. Ballhaus replied that the SMD Associate Administrator will need to make that case. Mr. Eichhorst gave an example of NASA's need for broader recognition of the infusion of its technology. The public is cloudy on this. Dr. Mountain observed that the National Science Foundation (NSF) and the U.S. Department of Energy consider NASA a success story in this sense.

The Committee began formulating charts to take to the full NAC, with emphasis on how to maintain STMD's momentum and keep the balance with the large programs. It was agreed to lead off with the charter for TI&E, which cuts across the Agency. Dr. Weber wanted to emphasize the great risk that history

may repeat itself with NASA's technology funding, requiring the Agency to be vigilant under a reorganization. Dr. Mountain advised stating that the lack of investment was a problem. Dr. Ballhaus pointed out that the EDL technologies for the Mars projects of the previous administration are quite different than the EDL technologies required for lunar exploration. This constitutes a change of direction and does not reflect a lack of focus. Mr. Terrier noted that STMD provides integration across the mission directorates, which is why OCT remains at the table to advise on the big picture. Dr. Ballhaus agreed about OCT, but thought that it might make sense to focus on exploration and science. However, the need to protect the early TRL efforts remains, because there is no pull.

Dr. Mountain said that technology was largely ignored prior to the inception of STMD. It is tempting for programs to raid technology funds. Dr. Ballhaus said that the major missions NASA is flying today depend on technology investments made many years ago. From 2005-09, however, much of the technology development funding was removed. NASA then had to attempt to catch up. NASA conducts R&D for the country, which needs to include enrichment of the technology base.

Dr. Ballhaus wanted the presentation to the NAC to address three key questions:

- What is the appropriate percentage of the NASA budget to devote to technology investment?
- What fraction of that allocation should be organizationally fenced off as "seed corn" for the future and as cross-cutting investment?
- How is NASA managing its technical, critical core competencies?

There would be nothing set aside for seed corn under the new structure. The grand missions of NASA are enabled by technology. TI&E had previously determined that NASA's technology investment should be 10 percent of the Agency's total budget, with three percent for seed corn. For focus, there should be a systems analysis capability to guide the S&T capability, and it was not clear that NASA had kept up its expertise in that area. Mr. Terrier noted that there have been several efforts to carve out an approach to engineering methods, but nothing has been settled. Dr. Ballhaus cited a previous TI&E recommendation that NASA establish a basic research/engineering science program. This has not happened.

Dr. Weber advised making the point that this administration wants the United States to reassert its dominance in space. Critical to that is technology development. Dr. Ballhaus added that language to the chart. Next were the three key questions identified above. There was debate over whether to repeat the recommendation that a specific percentage of the budget be dedicated to technology investment, but nothing was decided at the meeting. Dr. Weber pointed out that this situation directly affects the administration's call for leadership in space and making "America first among the stars." It was noted that in FY2005-09, NASA technology budgets were reduced by $1.4 billion and the technology shelf was depleted. STMD was then supposed to receive $1 billion per year, but that never materialized. Regarding university engagement, which lapsed in FY2005-09, STMD re-established those contacts in a number of ways, including the Space Technology Research Grants Program. These points might be introduced as risks: there is concern that the FY2005-09 cuts could happen again, decimating technology programs and hurting interactions with universities.

Dr. Mountain urged recognition of the change in priorities at NASA. What the Agency faces under the new structure is the temptation to use technology development funds to solve near-term problems. Dr. Ballhaus stated that TI&E was not advocating for or against a particular organizational structure, but rather was advocating caution to not repeat a past mistake. In addition, he felt it would be better to cast this as a finding instead of as a recommendation. If NAC were to carry it forward as a recommendation, it would be their decision.

Dr. Ballhaus wanted to note the restructuring decision, cite the rationale for it, and state some of its advantages. While he agreed with Dr. Weber that this should be brief, he wanted to have additional slides in case he needed them. He would then mention the importance of technology development in NASA's grand missions, and describe the negative impact of the 2005-09 budget cuts. Next, he would point out

the need to ensure that this does not happen again. He observed that the current NAC members all support technology funding.

The Committee agreed that the presentation should explain that NASA needs cutting edge technologies, as current missions employ technologies developed over a period of decades. It was also important to note that one of the things NASA does for country is R&D. The draft presentation had a slide of a previous recommendation that NASA continue commitment to sustain and grow the Agency's technology programs in order to enable future missions and maintain U.S. technical leadership in space. The draft presentation also noted that NASA management has done an excellent job within budget constraints, and showed what STMD had accomplished, including re-engagement with core communities.

The general outline of the presentation evolved to stating the points TI&E has made over the past several years, what has changed, and the need to avoid repetition of past mistakes. Mr. Green suggested that the last point be constructed as stating that there are risks, TI&E has concerns, and the Committee looks forward to the Agency's response. Dr. Mountain added that the fundamental issue is that there must be substantial resources for a return to the Moon. Dr. Ballhaus said that he would lead with his frustration that he witnessed the same conversations in the 1980s. Despite the many accomplishments since the dawn of the space age, NASA has fallen behind in human exploration, and there has been no clear path on what to do after ISS is no longer viable. It is important to avoid repeating what happened during the Constellation era. Dr. Mountain advised mentioning that STMD has a high level of visibility as a result of having an Associate Administrator of a Mission Directorate. Mr. Oschmann added that technology must have an influential champion within NASA, and there is no certainty that successors to the current Agency leaders will have the same priorities.

Adjournment

The meeting was adjourned at 1:30 p.m.

APPENDIX A

Agenda

NAC Technology, Innovation and Engineering Committee Meeting
March 26, 2018
NASA's Goddard Space Flight Center
Building 34, Conference Room 120A
Greenbelt, Maryland

March 26 – FACA Open Meeting

9:00 a.m.	Welcome and Overview of Agenda/Logistics (FACA Session – Public Meeting) Mr. Mike Green, Executive Secretary
9:05 a.m.	Opening Remarks Dr. William Ballhaus, Chair
9:10 a.m.	Welcome to NASA GSFC Mr. Chris Scolese, Director, NASA Goddard Space Flight Center
9:30 a.m.	STMD Update and FY 2019 President's Budget proposal Mr. Steve Jurczyk, Associate Administrator (Acting), NASA Mr. James Reuter, Associate Administrator (Acting), Space Technology Mission Directorate (STMD)
11:00 a.m.	Break
11:15 a.m.	Discussion and Recommendations
12:00 p.m.	Lunch Break (non-public)
12:45 p.m.	Discussion and Recommendations continued
1:30 p.m.	Adjournment

APPENDIX B

Committee Membership

Dr. William Ballhaus, *Chair*
Mr. G. Michael Green, *Executive Secretary*
Mr. Gordon Eichhorst, Aperios Partners, LLC
Dr. Kathleen C. Howell, Purdue University
Mr. Michael Johns, Southern Research Institute
Dr. Matt Mountain, Association of Universities for Research in Astronomy
Mr. David Neyland
Mr. Jim Oschmann, Ball Aerospace
Dr. Mary Ellen Weber, Stellar Strategies, LLC

APPENDIX C

Meeting Attendees

Committee Attendees:
William Ballhaus, Jr., *Chair*
G. Michael Green, *Executive Secretary*
Gordon Eichhorst
Michael Johns
Matt Mountain
Jim Oschmann
Mary Ellen Weber

NASA Attendees:
Anyah Dembling
Peter Hughes
Crystyl Johnson
James Reuter, *STMD Acting Associate Administrator*
Chris Scolese
Douglas Terrier

Other Attendees:
Amy Reis, Ingenicomm
Elizabeth Sheley, Ingenicomm

WebEx:
Gina Anderson
Judith Carrodeguas
William Cirillo
Dennon Clardy
Stephen Clark
Leonard David
Jeff Foust
David Gump
Phillip Harman
Floyd Hovis
Ron Jones
Stephen Jurczyk
Ben Kallen
Gene Mikulka
Patrick Murphy
Mason Peck
David Reeves
Marcia Smith
Max Suarez
Harley Thronson

APPENDIX D

Presentations

1) Welcome to GSFC [Scolese]
2) STMD Update [Reuter]