NASA

National Aeronautics and Space Administration

Office of Inspector General

2019 Report on NASA's Top Management and Performance Challenges

November 13, 2019

Office of Inspector General

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MESSAGE FROM THE INSPECTOR GENERAL

Throughout its 60-year history, NASA has stood at the forefront of aeronautics, science, and space exploration, responsible for numerous scientific discoveries and technological innovations. In NASA's first half century, long-term space flight priorities such as Apollo, the Space Shuttle Program, and the International Space Station (ISS or Station) progressed through formulation, development, and operation over the course of decades and multiple presidential administrations and congresses. However, over the past 10 years the Agency's space exploration priorities have shifted from the Constellation Program's lunar ambitions to an asteroid retrieval effort focused on developing technologies to enable a human mission to Mars and then back to a planned but recently expedited crewed return to the Moon. While human exploration of Mars has remained a consensus long-term exploration goal throughout the past decade, the lack of stable mid-term human exploration priorities has left NASA lurching from major program to major program, expending time and resources to plan and replan instead of focusing on a clear, unified, and sustaining vision. Consequently, achieving a constancy of purpose is perhaps the greatest overall challenge facing NASA.

As required by the Reports Consolidation Act of 2000, this report presents the Office of Inspector General's (OIG) independent assessment of the top management and performance challenges facing NASA. Looking to 2020, we identified seven challenges and linked each challenge to one of NASA's strategic objectives (see Table 1).[1]

Table 1: NASA Top Management and Performance Challenges for 2020

Challenge	NASA Strategic Objective
Landing Humans on the Moon by 2024	*NASA Strategic Objective 2.2:* Conduct exploration in deep space, including to the surface of the Moon
Improving Management of Major Projects	*NASA Strategic Objective 1:* Expand human knowledge through new scientific discoveries *NASA Strategic Objective 2:* Extend human presence deeper into space and to the Moon for sustainable long-term exploration and utilization *NASA Strategic Objective 4.3:* Assure safety and mission success
Attracting and Retaining a Highly Skilled Workforce	*NASA Strategic Objective 4.4:* Manage human capital
Sustaining a Human Presence in Low Earth Orbit	*NASA Strategic Objective 2.1:* Lay the foundation for America to maintain a constant human presence in low Earth orbit enabled by a commercial market
Improving Oversight of Contracts, Grants, and Cooperative Agreements	*NASA Strategic Objective 4.1:* Engage in partnership strategies
Addressing Long-standing IT Governance and Security Concerns	*NASA Strategic Objective 4.5:* Ensure enterprise protection
Sustaining Infrastructure and Facilities	*NASA Strategic Objective 4.6:* Sustain infrastructure capabilities and operations

Source: NASA OIG analysis.

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[1] NASA, *NASA Strategic Plan 2018* (February 12, 2018). See: https://www.nasa.gov/sites/default/files/atoms/files/nasa_2018_strategic_plan.pdf (last accessed September 18, 2019).

In deciding whether to identify an issue as a "top challenge," we considered its significance in relation to NASA's mission; whether its underlying causes are systemic in nature; and its susceptibility to fraud, waste, and abuse. Identification of an issue as a top challenge does not necessarily denote significant deficiencies or lack of attention on NASA's part. Rather, all of these issues are long-standing and inherently difficult challenges central to the Agency's mission and, as such, will likely remain challenges for many years. Consequently, these issues require consistent, focused attention from NASA management and ongoing engagement on the part of Congress, the public, and other stakeholders.

Not surprisingly, given the importance and scope of the issues, this year's list includes many of the same themes discussed in previous reports. However, for this report we updated our approach to presenting the challenges to highlight progress NASA has made in addressing these issues and the work the Agency still needs to complete. To further aid the Agency, we have also linked each challenge to a NASA strategic objective, as noted above in Table 1.

In this report and in all its undertakings, the OIG is committed to providing independent, aggressive, and objective oversight of NASA programs and projects with the singular goal of improving the Agency. To that end, we plan to conduct audits and investigations in the coming year that focus on NASA's continuing efforts to meet these and other challenges.

Paul K. Martin
Inspector General

Landing Humans on the Moon by 2024

Why This Is a Challenge

In December 2017, the President directed NASA to change its mid-term human exploration objectives from uncrewed and crewed asteroid exploration missions to a crewed return to the Moon with the eventual goal of landing humans on the surface of Mars. In March 2019, the administration announced the Agency's goal of landing humans on the Moon would be accelerated by 4 years to 2024 and later named this effort the Artemis program. The Agency subsequently requested an additional $1.6 billion in its fiscal year (FY) 2020 budget as initial funding to meet the program's new timetable.

Central to achieving NASA's human exploration goals beyond low Earth orbit is the Space Launch System (SLS) rocket, the Orion Multi-Purpose Crew Vehicle (Orion), and launch infrastructure under development by the Agency's Exploration Ground Systems (EGS) Program. While development of the SLS and launch infrastructure are well underway, a more powerful SLS upper stage and updates to the EGS's Mobile Launcher platform are necessary to maximize the capabilities of both systems. Furthermore, NASA's investments to date do not substantially include funding for the additional capabilities essential to landing and living on the Moon: the Lunar Gateway (Gateway), which will orbit the Moon and act as a waypoint for crews reaching its surface; spacecraft to land on and launch from the Moon's surface; crew habitation modules on the lunar surface; and commercial launch vehicles to accelerate robotic or human space flight hardware deliveries to the Moon. NASA plans to leverage international and commercial partnerships to accelerate and share the development costs of these critical capabilities. Nonetheless, in order to realize its lunar ambitions on the expedited timetable, NASA has estimated needing an aggregate budget increase of $20 to $30 billion during the 5-year period leading up to 2024, on top of the Agency's approximately $21 billion annual appropriation. NASA will have spent roughly $34 billion on the SLS, Orion, and EGS programs through 2019, a sum projected to increase to over $50 billion by 2024.

NASA's development of a deep-space human exploration capability to reach the Moon and then Mars is the Agency's most ambitious and costliest ongoing activity and currently includes three flagship programs (SLS, Orion, and EGS) with more in the future. NASA has experienced a series of setbacks caused by technical challenges, cost increases, and schedule delays in each of the programs. Returning humans to the Moon by 2024 clearly will be NASA's top management challenge for at least the next 5 years and the Agency's success in this endeavor will directly impact its timetable for transporting humans to Mars.

Progress in Addressing the Challenge

While the SLS, Orion, and EGS programs are making progress, each has experienced cost increases and schedule delays. Both Artemis 1, the first uncrewed mission of the integrated SLS/Orion system, and Artemis 2, the first crewed mission, are about 2 years behind schedule and collectively have experienced more than $2.6 billion in cost increases, as reported by the Government Accountability Office (GAO),

compared to each program's baseline cost commitments.[2] Artemis 1 is scheduled to launch and orbit the Moon by November 2020, while Artemis 2 is planned to orbit the Moon by 2023. However, the Artemis 1 date may slip further and that, in turn, may impact the Artemis 2 launch date. NASA's third SLS mission—Artemis 3—is scheduled to land crew on the Moon's surface in 2024 using a lunar lander that docks with Orion and the Gateway.

In 2018, we found that SLS Core Stage development was significantly behind schedule and the associated contract with The Boeing Company (Boeing) would need to be increased by more than $2 billion to complete the production of two Core Stages without even finishing development work on the Exploration Upper Stage. Additionally, we found NASA's award fees overly generous in light of the program's significant cost increases and schedule slippage and recommended reforms to ensure poor contractor performance is reported to the award fee rating officials. Orion has also struggled to meet its schedule due in part to delays tied to development of its Service Module, a critical element that provides propulsion, air, water, and power to the crew module while in space. For its part, the EGS Program is working to complete launch control software while also managing late requirements changes and cost overruns. The new, second Mobile Launcher and an upgraded version of the SLS rocket present longer-term challenges to EGS.

NASA is moving forward to either develop or purchase the additional capabilities needed to meet its goal of landing humans on the Moon by 2024. In May 2019, NASA awarded a contract to Maxar Technologies to develop power, propulsion, and communications capabilities for the Gateway. NASA is also in early stages of awarding a sole-source contract to Northrop Grumman Aerospace Systems to develop and deliver the Gateway's habitation module. In August 2019, the Agency also announced plans for Marshall Space Flight Center to lead the development of the lunar lander program with Johnson Space Center responsible for developing the lunar ascent spacecraft.

● **Key Implemented Recommendations**

Establish more rigorous cost and schedule estimates for the SLS and EGS programs for the Artemis 2 mission mapped to available resources and future budget assumptions and independently reviewed by the Office of the Chief Financial Officer (IG-17-017).

Work That Needs to Be Done

Achieving the ambitious goals of landing humans on the Moon by 2024 and Mars in the 2030s will require strong, consistent, and sustained leadership by the President, Congress, and NASA. For its part, NASA must determine the long-term costs, set realistic schedules, define system requirements and mission planning, form or firm up international partnerships, and leverage commercial space capabilities. To this end, our oversight work has found NASA consistently struggling over the past decade to set realistic program cost and schedule goals. Therefore, the accelerated timetable for a lunar landing set out in the Artemis program further increases the risk of inefficient development programs or contract awards with increased costs due to limited competition or unstable program requirements.

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[2] GAO, *NASA Human Space Exploration: Persistent Delays and Cost Growth Reinforce Concerns over Management of Programs* (GAO-19-377, June 19, 2019).

Although NASA has made significant progress on several fronts to further its human exploration efforts, many questions remain about the total costs, schedule, and scope of the Agency's Moon and Mars ambitions. In the near term for Artemis 1, the SLS Program will need to complete the Core Stage, integrate the rocket, and conduct a series of test fires; Orion will need to fully integrate with the Service Module; and EGS will need to complete development of launch software. For later missions, NASA will need to complete development of the SLS's Exploration Upper Stage and the second Mobile Launcher. Concurrently, plans for the lunar Gateway and crewed lunar landings will need to be finalized to meet NASA's goal of landing on the Moon by 2024 while also preparing to reach Mars in the 2030s.

○ Key Unimplemented Recommendations

Develop a corrective action plan for completing the two Core Stages and Exploration Upper Stage and brief that plan to Boeing and senior NASA officials to gain their approval (IG-19-001).

Establish objectives, need-by dates for key systems, and phase transition mission dates for the Journey to Mars (IG-17-017).

Include cost as a factor in NASA's Journey to Mars feasibility studies when assessing various missions and systems (IG-17-017).

Ongoing and Anticipated Future Audit Work

NASA's Management of the Mobile Launcher
This audit is examining the status of Mobile Launcher 1 as well as NASA's development plans for Mobile Launcher 2 and the extent to which the EGS Program is meeting cost, schedule, and performance goals related to the Mobile Launchers.

NASA's Efforts to Manage Space Launch System Program Costs and Contracts
This audit is evaluating how the SLS Program is tracking and reporting overall costs as well as NASA's effectiveness in controlling cost growth for four major SLS contracts, including the RS-25 engines, solid rocket boosters, and upper stage.

Audit of Orion Multi-Purpose Crew Vehicle
This audit is examining NASA's management of the Orion Program and its prime contractor, Lockheed Martin Corporation, and the extent to which NASA is meeting cost, schedule, performance, and affordability goals for the Artemis program.

Additionally, within the next year we plan to review procurements for the Deep Space Gateway and other infrastructure needed for the lunar missions, management of the astronaut corps, launch systems for deep space exploration, and commercial lunar payload services.

Why This Is a Challenge

While NASA continues to stand at the forefront of aeronautics, science, and space exploration, many of the Agency's major projects—those with an estimated life-cycle cost of more than $250 million—cost significantly more and take much longer to complete than originally planned. Cost increases and schedule slippage with major ongoing projects such as the Mars 2020 mission, James Webb Space Telescope (JWST), and the SLS can have a cascading effect across other NASA projects. For example, for the past 2 years the Agency has proposed terminating funding for the Wide Field Infrared Survey Telescope (WFIRST), NASA's next major astrophysics telescope, largely due to increased funding requirements and continued delays for JWST, which as of May 2019 was $4.4 billion over budget and 81 months delayed.[3] The Agency has argued that funding both JWST and WFIRST at the same time would require redirecting money from other programs, thereby disrupting the balance of the Agency's overall science portfolio. To date, Congress has disagreed and in FY 2019 appropriated $312.2 million for WFIRST.

Cost increases and schedule delays are long-standing challenges for the Agency. Since its first annual assessment in 2009, GAO has consistently reported on cost growth and schedule delays in the Agency's major projects.[4] For example, in its 2019 assessment GAO found that cost and schedule performance of major projects had deteriorated over the prior year with 9 of 17 projects in development reporting an average cost growth of 27.6 percent over the Agency Baseline Commitment and average launch delays of approximately 13 months.[5] GAO noted the deterioration in cost and schedule performance was largely due to integration and test challenges on JWST and continued production challenges for the SLS.

In our oversight work over the years, we have identified several factors that affect NASA's ability to complete major projects within planned cost and schedule, including

- *Culture of Optimism.* Although optimism encourages innovation, it may also prevent leaders from making critical assessments of requirements, budgets, and schedules to determine what a project can realistically accomplish within a set budget and timetable. Furthermore, few projects in NASA's recent past have been canceled because of poor cost and schedule performance, and this reality fosters a "too big to fail" mentality that pervades Agency thinking when it comes to NASA's larger and most important missions. However, this culture may be beginning to change. In July 2019, the Administrator cited unrealistic cost and schedule estimates as a reason for removing two top executives within the Human Exploration and Operations Mission Directorate.

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[3] GAO, *NASA: Assessments of Major Projects* (GAO-19-262SP, May 30, 2019).

[4] GAO, *NASA: Assessments of Selected Large-Scale Projects* (GAO-09-306SP, March 2, 2009).

[5] GAO-19-262SP. The Agency Baseline Commitment contains the cost and schedule parameters NASA submits and is held accountable by the Office of Management and Budget and Congress.

- *Underestimating Technical Complexity*. NASA historically has underestimated the level of effort needed to develop, mature, and integrate one-of-a-kind, first-of-their-kind technologies, instruments, and spacecraft, as well as account for the extensive pre-launch testing required to reduce risk and increase the likelihood that the technologies will operate as designed in space. In February 2009, NASA delayed the launch of the Mars Science Laboratory by 2 years to resolve underlying technical issues, which increased the project's development costs by 86 percent, from $969 million to about $1.8 billion. For its follow-on rover mission, in May 2019 the Agency notified Congress that the Mars 2020 project may need more than $100 million more than its original FY 2020 budget request for design modifications and rework to resolve technical issues and complete development ahead of the project's planned July 2020 launch date.

- *Funding Instability*. Funding instability includes situations in which a project receives a different amount than planned or funds are disbursed on a schedule different than expected. Such instability can require deferring critical tasks or de-scoping or discontinuing lower priority tasks to keep project costs within a revised budget profile—actions that ultimately lead to cost increases and schedule delays. Conversely, a large influx of unplanned funding can also create challenges. For example, although early funding by Congress provided the Europa mission with opportunities to invest in technically challenging areas and "buy down" risk, the influx of money resulted in an aggressive schedule during instrument selection that increased project integration challenges.

The Agency's ability to deliver projects on time and within budget is critical to not only ensuring mission objectives and strategic goals are met, but also to honoring its commitment to Congress and taxpayers.

Progress in Addressing the Challenge

In 2009, NASA began requiring all major programs and projects with an estimated life-cycle cost greater than $250 million to develop a Joint Cost and Schedule Confidence Level (JCL) analysis prior to project confirmation in order to ensure that cost and schedule estimates were realistic and planned for anticipated risks. The JCL is a point-in-time estimate that, among other things, incorporates and quantifies known risks, assesses the impacts of cost and schedule to date, and addresses available annual resources. In June 2018 congressional testimony, the Agency's Associate Administrator stated that NASA has launched more projects at or closer to their original cost and schedule baselines since establishing the JCL policy than prior to the policy. In addition, he said the Agency continues to improve JCL estimates as managers gain more experience with the analysis.[6] In May 2019, NASA updated its JCL policy to impose additional requirements on projects costing $1 billion or more to include performing multiple JCL analyses during the project's life cycle.

In response to cost and schedule growth experienced by the Agency's highest profile missions, and the fact that NASA's acquisition practices remain on GAO's High Risk list, in December 2018, NASA established a new corrective action plan to strengthen the Agency's project management efforts and improve both transparency to stakeholders and the Agency's monitoring of contractors through

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[6] Statement of Stephen Jurczyk, Associate Administrator, NASA, before the Subcommittee on Space, Committee on Science, Space, and Technology, U.S. House of Representatives (June 14, 2018).

appropriate insight and oversight.[7] Among other things, NASA plans to strengthen Earned Value Management practices, improve the Human Exploration and Operations Mission Directorate's internal portfolio analysis and planning, and enhance the Agency's annual strategic review process.[8]

The Agency has also used Independent Review Boards (IRB) or Teams to evaluate projects and make recommendations to improve project management and a mission's chance of success. For example, the October 2017 IRB review of the WFIRST project determined that reductions in scope and complexity were needed to fit the project's budget profile, while the June 2018 IRB review of JWST found that technical issues, including human errors, greatly impacted the project's development schedule. The JWST IRB review offered recommendations to maximize the mission's probability of success, including that NASA conduct an audit of designs, processes, and tests to identify undiscovered problems. The review also recommended that Northrop Grumman Aerospace Systems (the telescope's primary contractor) establish corrective actions in its training, personnel certification, and individual accountability processes as well as a robust testing, analysis, and inspection process.

Finally, domestic and international partnerships are playing an increasingly important role in NASA's development of major programs and projects. These collaborations can reduce NASA's investment through sharing of capabilities, expertise, and scientific research while cultivating positive relations among nations. For instance, NASA has partnered with several commercial companies through its commercial crew and cargo programs to develop safe, reliable, and cost-effective space transportation capabilities to support the ISS and other Agency needs in low Earth orbit. In addition, as the first major step to return astronauts to the Moon, NASA is working with nine U.S. companies to develop delivery services to the lunar surface through Commercial Lunar Payload Services contracts. Additionally, Canada has pledged to contribute a robotic arm to repair and maintain NASA's proposed Gateway, a lunar space station that will assist in ferrying astronauts to the surface of the Moon.

● Key Implemented Recommendations

Reassess the [Europa] Clipper JCL with launch vehicle risks for the Delta IV Heavy, Falcon Heavy, and SLS prior to Key Decision Point C and establishing the Agency Baseline Commitment (IG-19-019).

Establish more rigorous cost and schedule estimates for the SLS and EGS programs for the Artemis 2 mission mapped to available resources and future budget assumptions and independently reviewed by the Office of the Chief Financial Officer (IG-17-017).

Design a strategy for collaborating with international space agencies in their cislunar space exploration efforts with a focus on advancing key systems and capabilities needed for Mars exploration (IG-17-017).

Continue to work with international partners facing project funding issues, including developing alternate options to mitigate delivery delays and potentially reduce technical capability or non-inclusion of the instruments (IG-17-009).

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[7] GAO first cited the Agency's acquisition management as a high risk in 1990. GAO, *High-Risk Series: Substantial Efforts Needed to Achieve Greater Progress on High-Risk Areas* (GAO-19-157SP, March 6, 2019), is the most recent in which NASA's acquisition management is cited as a high risk. NASA's corrective action plan is located at https://www.nasa.gov/sites/default/files/atoms/files/nasa_high_risk_corrective_action_plan_2018.pdf (last accessed September 3, 2019).

[8] Earned Value Management is an integrated management control system for assessing, understanding, and quantifying what a contractor or field activity is achieving with program dollars.

Work That Needs to Be Done

NASA must redouble its efforts to ensure that its science and space exploration projects meet cost, schedule, and performance goals. Given a limited budget to fund multiple ambitious projects, it is critical that NASA implement planned changes to its JCL policy, as well as demonstrate sustained progress completing initiatives in its December 2018 corrective action plan. Furthermore, as the Agency seeks to implement an expedited timetable with the Artemis program to land humans on the Moon by 2024, this challenge presents NASA with an opportunity to fundamentally change how it develops and manages major projects. NASA's Administrator has challenged leaders to temper the Agency's culture of optimism by requiring more realistic cost and schedule estimates, specifically citing the need to better manage the cost and schedule for Artemis. Those estimates can only be obtained by establishing well-defined and stable requirements and maturing technologies early in project development. In addition, Congress should ensure that funding is adequate, stable, and properly phased. Likewise, project managers must identify funding instability as a risk and account for it in risk mitigation strategies. Finally, the Agency needs to create a culture where leaders and staff are incentivized to develop realistic cost and schedule estimates and take steps to recognize, mitigate, and communicate risks to those estimates as soon as practicable.

○ Key Unimplemented Recommendations

Evaluate the impact on the entire Planetary Science Division budget portfolio if [Europa] Clipper's increased funding levels were disrupted and develop mitigation strategies (IG-19-019).

Require all Standing Review Boards to explicitly monitor and document variances from NASA's JCL policy—specifically regarding international partners and launch vehicle risks—and their potential cost and schedule impacts (IG-18-011).

Include cost as a factor in NASA's Journey to Mars feasibility studies when assessing various missions and systems (IG-17-017).

Ongoing and Anticipated Future Audit Work

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Audit of Orion Multi-Purpose Crew Vehicle
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Management of the Stratospheric Observatory for Infrared Astronomy (SOFIA) Airborne Observatory
This audit is assessing NASA's management of the SOFIA airborne observatory during its ongoing prime operations phase relative to cost, technical performance, and scientific achievements.

Management of the Low-Boom Flight Demonstrator Project
This audit is assessing to what extent NASA is managing the Demonstrator project to accomplish its technical objectives while meeting established milestones and controlling costs.

Additionally, we plan to initiate multiple reviews examining NASA's progress toward returning humans to the Moon under the Artemis program and continue reviewing the Agency's management of individual science missions.

Attracting and Retaining a Highly Skilled Workforce

Why This Is a Challenge

The success of NASA's many projects relies on the Agency attracting and retaining a highly skilled workforce with a diverse set of technical and management capabilities. NASA continues to rank as one of the top places to work in the federal government, a reputation that helps retain highly qualified individuals who are motivated by the Agency's mission. Despite this, NASA faces significant workforce challenges that can hinder its ability to deliver projects in a cost effective and timely manner. The OIG and GAO have reported on multiple NASA projects—Mars 2020, Europa Clipper, Space Network Ground Segment Sustainment, and EGS—that have experienced workforce challenges, including not having enough staff or staff with the right skills. For example, in our May 2019 report on the Europa mission, we found that the Jet Propulsion Laboratory's (JPL) Clipper workforce was persistently understaffed, particularly in critical areas such as the mechanical and electrical cable harness subsystem, science instruments, and avionics. NASA's workforce capacity will be further challenged as the Agency's ambitious Artemis program ramps up to meet its goal of returning humans to the Moon's surface in 2024.

In June 2018, the Executive Director of the American Institute of Aeronautics and Astronautics testified to Congress about a nationwide shortage of workers for jobs requiring science, technology, engineering, arts, and mathematics impacting the entire aerospace community and suggested that significant investments must be made to address workforce development challenges.[9] NASA staff represent only a fraction of the nation's overall aerospace workforce, and the Agency must compete with other government agencies, private industry, and academia for skilled workers. In addition to aerospace staffing concerns, NASA's procurement Business Services Assessment (BSA) conducted in 2015 found the Agency had an inadequate supply of cost and pricing analysts across its Centers.[10] Furthermore, these workforce concerns are not just limited to NASA. In December 2015, GAO found that the Department of Defense did not meet its workforce growth goals in contracting, business, and engineering.[11] Collectively, these issues increase the risk that a tight supply of aerospace workers combined with sharp increases in demand will result in more pronounced staffing shortages in NASA's critical skill areas.

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[9] Testimony of Daniel L. Dumbacher before the Subcommittee on Space, Committee on Science, Space, and Technology, U.S. House of Representatives (June 14, 2018).

[10] In 2014, NASA established the BSA to examine key capabilities across the Agency such as information technology, procurement, human capital, budget management, and facilities management. BSA teams conducted their evaluations by interviewing stakeholders, reviewing audits and regulations, benchmarking external organizations, and performing a detailed assessment of internal operations. Recommendations from the BSAs were presented to Agency senior management who instructed the business areas to create implementation plans detailing how the adopted recommendations would be implemented.

[11] GAO, *Defense Acquisition Workforce: Actions Needed to Guide Planning Efforts and Improve Workforce Capability* (GAO-16-80, December 14, 2015).

Exacerbating NASA's workforce supply challenges is a potential retirement wave that could result in a significant loss of institutional knowledge and skills. Over the past 4 years, NASA's civil servant headcount has remained constant at around 17,000 employees, with about 65 percent of this workforce falling under the occupation category "science and engineering" (S&E). Within S&E, roughly half of the employees are over 50 years old. More concerning is that 28 percent of the total S&E employees, or roughly 3,000, are currently eligible to retire, with an additional 2,000 employees becoming eligible to retire within the next 5 years. NASA's current human resources modeling predicts only a small reduction in the Agency's S&E workforce given that many NASA employees continue to work well past their retirement eligibility date. However, before a large wave of retirements occur, it is imperative that NASA hire and begin developing the next generation of employees with the skills to manage its highly technical and largely contractor-driven space, science, and aeronautics projects.

Progress in Addressing the Challenge

Over the past few years, NASA has taken several steps to improve workforce planning across the Agency. In 2012, the Agency began a broad look at its operating model, including reviewing mission support functions through the BSA. Additionally, the Agency created the Technical Capabilities and Assessment Team initiative, which helped assess NASA's technical capabilities, including workforce, and made recommendations for investing in, consolidating, or eliminating duplicative capabilities based on current and future mission requirements. As that process matured, NASA Headquarters assigned responsibility of monitoring technical capability to the Centers based on their technical specialties as they relate to STEM (i.e., science, technology, engineering, and math). The Centers work with capability leaders to provide workforce information and analyses on their specific discipline. Moreover, Technical Discipline Teams work across the Centers to look outside of the Agency, including academia, to strategically assess where NASA and the aerospace industry are heading and gauge the future supply of workers and skills based on technology development. The Agency highlights the opportunity to work on exciting missions and the goodwill of the NASA brand as potent recruiting and retention tools.

One of NASA's strategic goals is to inspire and engage the public as improved support of the education community and young professionals is critical to maintaining a sufficiently talented aerospace workforce supply.[12] To encourage the next generation of employees into aerospace and STEM, NASA is actively engaged in partnerships with nonprofit organizations and educational institutions using grants and fellowships. Funding to these groups comes through either the traditional education portfolio, managed by the Office of STEM Engagement, or the Mission Directorates. For the past 3 years, the Agency has proposed eliminating NASA's traditional education programs, which included funds for internships provided by Space Grants, minority engagement in K-12 education in the New Minority University Research and Education Project, university participation in the Established Program to Stimulate Competitive Research, and general STEM engagement in STEM Education and Accountability Projects.[13] Congress has disagreed and instead continues to fund these education programs. NASA's Mission Directorates also continue to engage the community through initiatives related to their space and science work. For example, the Launch Service Program's CubeSat Launch Initiative (CSLI) provides rideshare opportunities for small satellite payloads to fly on launches when space is available. These partnerships have provided regular educational opportunities for students in STEM disciplines. In FY 2018, NASA launched 21 CSLI CubeSats. Additionally, the Agency's Robotics Alliance Project (RAP)

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[12] *NASA Strategic Plan 2018*.

[13] In FY 2019, the Office of STEM Engagement received $110 million in funding that was not requested by NASA but appropriated by Congress.

hopes to inspire youth in STEM fields through activities and competitions in robotics. In FY 2018, RAP sponsored 270 FIRST Robotics Competition teams (involving approximately 7,000 students), sponsored 50 VEX robotics teams (approximately 500 students), and sponsored or supported 18 FIRST Robotics Competition events (approximately 48,000 students). The Agency is also embedding undergraduate and graduate-level students directly into active planetary science missions. For example, the Lucy Student Pipeline Accelerator and Competency Enabler (L'SPACE) provides undergraduates the opportunity to support NASA's Lucy Mission from the fall of 2018 through 2021.[14]

● **Key Implemented Recommendations**

The JPL Director should evaluate current and future critical technical staffing requirements and make adjustments as necessary (IG-18-011).

The Associate Administrator should create standardized guidance for performing annual capability assessments that considers, at a minimum, the appropriate time and resources for performing the assessments and the required data, analyses, and expected goals or results (IG-17-015).

Work That Needs to Be Done

For the short- to medium-term, NASA has to determine if it is attracting and developing the talent it will need to execute the Artemis program and the follow-on Mars missions while maintaining the world-class workforce in its other space science and aeronautics research portfolios. NASA last created a workforce master plan 12 years ago, a forward-looking document that creates a human resource vision for the Agency. GAO recommends such a process should incorporate five key principles: (1) involve management and employees, (2) analyze workforce gaps, (3) employ workforce strategies to fill the gaps, (4) build the capabilities needed to support workforce strategies, and (5) evaluate and revise strategies.[15] Currently, NASA is in the first year of formulating a 5-year workforce master plan. As part of the plan, the Centers are identifying their requirements to hire and train a workforce to meet projected demands. While this is a positive first step, ideally workforce master plans look 10, even 20 years into the future to identify critical skills and articulate a strategy for addressing anticipated workforce needs. Furthermore, as recently as August 2019, the White House National Space Council recommended the NASA Administrator, Director of the Office of Personnel Management, and Director of the Office of Management and Budget report at the next Council meeting on the status of workforce modernization efforts to address the barriers in federal statutes, regulations, policies, or practices that impede NASA's ability to deliver on its critical mission requirements.

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[14] Lucy is a satellite spacecraft mission expected to launch in October 2021 with a primary mission to visit "Trojan" asteroids of Jupiter that are grouped ahead and behind the giant planet on its orbit around the Sun.

[15] GAO, *NASA Progress Made on Strategic Human Capital Management, but Future Program Challenges Remain* (GAO-07-1004, August 8, 2007).

NASA has access to several special hiring authorities that can help address its workforce gaps in highly specialized, critical skill areas. For example, the National Aeronautics and Space Act authorizes the Administrator to hire up to 425 scientific, engineering, or administrative employees (NASA excepted, or "NEX") without regard to the Classification Act of 1949 rules for classifying positions and assigning pay rates. NASA is currently using less than 20 of these positions.[16] Given the Agency's ambitious mission goals, it is important that NASA takes full advantage of such tools to meet its future workforce needs.

○ Key Unimplemented Recommendations

Associate Administrator for Science Mission Directorate to evaluate current and future critical technical staffing requirements by project over the next 5 years (IG-19-019).

The JPL Director to evaluate current and future critical technical staffing requirements, make staffing adjustments to the Europa Clipper project as necessary, and reassess Lander commitments (IG-19-019).

Ongoing and Anticipated Future Audit Work

We will continue to monitor progress on the Agency's 5-year workforce master plan and may initiate an audit to assess NASA's workforce challenges. We will also continue to examine specific workforce issues as part of broader audits and reviews. For example:

Management of the Stratospheric Observatory for Infrared Astronomy (SOFIA) Airborne Observatory
The overall objective is to assess NASA's management of the SOFIA airborne observatory during its ongoing prime operations phase relative to cost, technical performance, and scientific achievements.

Management of the Low-Boom Flight Demonstrator Project
The overall objective is to assess whether NASA is managing the Demonstrator project to accomplish its technical objectives while meeting established milestones and controlling costs.

Management of NASA's Planetary Science Portfolio
The overall objective is to assess NASA's management of its planetary science portfolio and examine whether it is achieving established goals and priorities.

Audit of Orion Multi-Purpose Crew Vehicle
This audit is examining NASA's management of the Orion Program and its prime contractor, Lockheed Martin Corporation, and the extent to which NASA is meeting cost, schedule, performance, and affordability goals for the Artemis program.

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[16] The National Aeronautics and Space Act, 51 U.S.C. § 20113(b) and the Classification Act of 1949, Title 5 U.S.C. Chapter 51.

Sustaining a Human Presence in Low Earth Orbit

Why This Is a Challenge

For over 20 years, the ISS has served as a platform for humans to learn about living and working in space. However, the cost of operating the ISS and transporting astronauts to and from the Station consumes about half of the Agency's human space flight budget—$3 to $4 billion annually—until the Station's planned retirement in 2024, but likely well beyond.[17] To reduce these costs and fulfill NASA's vision to commercialize low Earth orbit, the Agency is considering options to transition from being the sole operator of the ISS to being one of many customers for privately-owned and operated platforms in low Earth orbit.

Principal among NASA's challenges in 2020 is sustaining a human presence in low Earth orbit given delays in the initiation of U.S. commercial crew transportation to the ISS. If commercial transportation is delayed beyond April 2020, the U.S. on-orbit segment of the ISS may be forced to operate with only a single crewmember beginning in April 2020. This crew reduction will significantly decrease the amount of on-board scientific research, make it more difficult to perform repairs on the ISS, and hamper NASA's recently announced plans to host private astronauts on the ISS beginning as early as 2020. Presently, the ISS is the only platform available to NASA for critical on-orbit research into human health risks and demonstration of technologies required for future missions to the Moon and Mars. NASA currently forecasts that research for at least 8 of 20 human health risks and 4 of 37 technology gaps will not be completed by 2024, meaning that even minor schedule slippage could push completion beyond the ISS's current retirement date.

The feasibility of increased commercial activity in low Earth orbit in the short or medium term poses another significant challenge to NASA's plans for increasing commercialization in low Earth orbit. In prior reports, we found that the Center for the Advancement of Science in Space, Inc. (CASIS) has had limited success in fostering commercial interest in ISS-based research, recruiting users for the ISS National Laboratory, and accomplishing tasks important to building a commercial space economy in low Earth orbit. In addition, we found that NASA failed to oversee CASIS's technical performance which contributed to the organization's inability to meet expectations. In August 2019, NASA announced an independent review of CASIS to ensure its activities are in line with the Agency's research.

Progress in Addressing the Challenge

NASA has accomplished many of the goals originally set for the ISS Program over the past two decades, sponsoring research in life and physical sciences, human health, astrophysics, Earth sciences, space science, and commercial research and development for pharmaceuticals, materials, manufacturing, and

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[17] 51 U.S.C. § 70907(a)(3). ISS operations are currently authorized through September 2024, but several legislative proposals propose extending Station operations through 2030.

consumer products. While human research and technology gaps remain, the Agency has studied and mitigated a number of health concerns associated with space travel.

Most significantly, NASA has matured the commercial launch market by introducing competition and helping develop new domestic space transportation capabilities. In April 2018, we reported that NASA had awarded $17.8 billion towards development of commercial vehicles to deliver crew and cargo to the ISS through 2024. To date, these efforts include a successful, uncrewed test flight of Space Exploration Technologies Corporation's (SpaceX) crew vehicle to the ISS in March 2019. Boeing's uncrewed test flight currently is planned for late 2019 with crewed flights to follow in early 2020, dates we believe are unrealistic.

In June 2019, the Agency issued its Plan for Commercial Low Earth Orbit Development seeking to enable a commercially driven economy in a low-Earth orbit comprised of privately-owned, human-tended, or permanently-crewed platforms supported by U.S. crew and cargo transportation capabilities, no longer exclusively managed by the U.S. government.[18] In particular, NASA said it would make 5 percent of its ISS utilization resources available for commercial efforts and provided a pricing policy for delivering cargo to and supporting crew aboard the ISS for commercial activities. Furthermore, the Agency issued the Next Space Technologies for Exploration Partnerships Broad Agency Announcement in July 2019 that will allow commercial entities to enter into public-private partnerships to develop commercial destination technologies—including habitable modules, external platforms, and deployable structures—to the ISS.[19]

While all these actions are positive steps, the new commercialization policy does not have performance metrics to evaluate how effectively NASA is nurturing commercial markets, although the Agency did agree with a recommendation we submitted during our review of the interim directive to add language establishing future metrics. Further, additional clarity may be needed on how to manage commercial mission and private astronaut requests and how their activities could impact commercial crew and cargo missions and crew capacity on the ISS.

● **Key Implemented Recommendations**

Ensure there is a contingency plan for each human health risk not scheduled to be mitigated prior to 2024 (IG-18-021).

Establish goals for CASIS raising non-NASA funds to offset operating expenses (IG-18-010).

Improve coordination with other federal agencies involved in commercial space (IG-16-025).

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[18] NASA, *NASA Plan for Commercial LEO Development* (June 7, 2019).

[19] NASA, *Next Space Technologies for Exploration Partnerships-2: Broad Agency Announcement NNH16ZCQ001K* (July 16, 2019). NASA released the initial *Next Space Technologies for Exploration Partnerships Broad Agency Announcement* in 2014 and made selections in 2015.

Work That Needs to Be Done

Successful initiation of NASA's commercial crew transportation effort is fundamental to full utilization of the ISS through its current retirement date of 2024 and beyond. In 2010, NASA initiated agreements with U.S. aerospace companies to develop commercial crew transportation to and from the ISS. Since this capability was not expected to be operational until 2015, NASA planned to rely on its purchase of seats on Soyuz vehicles to sustain transportation to the ISS.[20] Under a fixed-price contract, two contractors—Boeing and SpaceX—are working toward their first crewed test flights prior to delivery of 12 operational missions for NASA, which are expected to provide crew access to the ISS for at least 48 astronauts through 2024. However, as of May 2019, NASA has awarded approximately $8.5 billion on this effort but the program is several years behind schedule with both Boeing and SpaceX working to address a variety of technical and safety issues before they are certified to provide crew transportation. Importantly, securing additional Soyuz seats for mid-2020 is not a viable option because Russia has cut the number of yearly flights in half and manufacturing a Soyuz vehicle requires a 3-year lead time. In addition, NASA's waiver from prohibitions in the Iran, North Korea, and Syria Nonproliferation Act (INKSNA) against making payments to the Russian government for the purchase of additional Soyuz seats expires on December 31, 2020, preventing payment for additional seats that launch or return after December 2020.[21] To help mitigate the risk of limited crew availability, the Agency is implementing a recommendation from our July 2018 report to develop plans for one-year astronaut missions to the ISS.

NASA's plan for the ISS, as detailed in the President's FY 2020 budget request, envisions new commercial capabilities on the Station by 2025 as well as new commercial facilities and platforms in low Earth orbit. In addition, NASA announced plans to host private astronauts on the ISS and provide a range of capabilities for private researchers beginning as soon as 2020. These developments are a marked change from a proposal in NASA's FY 2019 budget request to end direct federal funding for the ISS beginning in 2025 and provide a more incremental approach to commercializing ISS operations. Nonetheless, the effectiveness of NASA's current plan to commercialize ISS operations while continuing to provide substantial Agency funding remains to be seen, particularly with regard to the feasibility of fostering increased commercial activity in low Earth orbit. Realistically, the ISS will require significant federal funding beyond 2025 given the current limited commercial market interested in assuming the Station's operational costs.

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[20] The operational date was later adjusted to mid-2017.

[21] The Iran Nonproliferation Act of 2000 discouraged U.S. dealings with states that would proliferate nuclear materials to Iran and required the President to report payments made to Russia in connection with the ISS. Pub. L. No. 106-178, 114 Stat. 38-45 (2000). The Iran Nonproliferation Amendments Act of 2005 and the 2009 Consolidated Security, Disaster Assistance, and Continuing Appropriations Act amended the Iran Nonproliferation Act to allow for unreported payments to Russia until 2012 for obligations associated with the ISS. Pub. L. No. 109-112 § 3, 119 Stat. 2368 (2005). Pub. L. No. 110-329 § 125, 112 Stat. 3577 (2008). The North Korea Nonproliferation Act of 2006 amended this legislation to include North Korea and renamed the statute accordingly. Pub. L. No. 109-353, 120 Stat. 2015-2016 (2006). The Space Exploration Sustainability Act amended INKSNA to extend NASA's exemption from reporting payments to Russia in connection with the ISS through 2020. Pub. L. No. 112-273 § 3, 126 Stat. 2454-2455 (2013).

Moving forward, NASA will need to establish the framework for private operators to support and sustain ISS operations. This includes working with other agencies to ensure that the adoption of regulations for the commercial use of space promote economic growth while minimizing uncertainty for taxpayers, investors, and private industry.[22] More broadly, whether NASA decides to extend, increase commercialization of , or retire the ISS, the timing of each of these decisions has a cascading effect on the funding available to support space flight operations in low Earth orbit, ambitions for establishing a permanent presence on the Moon, and ultimately sending humans to Mars. The sooner NASA, the Administration, and Congress agree on a definitive path forward for the future of the ISS, the better NASA will be able to plan for that future.

○ Key Unimplemented Recommendations

Ensure there is a contingency plan for each exploration-enabling technology demonstration not scheduled to be fully tested by 2024 (IG-18-021).

Complete all end-of-mission critical systems and open work related to nominal and contingency deorbit operations (IG-18-021).

Ongoing and Anticipated Future Audit Work

NASA's Management of Crew Transportation to the International Space Station
This audit examines contractor schedule delays and related safety concerns, NASA's plans for continuity of transportation to the ISS, and NASA's pricing and timing strategies for missions using contractor transportation.

In addition, we will continue to examine issues related to the Agency's efforts to facilitate commercialization in low Earth orbit.

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[22] 83 Fed. Reg. 24901, *Space Policy Directive 2: Streamlining Regulations on Commercial Use of Space* (May 30, 2018).

Improving Oversight of Contracts, Grants, and Cooperative Agreements

Why This Is a Challenge

In FY 2018, NASA spent about $19.2 billion of its approximately $23.4 billion in total obligations on contracts, grants, and cooperative agreements awarded primarily to business firms and educational and nonprofit institutions to fund research and development, and purchase services, supplies, and equipment to fulfill the Agency's mission.[23] The breadth and scale of these procurements underlie the significant challenges NASA faces ensuring the Agency receives good value for its investments and that recipients spend NASA funds appropriately to accomplish agreed upon goals.

NASA's challenges with contracting and acquisition oversight are long-standing. GAO first designated the Agency's acquisition management as high risk in 1990 given its history of persistent cost growth and schedule delays in the majority of its major projects. Similarly, the OIG has consistently reported on NASA's acquisition management challenges for the past 13 years when producing these top management challenge reports for Congress. For example, over the past decade we have reported on NASA's inadequate oversight of its contract with JPL, such as when the Agency paid the California Institute of Technology (Caltech) more than $16 million in unsupported award fees in 2009 and more recently when NASA failed to include controls in its contract to ensure Caltech properly managed and protected Agency information technology (IT) data, applications, and systems. In addition, in March 2019, the OIG issued two reports documenting areas where NASA could improve its data collection efforts to achieve cost savings, streamline technical requirements, and lessen administrative workload in its engineering and technical services contracts, as well as where NASA missed opportunities for cost savings on a $112 million blanket purchase agreement awarded to support Agency-wide independent programmatic and institutional strategic assessments.

NASA's poor contract management practices also contributed to the SLS Program's 2½-years of schedule slippage and approximately $4 billion over cost estimates. Specifically, in our October 2018 report on the Agency's contract with Boeing to produce the SLS's Core Stage, we found: (1) contrary to federal guidance, NASA lacks visibility into contract costs because the contractor's key activities are co-mingled into the same contract line item number, making it difficult for the Agency to track expenditures; (2) flaws in NASA's evaluation of Boeing's performance, resulting in NASA inflating the contractor's scores and leading to overly generous award fees; and (3) contracting officers approved contract modifications and issued task orders to several contracts without proper authority, exposing NASA to $321.7 million in unauthorized commitments, most of which required follow-up contract ratification.

The Agency has also been challenged in its oversight of grants. This includes instances where NASA and award recipients did not have an adequate system of controls to ensure proper administration and management of awards, and as a result grant funds were not used for their intended purposes. For

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[23] Total NASA obligations include salaries, benefits, and travel of NASA employees, as well as $109 million of purchase card transactions. The total includes a $2.26 billion contract with the California Institute of Technology to operate JPL for NASA. JPL is a federally funded research and development center located near Pasadena, California, that manages many of NASA's robotic space and Earth science missions.

example, in 2012 we found the U.S. Space and Rocket Center in Huntsville, Alabama, used grant funds to maintain office space for the direct benefit of NASA civil service personnel contrary to federal and NASA regulations. In a separate 2016 audit, we found that the Texas Space Grant Consortium inappropriately awarded scholarships to students who were not U.S. citizens. Furthermore, NASA's persistent failure to adequately manage its cooperative agreement with CASIS to support the National Laboratory aboard the ISS has had a negative impact on the Agency's goal of building a commercial space economy in low Earth orbit. More recently, NASA improperly allowed the National Space Biomedical Research Institute to use $7.8 million of cooperative agreement research funds to renovate and pay rent for laboratory space in a private building, an expenditure contrary to federal appropriations law.

NASA's contracts, grants, and cooperative agreements are also at risk of fraud and misconduct. In particular, the Agency's Small Business Innovation Research (SBIR)/Small Business Technology Transfer programs are a long-standing OIG concern. For example, a Delaware company and one of its co-owners agreed to pay $2.75 million in a civil settlement to resolve allegations the company mischarged labor costs and falsely certified work it performed by duplicating the same work under multiple SBIR/Small Business Technology Transfer contracts. In another investigation, a subcontractor lab supervisor pled guilty to mail fraud for his participation in a decades-long scheme to defraud NASA and the Department of Defense's Missile Defense Agency (MDA). The criminal behavior involved the fraudulent alteration of material properties test results for parts manufactured for use in rockets and military hardware, poor materials that NASA maintains caused two satellite launch failures resulting in losses exceeding $700 million.[24] The aluminum manufacturing company agreed to pay $34.1 million in combined restitution to NASA, MDA, and commercial customers, and also agreed to forfeit $1.8 million in ill-gotten gains. In another case, a software developer was sentenced to 3 months in federal prison after misrepresenting his company's financial condition in order to fraudulently obtain $200,000 in grant funds from NASA and the National Science Foundation. Finally, the owners of a California-based nonprofit educational organization primarily funded through a cooperative agreement with NASA are currently on trial for conspiring to embezzle hundreds of thousands of dollars from the organization.

Collectively, our audit and investigative work has consistently shown that NASA's poor management and oversight of contracts, grants, and cooperative agreements has resulted in inappropriate expenditures, wasted taxpayer dollars, and negatively impacted the Agency's mission.

Progress in Addressing the Challenge

While NASA has made some enterprise-wide changes to address challenges related to its procurement oversight and acquisition management, substantial progress appears slow. In what we view as a positive trend, NASA's use of award-fee contracts has diminished as a percentage of procurement dollars paid to businesses from 56 percent in FY 2014 to 48 percent in FY 2018. Furthermore, in 2016 the Agency revised the NASA Federal Acquisition Regulation Supplement to address a number of questionable practices we identified in a 2013 report, including award fees not justified by contractor performance and high ratings not supported by technical, cost, and/or schedule performance. However, NASA continues to struggle with proper oversight and application of award fees. For example, an October 2018 OIG audit found contract managers overseeing the SLS Stages Contract provided Boeing with $64 million in questionable award fees between 2014 and 2017 despite the contractor being significantly

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[24] NASA's Orbiting Carbon Observatory launched in February 2009 and Glory satellite launched in March 2011 both failed to reach their orbits when their respective Taurus XL launch vehicles failed due to faulty materials provided by aluminum manufacturer, Sapa Profiles, Inc.

over budget and behind schedule; only after our report did Program officials begin providing Boeing award fees that better reflected actual performance.

More than a decade ago, NASA established the Acquisition Integrity Program (AIP) within its Office of General Counsel to provide legal services regarding suspected fraud and other irregularities in the acquisition process, as well as coordinating remedies, suspension, and debarment. AIP works hand-in-hand with the OIG to deter procurement and grant fraud. For example, in August 2018, AIP officials notified the OIG that the Agency may have overpaid for fire services at Ames Research Center (Ames). Subsequently, we investigated the matter, and in April 2019 issued a memorandum alerting the Ames Center Director that contracting officials did not properly administer the Center's protective services contract and that this lack of oversight resulted in inappropriate and unnecessary costs of about $600,000 to the government. AIP continues to train the NASA workforce as well as supporting the investigation and prosecution of fraud, which is vital to the Agency's deterrence of illegal activities related to its acquisition of goods and services.

Finally, over the past 5 years NASA has revised its Grants and Cooperative Agreement Manual— including updating procedures regarding pre-award risk reviews and closeout of awards—in response to OIG recommendations and this has strengthened the Agency's grants management and oversight.[25]

Key Implemented Recommendations

Ensure annual [CASIS] metrics and targets are quantifiable and address recruitment of commercial users, the balance of applied research, support to commercial service providers, a mechanism to match projects seeking funding with funding sources, and soliciting funds other than sponsored program funds (IG-18-010).

Assess the feasibility of implementing internal controls, policies, and procedures to ensure that grant officers consider the financial condition of intended grant recipients prior to award and that additional reporting requirements are imposed and/or enhanced oversight efforts undertaken in appropriate circumstances (IG-12-016).

Work That Needs to Be Done

In 2017, NASA initiated the Mission Support Future Architecture Program (MAP) to optimize procurement and other services by moving toward a more interdependent model that enables the Agency to share capabilities across Centers, realign budget structure, and improve procurement services through collaboration. The Headquarters Office of Procurement began MAP activities in July 2018 and is scheduled to begin implementing follow-on recommendations by October 2019. Also in 2018, the Headquarters Office of Procurement developed an Acquisition Portfolio Assessment Team to address inefficient procurement operations across NASA, including redundant and duplicative contracts, duplicative services and workforce capabilities across multiple Centers, and limited procurement workload capacity. Successful implementation of these initiatives could provide more consistency in oversight and management of contracts, grants, and cooperative agreements, as well as sharing of lessons learned. However, as we have seen in past NASA enterprise-wide initiatives, progress can be slow and halting due largely to the Agency's decentralized management structure, lack of insight into Agency-wide

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[25] *NASA Grant and Cooperative Agreement Manual* and associated information can be found at https://prod.nais.nasa.gov/pub/pub_library/srba/index.html (last accessed October 2, 2019).

operations, and the limited authority of Headquarters to control budgets and implement change at the Center level. We have similar concerns with the Agency's ability to reorganize procurement management authority, operations, and oversight into a Headquarters-based, enterprise-level function.

○ **Key Unimplemented Recommendations**

Include requirements in the pending IT Transition Plan associated with NASA's contract with Caltech for implementation of continuous monitoring tools that provide the Agency's Security Operations Center with oversight of JPL network security practices to ensure they adequately protect NASA data, systems, and applications (IG-19-022).

Develop a community of practice to analyze what contract structure changes lead to the greatest efficiencies and to share these lessons learned with the Agency's procurement community (IG-19-014).

Establish policies and procedures as part of the *NASA Grant and Cooperative Agreement Manual* to periodically review a recipient's actual cost match and document award requirements are met prior to obligating the next increment of funding (IG-16-013).

Ongoing and Anticipated Future Audit Work

The Offices of Audits and Investigations, in conjunction with the OIG's Advanced Data Analytics Program, will continue to assist NASA in its acquisition oversight efforts by examining Agency-wide procurement and grant-making processes. These efforts will include steps NASA is taking to identify and mitigate grant fraud risks; auditing individual contracts, grants, and cooperative agreements; and investigating potential misuse of contract and grant funds. Examples of ongoing audits include:

Management of the Stratospheric Observatory for Infrared Astronomy (SOFIA) Airborne Observatory
The overall objective is to assess NASA's management of the SOFIA airborne observatory during its ongoing prime operations phase relative to cost, technical performance, and scientific achievements.

NASA's Efforts to Manage Space Launch System Program Costs and Contracts
This audit is evaluating how the SLS Program is tracking and reporting overall costs as well as NASA's effectiveness in controlling cost growth for four major SLS contracts, including the RS-25 engines, solid rocket boosters, and upper stage.

NASA's Management of the Mobile Launcher
This audit is examining the status of Mobile Launcher 1 as well as NASA's development plans for Mobile Launcher 2 and the extent to which the EGS Program is meeting cost, schedule, and performance goals related to the Mobile Launchers.

Additionally, we will continue to assess the impact of NASA's management and oversight of contracts, grants, and cooperative agreements relative to the Agency accomplishing its aeronautics, space, and science missions, as well as its ability to adequately protect its IT systems and data.

Why This Is a Challenge

NASA relies heavily on IT to support its unique space, science, and aeronautics missions as well as broader Agency operations. In FY 2018, NASA spent more than $2 billion on hundreds of information systems used to control spacecraft, collect and process scientific data, provide security for its IT infrastructure, and enable NASA personnel to collaborate with colleagues around the world.

Our concerns with NASA's IT governance and security are long-standing and reoccurring. For more than two decades NASA's Office of the Chief Information Officer (OCIO) has struggled to implement an effective IT governance structure that aligns authority and responsibility commensurate with the Agency's overall mission. Specifically, the Agency Chief Information Officer (CIO) and IT security officials have limited oversight and influence over IT purchases and security decisions within Mission Directorates and at NASA Centers. The decentralized nature of NASA's operations and its long-standing culture of autonomy hinder the OCIO's ability to implement effective IT governance. Furthermore, the Agency's IT practices continue to falter when measured against federal requirements. For example, in 2019 for the fourth year in a row NASA's performance during our annual Federal Information Security Modernization Act (FISMA) review fell short of the standards set by the Office of Management and Budget for an effective cybersecurity program. Additionally, despite some progress, NASA received a D- from the U.S. House of Representatives Committee on Oversight and Reform in the most recent Federal Information Technology Acquisition Reform Act (FITARA) assessment of the Agency's efforts to modernize its IT infrastructure.[26] NASA received this grade, the lowest since it received an F in May 2016, due to the Agency's failure to monitor and acknowledge IT project risks. NASA tied the Department of Homeland Security for the lowest grade of the 24 agencies included on the Committee's June 2019 scorecard.[27]

IT governance and security are persistent concerns because the Agency maintains a significant online presence with approximately 3,200 publicly accessible websites and web applications that allow NASA to share information on its aeronautics, science, and space programs with the public and worldwide research community. The Agency's vast connectivity with educational institutions, research facilities, and other outside organizations offers cybercriminals a larger target than most other government agencies and presents unique IT security challenges. For almost 20 years we have identified securing NASA's IT systems and data as a top management challenge. Limited progress by the OCIO to mitigate systemic and recurring IT security weaknesses over the past decades have not kept up with the changing IT landscape. These weaknesses, which have included issues such as patch management and incident response, adversely affect the Agency's ability to protect the confidentiality, integrity, and availability of

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[26] Beginning in November 2015, the U.S. House of Representatives Committee on Oversight and Reform has graded federal agencies biannually on their implementation of provisions in Title VIII, Subtitle D of Carl Levin and Howard P. ''Buck'' McKeon National Defense Authorization Act for Fiscal Year 2015, Pub. L. No. 113-291 (2014) to modernize the federal government's IT. Those provisions are referred to as FITARA.

[27] The 24 agencies included in the FITARA scorecard are the agencies identified in the Chief Financial Officers Act of 1990, as amended and codified in 31 U.S.C. § 901.

its critical data. For example, the failure to apply timely software patches increases the risk that known vulnerabilities will be exploited and unauthorized access could be gained, resulting in successful attacks on NASA's systems. In March 2017, a JPL server that runs source code used in ground operations for scientific spacecraft was compromised by foreign hackers because the system had not been patched on time and the system owner failed to timely review the application log to identify suspect activities. As a result, the intruders remotely executed a code on the server without authentication and were able to upload, manipulate, and execute files and commands.

Progress in Addressing the Challenge

NASA has taken several actions to improve its IT governance structure over the past few years, such as revising its governance boards; updating board charters; defining the roles and responsibilities of positions within the OCIO IT structure; and hiring four senior leadership positions in IT security, including a permanent Senior Agency Information Security Officer (SAISO).[28] However, after changing its organizational structure to make the Agency CIO a direct report to the NASA Administrator in 2013 in response to an OIG recommendation, the Agency in May 2019 moved that position under the Mission Support Directorate. According to NASA, the change was made to support improved management of Agency IT as a strategic resource and facilitate resource allocation to needed areas of emphasis within OCIO. This change impacted NASA's FITARA grade and added another layer of management over the OCIO that could have once again negatively impacted the governance, authority, and insight issues they have been trying to correct.[29] Shortly after the June 2019 FITARA scorecard was released, NASA reversed this decision and the CIO again reports directly to the Administrator.

While NASA has taken steps to improve the Agency's overall security posture, including making progress in implementing cybersecurity initiatives and increasing Security Operations Center (SOC) capabilities, its overall information security program struggles to adequately protect NASA data from cyberattacks. In March 2015, we found that NASA's SOC was not adequately integrated into JPL's computer network operations resulting in a lack of oversight for some JPL systems. As a result, NASA lacked the ability to monitor a large portion of JPL network traffic for suspicious activity, provide timely assistance in the event of an incident, and ensure its information systems and data are fully protected. In response to the report's recommendations, the Agency promised to improve SOC oversight at JPL. However, in April 2018 JPL discovered an account belonging to an external user had been compromised and used to illegally access its mission network. Given the network's architecture, the attackers were able to expand their access upon entry and move laterally across the JPL network. Classified as an advanced persistent threat, the attack exploited weaknesses in JPL's system of security controls and moved undetected within the network for approximately 10 months. Prior to detection and containment, the attacker exfiltrated approximately 500 megabytes of data from 23 files, 2 of which contained International Traffic in Arms Regulations information related to the Mars Science Laboratory mission. More recently, another Center experienced an intrusion where personally identifiable information was compromised. NASA is still reviewing the nature and extent of the intrusion.

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[28] Since 2007, 10 individuals had served as the Agency SAISO either in an acting or permanent role. The SAISO is responsible for Agency-wide IT security.

[29] The June 2019 FITARA grade was a D-. The minus attached to the grade denotes that the Agency CIO was no longer a direct report to the head of their agency.

● Key Implemented Recommendations

The SAISO should perform and document an analysis of maintaining the current SOC contract structure or transitioning to a dedicated SOC contract to improve performance and flexibility (IG-18-020).

Complete the charters for all IT governance boards and educate personnel on their functions (IG-18-002).

Implement a mitigation plan to address the skill set and capability issues facing the OCIO to improve its credibility (IG-18-002).

Work That Needs to Be Done

Achieving the Agency's IT security objectives will require sustained improvements in NASA's overarching IT governance and security practices. NASA needs to expedite its efforts to inculcate solid governance and operations procedures that provide secure, efficient, and cost-effective IT systems for Agency use. Increased collaboration among the OCIO, Mission Directorates, NASA Centers, and the Offices of Protective Services and Strategic Infrastructure is needed to stimulate IT improvements across the Agency. It is also essential that NASA achieve full compliance with FISMA, FITARA, and other federal laws and regulations related to managing its IT resources and portfolio. NASA should also continue its strategic workforce planning efforts to identify needed skills, assess current workforce composition to identify skill gaps, and plan for filling these gaps through training and recruitment. Moving forward, we will continue to examine NASA's IT governance and security operations through both targeted audits and statutorily required compliance reviews.

○ Key Unimplemented Recommendations

Include requirements in the pending IT Transition Plan for implementation of continuous monitoring tools that provide the NASA SOC with oversight of JPL network security practices to ensure they adequately protect NASA data, systems, and applications (IG-I9-022).

Develop a charter and set of authorities signed by the NASA constituent executives (including the NASA Administrator) that addresses the SOC's organizational placement, purpose, authority, and responsibilities (IG-18-020).

Reevaluate and implement necessary changes to the Annual Capital Investment Review process, its reporting requirements, and approval thresholds to ensure the Agency CIO gains adequate visibility and authority over all NASA IT assets (IG-18-002).

Ongoing and Anticipated Future Audit Work

Audit of NASA's Distributed Active Archive Data Centers
The objective of this audit is to assess NASA's management of the Distributed Active Archive Data Centers and the Earth Observing System Data and Information System's cloud transition efforts.

NASA's Policy and Practices Regarding the Use of Non-Agency IT Devices
This audit is assessing NASA's policy and plans regarding the risks of using, or prohibiting the use of, personal IT devices to conduct Agency business.

Evaluation of NASA's Information Security Program under the Federal Information Security Modernization Act for Fiscal Year 2019
As required by FISMA, this review will evaluate NASA's information security program for FY 2019.

In addition to our audit work, Special Agents in our Office of Investigations continue to investigate breaches of NASA's IT systems. The OIG works closely with NASA's Office of Counterintelligence, the OCIO, and the SOC to monitor and investigate network intrusions as well as other criminal and administrative issues. For example, the SAISO has been instrumental in providing the necessary access to NASA intrusion data as our Office of Investigations launched a threat hunting initiative in August 2019 to identify and track advanced cyber threats.

Sustaining Infrastructure and Facilities

Why This Is a Challenge

NASA and its partners rely on the Agency's infrastructure to prepare for missions to the Moon and Mars, facilitate a commercial space industry, conduct aeronautics research and development, and study Earth and space science. With installations in 14 states, NASA collectively manages $39 billion in assets with an inventory of more than 5,000 buildings and structures, making the Agency one of the largest property holders in the federal government. Over the past 60 years, NASA has used its unique facilities to develop new and innovative technologies for space exploration, scientific research, and aeronautics. To achieve its current exploration and research goals, NASA will need to maintain these facilities in a safe and sustainable condition.

Primary among NASA's challenges is that over 83 percent of the Agency's facilities are beyond their original design life. While NASA strives to keep these facilities operational, the Agency faces a deferred maintenance backlog of $2.65 billion as of 2019. This has resulted in unscheduled maintenance rather than scheduled maintenance costing up to three times more to repair or replace equipment after it has failed. The Agency is also responsible for 176 abandoned properties worth $356 million that present a safety and maintenance liability as many have structural, roofing, or interior deficiencies. Moreover, as NASA updates its ground support infrastructure for lunar missions, many of the Agency's facilities are undergoing modifications or updates to accommodate modern launch capabilities. For example, the EGS Program at the Kennedy Space Center is upgrading infrastructure and facilities required for the Artemis program, including modernization of Pad 39B and modifying the Vehicle Assembly Building to handle the SLS rocket and Orion capsule.

NASA is also managing several significant environmental cleanup efforts including the Santa Susana Field Laboratory (SSFL), a single project that accounts for 40 percent of the Agency's overall environmental cleanup liability. In March 2019, we questioned $377 million in unfunded liability costs associated with NASA's current soil cleanup plans for the SSFL. We questioned these costs because the Agency's current approach is not based on risks to human health and the environment or the expected future use of the land, the standard practice for environmental remediation at similar sites. Spending the more than $500 million required to clean the soil to the current exacting standards would preclude the Agency's ability to address other environmental cleanup priorities such as a project to remove contaminants from drinking water used by communities surrounding JPL.

In addition to routine maintenance and upkeep, NASA's expansive infrastructure footprint is impacted by unforeseen events such as hurricanes and wildfires. In 2014, NASA deemed its launch capabilities, space operations, and ground systems at risk from regional climate variability. Up to two-thirds of NASA's infrastructure and assets valued at more than $32 billion stand within 5 meters (16 feet) of sea level. These include laboratories, launch pads, airfields, testing facilities, data centers, and other infrastructure that could face significant threats without mitigation measures. While NASA received $59 million in supplemental funding in FY 2018 to repair facilities damaged at Johnson Space Center by Hurricane Harvey and $22.3 million to repair facilities damaged at Kennedy Space Center by Hurricane

Irma, the Agency may face significant unplanned expenses for facility repairs following storms and other climate events. The impact of such events on NASA facilities could be mitigated to some extent by addressing deferred maintenance and making enhancements such as elevating buildings and improving storm water drainage.

Progress in Addressing the Challenge

NASA's Construction of Facilities program focuses on modernizing the Agency's infrastructure into fewer, more sustainable facilities and repairing failing infrastructure to reduce overall maintenance costs. This has resulted in an increasing number of construction projects to eliminate or repurpose old or unused facilities. For example, in April 2019, NASA's Marshall Space Flight Center completed Building 4221, part of the refurbishment of the "4200 Complex" that included the demolition and replacement of old buildings with sustainable facilities. Additionally, as we reported in October 2018, the Agency is utilizing $18 million in historic property lease proceeds at Ames to maintain facilities including the Unitary Planned Wind Tunnel, Arc Jet Complex, and Vertical Motion Simulator.

Furthermore, the Agency has initiated a number of significant infrastructure projects to support its Artemis program, such as refurbishing Kennedy Space Center's Vehicle Assembly Building and Launch Complex 39B for the launch of Artemis 1; activation of Stennis Space Center's B-2 Test Stand in preparation for the SLS rocket's Green Run testing; and constructing the new Modular Supercomputing Facility at Ames to run complex simulations in support of the Artemis program.

● **Key Implemented Recommendation**

Complete the ongoing comprehensive technical capabilities assessment and ensure the process is established into policy (IG-13-008).

Work That Needs to Be Done

We have assessed a variety of infrastructure issues, including the Agency's environmental remediation efforts; management of NASA's historic real and personal property; efforts to "rightsize" the NASA workforce, facilities, and other supporting assets; construction of new assets such as test stands; and NASA's efforts to reduce unneeded infrastructure and facilities. Common themes from these reviews are NASA's slow implementation of corrective actions, inconsistent implementation of Agency policies, and a need for stronger life-cycle cost considerations in facility construction decisions.

In March 2017, we reported that after more than 4 years the Agency had yet to make key decisions about its capabilities or decide whether to consolidate or dispose of unused and unneeded facilities and other assets. Moreover, NASA's assessments of its capabilities did not consistently include information needed to make informed decisions, including mission needs or facility usage data, analyses to determine gaps or overlaps, recommendations to achieve cost savings, or firm timeframes for completing actions.

However, NASA will need to continue to make difficult decisions to invest, divest, or consolidate unneeded infrastructure; effectively communicate those decisions to stakeholders; and withstand the inevitable political pressure to retain unnecessary capabilities and facilities at Centers throughout the country. Despite some progress, the Agency needs to address its substantial deferred maintenance backlog and significant environmental cleanups at multiple sites.

⭕ Key Unimplemented Recommendations

Pursue all available options—administrative, legal, or political—to ensure NASA's SSFL soil cleanup is performed in an environmentally and financially responsible manner based on the intended future use of the property (IG-19-013).

Ensure NASA policies and procedures for using the proceeds from facilities leased under National Historic Preservation Act authority appropriately aligns with Agency goals to minimize excess facilities (IG-19-002).

Evaluate Capability Leadership Model assessments and teams to better ensure independence (IG-17-015).

Perform a comprehensive review of Program-funded construction projects to ensure adequate analysis, including all life-cycle costs, is completed prior to project initiation (IG-17-021).

Ongoing and Anticipated Future Audit Work

NASA's Management of the Mobile Launcher
This audit is examining the status of Mobile Launcher 1 as well as NASA's development plans for Mobile Launcher 2 and the extent to which the EGS Program is meeting cost, schedule, and performance goals related to the Mobile Launchers.

NASA's Management of Hazardous Materials
This audit evaluates NASA's processes and procedures regarding the acquisition, handling, storage, and disposal of hazardous materials.

APPENDIX A: RELEVANT OIG REPORTS

Landing Humans on the Moon by 2024

NASA's Management of the Space Launch System Stages Contract (IG-19-001, October 10, 2018)

NASA's Plans for Human Exploration Beyond Low Earth Orbit (IG-17-017, April 13, 2017)

Improving Management of Major Projects

NASA's Management of the Space Launch System Stages Contract (IG-19-001, October 10, 2018)

NASA's Surface Water and Ocean Topography Mission (IG-18-011, January 17, 2018)

NASA's Plans for Human Exploration Beyond Low Earth Orbit (IG-17-017, April 13, 2017)

NASA's Mars 2020 Project (IG-17-009, January 30, 2017)

NASA's Challenges to Meeting Cost, Schedule, and Performance Goals (IG-12-021, September 27, 2012)

Attracting and Retaining a Highly Skilled Workforce

Management of NASA's Europa Mission (IG-19-019, May 29, 2019)

NASA's Surface Water and Ocean Topography Mission (IG-18-011, January 17, 2018)

NASA's Efforts to "Rightsize" its Workforce, Facilities, and Other Supporting Assets (IG-17-015, March 21, 2017)

Sustaining a Human Presence in Low Earth Orbit

NASA's Management and Utilization of the International Space Station (IG-18-021, July 30, 2018)

NASA's Management of the Center for the Advancement of Science in Space (IG-18-010, January 11, 2018)

NASA's Response to SpaceX's June 2015 Launch Failure: Impacts on Commercial Resupply of the International Space Station (IG-16-025, June 28, 2016)

NASA's Efforts to Maximize Research on the International Space Station (IG-13-019, July 8, 2013)

Improving Oversight of Contracts, Grants, and Cooperative Agreements

Cybersecurity Management and Oversight at the Jet Propulsion Laboratory (IG-19-022, June 18, 2019)

Ames Research Center Protective Services Contract (IG-19-017, April 25, 2019)

NASA's Strategic Assessment Contract (IG-19-015, March 28, 2019)

NASA's Engineering and Technical Services Contracts (IG-19-014, March 26, 2019)

NASA's Management of the Space Launch System Stages Contract (IG-19-001, October 10, 2018)

Audit of the National Space Biomedical Research Institute (IG-18-012, February 1, 2018)

NASA's Management of the Center for the Advancement of Science in Space (IG-18-010, January 11, 2018)

NASA's Efforts to Improve the Agency's Information Technology Governance (IG-18-002, October 19, 2017)

Audit of NASA Space Grant Awarded to the University of Texas at Austin (IG-16-013, February 18, 2016)

Extending the Operational Life of the International Space Station Until 2024 (IG-14-031, September 18, 2014)

NASA's Use of Award-fee Contracts (IG-14-003, November 19, 2013)

NASA's Efforts to Maximize Research on the International Space Station (IG-13-019, July 8, 2013)

Audit of NASA Grant Awarded to HudsonAlpha Institute for Biotechnology (IG-12-019, August 3, 2012)

Audit of NASA Grants Awarded to the Philadelphia College Opportunity Resources for Education (IG-12-018, July 26, 2012)

Audit of NASA Grants Awarded to the Alabama Space Science Exhibit Commission's U.S. Space and Rocket Center (IG-12-016, June 22, 2012)

NASA Should Reconsider the Award Evaluation Process and Contract Type for the Operation of the Jet Propulsion Laboratory (IG-09-022, September 25, 2009).

Addressing Long-standing IT Governance and Security Concerns

Cybersecurity Management and Oversight at the Jet Propulsion Laboratory (IG-19-022, June 18, 2019)

Audit of NASA's Security Operations Center (IG-18-020, May 23, 2018)

NASA's Efforts to Improve the Agency's Information Technology Governance (IG-18-002, October 19, 2017)

NASA's Information Technology Governance (IG-13-015, June 5, 2013)

Sustaining Infrastructure and Facilities

NASA's Progress with Environmental Remediation Activities at the Santa Susana Field Laboratory (IG-19-013, March 19, 2019)

Audit of NASA's Historic Property (IG-19-002, October 22, 2018)

NASA's Efforts to "Rightsize" its Workforce, Facilities, and Other Supporting Assets (IG-17-015, March 21, 2017)

NASA's Efforts to Reduce Unneeded Infrastructure and Facilities (IG-13-008, February 12, 2013)

National Aeronautics and Space Administration
Office of the Administrator
Washington, DC 20546-0001

November 6, 2019

TO: Inspector General

FROM: Administrator

SUBJECT: Agency Response to Office of Inspector General Report, "2019 Report on
        NASA's Top Management and Performance Challenges"

The National Aeronautics and Space Administration (NASA) appreciates the opportunity
to review and comment on the Office of Inspector General (OIG) report entitled, "2019
Report on NASA's Top Management and Performance Challenges."

The audits and investigations conducted by your office provide NASA's leadership and
management with valuable contributions to the collective effort to provide oversight and
gain insight into NASA's broad portfolio of programs, projects, and mission support
activities with which it is entrusted. The efforts expended by your office during this past
year have furthered the cause of providing the taxpayer with maximum value for each
dollar invested in NASA's wide-ranging, ambitious, and challenging portfolio. As an
Agency, we continue to aggressively pursue the mitigation and remediation of findings
related to the audit recommendations issued by your office, including those which form
the underpinnings of your observations as cited in your 2019 Report on NASA's Top
Management and Performance Challenges.

While we fundamentally agree that the seven areas outlined in your 2019 report
constitute significant challenges for the Agency, we would like to highlight the following
mitigation and remediation efforts relative to each challenge outlined in your report that
have either been taken or are currently under way. We believe these efforts substantively
demonstrate NASA's commitment to addressing its most significant management and
performance challenges faced by the Agency:

Challenge 1: Landing Humans on the Moon by 2024

NASA agrees that landing humans on the Moon by 2024 is a top management and
performance challenge.

Significant progress has been made toward the launch of Artemis I, the first integrated
test of NASA's deep space exploration systems: the Orion spacecraft, Space Launch
System (SLS) rocket, and the ground systems at Kennedy Space Center (KSC) in Cape
Canaveral, Florida. The Orion crew and service module is expected to ship to Plum
Brook Station in November 2019 for environmental testing prior to being shipped to

KSC. SLS engines, boosters, Orion Stage Adapter, Interim Cryogenic Propulsion Stage, and Launch Vehicle Stage Adapter are all complete. The Core Stage will be completed and shipped to Stennis Space Center for Green Run testing in December 2019. Also in December, the Mobile Launcher will complete multi-element verification and validation and return to the Vehicle Assembly Building to support stacking.

NASA has continued to progress toward Artemis I, while concurrently building flight hardware for Artemis II, and beginning long-lead procurements and planning for Artemis III.

NASA has also initiated activity for the commercial development of lunar human landing systems; a Gateway configuration aligned with minimally required systems for 2024 landing support for short-duration surface missions; and lunar surface suit systems development with initial ground- and ISS-based testing.

For Gateway, NASA has accelerated plans and procurements for the lunar landing in 2024 by focusing development on the initial critical elements required to support Artemis III: the Power and Propulsion Element (PPE), the Habitation and Logistics Outpost (HALO), and logistics delivery services. NASA awarded the contract for PPE to Maxar Technologies in May 2019 and released requests for proposals for HALO to Northrup Grumman Innovation Systems in September 2019 and for Gateway Logistics Services in August 2019. Finally, a request for information for lunar surface suits under the Exploration Extra-Vehicular Activity project was released in October 2019.

For Human Landing Systems to the lunar surface, NASA plans to evolve an initial capability, focused on missions in 2024 and 2025, into a sustainable transportation system that will provide frequent access to the lunar surface for both crew and cargo delivery services. NASA further intends for public and private investments in lunar exploration capabilities to eventually expand to include surface elements necessary to support prolonged human exploration to accomplish increasingly advanced exploration goals, including a mission to Mars. To this end, NASA released a series of two solicitations under the Agency's Next Space Technologies for Exploration Partnerships (NextSTEP) Broad Agency Announcement (BAA) vehicle. In May 2019, NASA awarded contracts to 11 companies for human lunar lander studies under the NextSTEP Appendix E solicitation. In July and August 2019, NASA released draft BAAs for NextSTEP Appendix H, for the development and demonstration of systems to carry humans to the lunar surface by 2024. NASA received over 1,150 comments to these first two drafts, which the Agency used to update and streamline the partnership approach and empower industry to meet NASA's functional requirements, which were included in the final Appendix H solicitation issued in September 2019, with proposals due in early November 2019 and awards planned for late December 2019/early January 2020.

Key Unimplemented Recommendations:

Develop a corrective action plan for completing the two Core Stages and Exploration Upper Stage and brief that plan to Boeing and senior NASA officials to gain their approval (IG-19-001)

In May of 2019, NASA and the OIG agreed on a path forward toward implementation of this recommendation. NASA provided documentation to the OIG in October 2019 in support of closure of this recommendation.

Establish objectives, need-by dates for key systems, and phase transition mission dates for the Journey to Mars (IG-17-017)

NASA agreed with this OIG recommendation and provided documentation in support of closure to the OIG in October 2019.

Include cost as a factor in NASA's Journey to Mars feasibility studies when assessing various missions and systems (IG-17-017)

NASA agreed that cost should be considered as a factor when assessing missions and systems for NASA's Moon to Mars efforts. The Agency is studying this and will provide details to the OIG, including cost estimates, as this work progresses.

Challenge 2: Improving Management of Major Projects

NASA is intensely focused on its mission of exploration. In support of this mission, the Agency has developed a rigorous process for program formulation, approval, implementation, and evaluation. We view excellence in program management as a core capability, critical for enabling exploration. NASA's program management expertise brings together the people, resources, and processes necessary to execute the most challenging and complex programs as we explore our world and our universe.

As NASA carries out the Administration's exploration plans, the Agency has been making steady progress on improving program planning and control and increasing transparency for external stakeholders. NASA leadership continues to evaluate the considerable progress made to date on implementation of the Agency's high-risk Corrective Action Plan (CAP) intended to address long-standing issues in this area and is proceeding forward with a potential update to the CAP in 2020. NASA is also making substantial progress in the implementation of the Program Management Improvement and Accountability Act, specifically with regard to the assessment and improvement of program and project management practices for flight missions. The Agency is committed to pursuing the most critical changes to increase transparency, improve cost and schedule estimation, and maintain focus on accountability.

We take our responsibility as stewards of limited Federal resources very seriously, and we will continue to apply all available authorities to accomplish our mission efficiently.

At the same time, the Nation expects NASA to embrace big challenges it is presented with, consequently NASA must continue to accept risk. Our missions will continue to incorporate the leading edge of technology in the hostile environment of space. NASA missions must do things that have never been done before. Our missions will employ technologies that must be developed and tested on Earth, but can only be demonstrated in space. Innovation must remain at the core of everything NASA does, and we cannot encourage innovation and discovery without accepting some risk and some uncertainty.

NASA's challenge is to develop and improve the processes necessary to ensure both efficiency and accountability in what is inevitably a dynamic development environment. We appreciate that, in order to retain the confidence of Congress and the American people, we must execute; delivering missions on-cost and on-schedule while identifying and characterizing risks and related mitigation activities. NASA's monthly internal Baseline Performance Review chaired by the NASA Associate Administrator has been revamped to better reflect portfolio performance against external commitments, focus discussion on issues requiring leadership awareness, and accelerate the identification of solutions to challenges as they arise. NASA has also recently formed the NASA Acquisition Strategy Council to address acquisition decisions holistically under a single Decision Authority. NASA's renewed emphasis on strategic acquisitions will improve the Agency's efficacy in intelligently moving forward on large acquisitions and making data-driven decisions, ensuring a universal view of the aerospace industrial base, international partners, and NASA in-house performance and capacity.

Furthermore, the Science Mission Directorate (SMD) is launching an approximately seven-month Large Mission Study (LMS) in order to make and implement selected recommendations to ensure that SMD is more successful at delivering large strategic missions on time and within budget. The study will examine how NASA makes critical decisions during pre-formulation and formulation (Pre-Phase-A through Phase B) that either enable or prevent mission success. And, it will examine how NASA addresses problems during implementation (Phases C through F) when solution space is limited and delays are expensive.

As we strive to return humans to the surface of the Moon in 2024, NASA will continue to foster a culture where leaders and staff are incentivized to develop realistic cost and schedule estimates; take steps to recognize, mitigate, and communicate those estimates; and demonstrate progress in our program management improvement efforts.

Key Unimplemented Recommendations:

Evaluate the impact on the entire Planetary Science Division budget portfolio if [Europa] Clipper's increased funding levels were disrupted and developed mitigation strategies (IG-19-019)

Require all Standing Review Boards to explicitly monitor and document variances from NASA's JCL policy—specifically regarding international partners and launch vehicle risk—and their potential cost and schedule impacts (IG-18-011)

Include cost as a factor in NASA's Journey to Mars feasibility studies when accessing various missions and systems (IG-17-017)

With regard to the Key Unimplemented Recommendations cited above, SMD continues actively pursuing implementation, including but not limited to the Planetary Science Division's (PSD) ongoing assessment of the impact of the Europa Lander mission, if selected, on the PSD's portfolio.

Challenge 3: Attracting and Retaining a Highly Skilled Workforce

NASA agrees with the challenges identified in the *Attracting and Retaining a Highly Skilled Workforce* section of the report. One area of clarification is in regard to a reference to the Jet Propulsion Laboratory's (JPL) Clipper workforce being understaffed in critical skill areas. NASA would like to note that JPL is a Federally Funded Research and Development Center (FFRDC) and as such employs its own workforce (non-civil servant) to achieve work contracted by NASA. NASA has no responsibility or authority over the JPL workforce.

There is agreement that as the Agency continues to implement the Artemis program, there will be greater stress placed on the workforce and Human Capital program. NASA is working with OPM to identify and implement as many hiring flexibilities as possible to allow the Agency to hire, retain, and reward the personnel necessary to ensure Artemis' success.

In reference to the American Institute of Aeronautics and Astronautics Congressional testimony regarding a nationwide shortage of workers for jobs requiring science, technology, engineering, arts, and mathematics impacting the entire aerospace community, NASA completely agrees. To that end, the Office of the Chief Human Capital Officer (OCHCO) continually looks for ways to more broadly recruit employees. Most recently, the Agency has embraced using LinkedIn as a way to more broadly advertise open positions, ensuring a broader reach of potential candidates who are actively and passively seeking opportunities.

Over the past year, NASA has been working to institute a new Workforce Master Plan as part of the Agency's Strategic Workforce Planning program. Mission Directorates and Centers were asked to complete a comprehensive review of the skills and workforce that is currently onboard and what will be needed five years in the future. These submissions were rolled up and will be discussed at a future senior leadership meeting. Additionally, the intent is to conduct this activity on an annual basis in order to continually refine the Agency's workforce needs.

Finally, OCHCO has been working to increase the use of the various hiring flexibilities that have been granted by OPM. In October 2019, a Human Resources Business Partner (HRBP) community meeting will be held at KSC. This workshop will include educational opportunities for HRBPs to continue to learn how and when best to use the

various hiring flexibilities available. As NASA perfects the use of these flexibilities, it is also working with OPM to get additional flexibilities that will allow the Agency to be more agile and in line with private sector best practices.

Key Unimplemented Recommendations:

Associate Administrator for Science Mission Directorate to evaluate current and future critical technical staffing requirements by project over the next 5 years (IG-19-019)

The JPL Director to evaluate current and future critical technical staffing requirements, make staffing adjustments to the Europa Clipper project as necessary, and reassess Lander commitments (IG-19-019)

Regarding the Key Unimplemented Recommendations in the OIG's report IG-19-019 noted above, SMD is in the process of evaluating staffing procedures and requirements and anticipates to provide a detailed analysis in early 2020.

Challenge 4: Sustaining a Human Presence in Low-Earth Orbit

The International Space Station (ISS) International Partnership and the ISS National Lab continue to mature the safe operations and utilization of this unique on-orbit research platform. Research and utilization for the wide variety of fields, including human health and performance, long-duration life support demonstrations, life and physical sciences, Earth and space science, astrophysics, and multiple technology development fields, continue to expand in the number of experiments and the number of investigators. From FY18 to FY19, crew time increased from 2820 to 2944 hours, an increase of 4.4 percent. In addition, the number of investigations increased from 2390 at the end of FY 2017 to 2872 at the end of FY 2019, an increase of 20 percent.

This is made possible by the combined ongoing efforts of the ISS program, the ISS National Lab operator, and the commercial cargo suppliers to utilize and operate the ISS to its utmost capability. The ISS program is now operating based on the many years of experience gained in pre-flight integration activities, on-orbit crew planning and execution, logistics planning and management, and other aspects of ISS management and operations; all of which are providing dividends in returning benefits to humanity, enabling the development of a commercial market, and enabling deep space long-duration exploration. Research clients are able to insert experiments into orbit in as little as four months. In recognizing that different resources are required for different types of research, NASA continues to evaluate the needs of the research community and add resources to alleviate limitations whenever possible.

Research, technology development, and commercial development efforts onboard the ISS by NASA, other Government agencies, and by the private sector through the National Lab continues to see benefits applied here on Earth as reflected in the third version of the

ISS Benefits to Humanity Document, which was released in June 2019 (www.nasa.gov/stationbenefits).

Through the NASA budget process, the ISS program has projected the resources necessary to continue with its mission based on actual contract and on-orbit performance data for many aspects of the ISS program, including transportation, maintenance, and operations. The ISS integration process for utilization continues to become more efficient because of private industry inputs and interactions with the National Lab providers.

Overall, the ISS program is starting to realize its full potential in accomplishing NASA's and the Nation's goals in exploration, commercial development, and extending human presence beyond low-Earth orbit (LEO).

Over the past year, NASA has made significant progress with the SpaceX and Boeing on the certification effort of their respective crew transportation vehicles including the flight of the first SpaceX demonstration mission. In addition, NASA has secured limited seats on Soyuz vehicles for 2020 to allow for a continued U.S. Orbital Segment astronaut presence on the ISS through October of 2020.

In the area of commercialization, NASA has released a five-part plan to enable economic development of LEO. NASA has released solicitations to enable commercial and marketing activities on ISS; flights of private astronaut missions; use of the ISS Node 2 forward port for a commercial element attached to ISS; a draft solicitation for free-flying commercial LEO platforms; and multiple solicitations for ideas that would enable sustainable, scalable commercial demand for use of LEO.

Both commercial crew providers, Boeing and SpaceX, are making steady progress in returning domestic crew launches to the U.S. Both providers are working through development of technical challenges that are not uncommon in the human spaceflight and launch industries Nationwide. NASA maintains close coordination with both entities to understand their progress as well as to assess their readiness for flight from a safety perspective. The ISS program continues to evaluate commercial crew readiness schedules and is working to identify options that ensure the U.S. has uninterrupted access to the ISS for U.S. and partner astronauts.

Key Unimplemented Recommendations:

Ensure there is a contingency plan for each exploration-enabling technology demonstration not scheduled to be fully tested by 2024 (IG-18-021)

In response to the OIG's recommendation, NASA requested closure in July 2019. However, a subsequent discussion to provide clarification to the OIG is pending.

Complete all end of mission critical systems and open work related to nominal and contingency deorbit operations (IG-18-021)

NASA is committed to developing a Space Station Program 51066 "ISS Deorbit Strategy and Contingency Action Plan" in cooperation with international partners. Efforts to develop the action plan are currently in progress.

Challenge 5: Improving Oversight of Contracts, Grants, and Cooperative Agreements

NASA's Office of Procurement (OP) continues to make strides intended to improve the contracting processes throughout the Agency and appreciates the investigative and audit work conducted by the OIG.

OP received approval by NASA's Mission Support Council (MSC) to implement its Mission Support Future Architecture Program (MAP) transformation approach which includes an enterprise approach to governance, hiring, training, performance metrics, new and improved IT tools, and knowledge sharing among the Procurement workforce. The transformation included a realignment of OP's historical decentralized budget (labor, travel, and procurement) to a centrally controlled budget managed by NASA Headquarters' OP. Supervision of the local Procurement directors has also been realigned to Headquarters enabling consistency in management of procurement processes.

NASA continues to strengthen its overall procurement processes and policy by utilizing 23 designated institutional-related services categories. This strategic approach to procuring and managing the Contract Portfolio requires the contracting officer to coordinate the requirement(s) with the Procurement Portfolio Manager in the Office of Procurement and the Enterprise Requirement Manager in the Mission Directorate or requirements owning organization before moving forward with the acquisition. All major acquisitions are reviewed as a part of this process to determine whether a procurement will be centralized, regionalized or remain localized. This approach enables consistency in streamlined strategies, seeks to reduce unnecessary duplication, leverages spend under management, and enables insight into procurement operating cost.

Other key initiatives under way include strengthening acquisition planning to ensure that the right contract vehicle is utilized for the requirement, a strategic sourcing policy and Web site to assist in optimizing the use of existing contract vehicles, and the NASA FAR Supplement (NFS) Quality Review Process which is a systematic approach for continually reviewing and updating relevant NFS parts and eliminating outdated and unnecessary policy.

NASA remains dedicated to ensuring and monitoring the coordination of criminal, civil, contractual, and administrative (suspension and debarment) fraud remedies through the Agency's Office of the General Counsel and with the representatives of the NASA

Acquisition Integrity Program (AIP). NASA's AIP is responsible for ensuring that significant allegations of fraud on contracts, grants, cooperative agreements, funding instruments, and other commitments are identified and investigated.

NASA is continuing its efforts to identify and implement activities and processes to strengthen the overall administration and management of its Federal financial assistance awards. Following the transition of the Grants Policy and Compliance Branch from OP to the Office of the Chief Financial Officer (OCFO), NASA has shifted its focus to developing clear lines of delineation between contracting officers and grant officers and specialists. This focus enables NASA staff to hone Federal-wide grants management knowledge as it relates to the grants management regulations (2 CFR 200 and 2 CFR 1800), as well as practical day-to-day activities. In keeping with this new focus, OCFO is sunsetting legacy Center processes and reinforcing the role of the NASA Shared Services Center to award and manage all grants and cooperative agreements. Enforcing the awarding and management of grants and cooperative agreements to be centralized at one Center enables better focus on training efforts and required skills for grants subject-matter experts. This year NASA has developed and rolled out new Agency-wide training modules and mandatory templates and other job aids to assist in standardizing key processes.

Another major initiative under way includes the implementation of an enterprise-wide, end-to-end grants management system. The implementation of this system will increase Agency efficiency, transparency, and accountability as it relates to the management of Federal financial assistance awards.

Key Unimplemented Recommendations:

Include requirements in the pending IT Transition Plan associated with NASA's contract with Caltech for implementation of continuous monitoring tools that provide the Agency's Security Operations Center with oversight of JPL network security practices to ensure they adequately protect NASA data, systems, and application (IG-19-022)

NASA's OP reasserts its commitment to assisting the Agency CIO with regard to ensuring implementation of this OIG recommendation.

Develop a community of practice to analyze what contract structure changes lead to the greatest efficiencies and to share these lessons learned with the Agency's procurement community (IG-19-014)

NASA's OP continues efforts toward the implementation of all recommendations associated with this OIG audit report.

Establish policies and procedures as part of the NASA Grant and Cooperative Agreement Manual to periodically review a recipient's actual cost match and

document award requirements are met prior to obligating the next increment of funding (IG-16-013)

OCFO is in the process of revamping the Grant and Cooperative Agreement Manual (GCAM), which is utilized by NASA Program Managers, Technical Officers and Grant Officers as internal guidance to implement Government-wide and NASA-specific regulations. When done, the updated GCAM will address several open OIG recommendations, including the above referenced recommendation.

Challenge 6: Addressing Long-standing IT Governance and Security Concerns

NASA's Information Technology (IT) provides foundational capabilities necessary to accomplish NASA's missions. NASA remains firmly committed to managing IT as a strategic resource to enable mission success, ensure effective communications and collaboration, and safeguard both the IT environment and the resources that support the Agency's priorities. NASA's focus on IT as a strategic resource began in 2014, establishing a basis for the work that continues today.

Several critical elements inform the deliberate process by which NASA continues improving the IT infrastructure and environment. These elements include making assessments to ensure that all NASA IT can be identified, monitored, protected, and, if necessary, removed from the environment and reducing duplications and inefficiencies, resulting in appropriate enterprise solutions. Simultaneously, and in coordination with the above, the Office of the Chief Information Officer (OCIO) is executing the Agency's IT governance processes so that they are robust and a deliberative collaboration between the OCIO and every NASA stakeholder that complies with all laws, directives, and requirements.

Building upon the foundation provided by NASA's Business Services Assessment (BSA) for IT initiated in 2015, the OCIO has, through streamlined governance which includes our key stakeholders, successfully transitioned to a new end user services contract; migrated to Office 365 (which provides improved, cloud-based collaboration tools); begun addressing NASA's legacy IT systems and applications through a targeted IT modernization Investment Fund; and, led change management efforts to restructure the process to Authorize Systems to Operate within NASA's IT environment. NASA's IT governance also continues to drive portfolio value. Current governance processes approved an Agency Software Management Plan that yielded a $55.37M cost avoidance (through the third quarter) for FY 2019 through smart buys and management of software licenses. For the third consecutive year, the current IT governance processes also facilitated increased insight into NASA's $2.17B FY 2021 IT portfolio and budget, broadening the mission's ability to participate, advocate, and, ultimately, utilize Agency-wide resources. Additionally, in FY 2019, NASA named its first Chief Data Officer to lead data governance and life-cycle data management.

OCIO's increased participation in mission governance, boards, councils, and working groups has resulted in improvements to NASA IT management as well. The OCIO, in partnership with Mission Directorate and Center leadership, is actively working to strengthen how NASA plans for and operates IT, including cybersecurity, throughout the mission program and project life cycle. As such, the NASA OCIO is an engaged member of Agency councils, such as the Agency Program Management Council and the newly established NASA Acquisition Management Board where the OCIO fosters communication, ensures mission alignment with IT objectives and conducts oversight of cybersecurity, and IT spend in acquisitions.

In addition to increased participation in NASA mission governance boards, the OCIO has collaborated with missions to develop guidelines and reference materials to support addressing cybersecurity in the program and project management life cycle. For example, the OCIO and SMD conducted extensive outreach briefings across the Agency to educate program and project managers on the criticality of cybersecurity and the resources available through the OCIO.

In FY 2019, the Agency continued work toward an even stronger Agency cybersecurity posture and continues to be a full partner in the Agency's Enterprise Protection Program, ensuring all layers of IT including those supporting mission projects, corporate services, and physical infrastructure are secure. NASA maintained the highest Federal Information Security Management Act rating of "Managing Risk" in FY 2019 while using the governance process to provide oversight for Agency-wide IT risk management. The OCIO's systematic approach led to the identification of board-approved risks that are reported at the NASA Baseline Performance Review quarterly.

Similarly, the NASA CIO's efforts to manage risk have resulted in proactive cybersecurity improvements that also lessen the implementation burden to NASA missions and customers. As an example, the IT environment at NASA's Michoud Assembly Facility was secured to enable manufacturing excellence "on the floor" in support of Artemis, providing safe and effective partner access. Another example is that suspicious/malicious e-mails are now blocked before reaching e-mail inboxes, and Web links embedded in delivered messages are pre-scanned, thereby allowing navigation to only those deemed safe and protecting mission information in the process.

OCIO improvements allowed for more proactive partnerships in cybersecurity to further support NASA missions and have been recognized within the Federal Government for excellence. Recently, NASA's Senior Advisor for Cybersecurity was detailed to the Human Exploration and Operations Mission Directorate's Artemis Program to collaborate on cybersecurity. The OCIO has also been working with SMD for more than a year to streamline and clarify requirements and processes for developing system security plans for holistic mission security. Additionally, work is under way to secure partner access for collaborative work with the National Oceanic Atmospheric Administration and the European Space Agency.

NASA's Identity, Credential and Access Management program, a cross-Agency program responsible for multiple aspects of cyber- and physical security, earned second runner up for the National Security Agency's prestigious Frank B. Rowlett Award, which recognizes outstanding Federal Government excellence in the field of cybersecurity. NASA's award submission included letters of recommendation from Department of Homeland Security and the General Services Administration. In addition, NASA exceeded the Federal cybersecurity Cross-Agency Priority (CAP) goal for Intrusion Detection and Prevention by certifying that 100 percent of Government-furnished devices are scanned for malware before connecting to the network, enhancing NASA's ability to detect and prevent network intrusions. NASA also exceeded the CAP goal for Personal Identify Verification (PIV) card authentication by achieving 90 percent PIV card authentication for unprivileged users, 100 percent for privileged users, and developing PIV solutions for a variety of unique NASA systems via Continuous Diagnostics and Monitoring efforts, further solidifying the security of identity management and access on the Agency's network.

Key Unimplemented Recommendations:

Include requirements in the pending IT Transition Plan for implementation of continuous monitoring tools that provide the NASA SOC with oversight of JPL network security practices to ensure they adequately protect NASA data, systems, and applications (IG-19-022)

Develop a charter and set of authorities signed by the NASA constituent executives, (including the NASA Administrator) that addresses the SOC's organizational placement, purpose, authority, and responsibilities (IG-18-002)

Reevaluate and implement necessary changes to the annual capital investment review process, its reporting requirements, and approval thresholds to ensure the Agency CIO gains adequate visibility and authority over all NASA IT assets (IG-18-022)

With regard to the above unimplemented recommendations, there is continued work to be done to achieve fully integrated IT governance, particularly IT Authority and Investment Management for NASA's full IT portfolio and for management of cyber risk. This work includes addressing the remaining audit recommendations in OIG reports IG-19-022, IG-18-020, and IG-18-002 in a way that enables continued mission success and aligns with Federal requirements. The OCIO recognizes this success is dependent on the Agency's continued support, partnership and collaboration with internal and external partners. With the execution of the Mission Support Future Architecture Program initiative, the OCIO looks forward to sustained IT transformation and the expected benefits of implementing an even more efficient IT operating model, while implementing a consistent enterprise architecture providing greater simplicity and effectiveness. Through robust partnerships and governance, NASA OCIO welcomes the opportunity to continue collaborating with mission and

mission support organizations to continue the improvements already under way to manage the full life cycle of IT.

Challenge 7: Sustaining Infrastructure and Facilities

NASA agrees with the characterization of this challenge and acknowledges that the underlying issues relate largely to the age and condition of our inventory. To address the challenges with obsolete facilities and structures, we have implemented a multi-pronged approach to either remove facilities from our inventory altogether or replace them through our renewal or recapitalization program. Over the past several years, NASA has gradually increased its funding for demolition of facilities and has had great success with a dedicated demolition program manager. NASA continues to invest in its recapitalization program to replace and consolidate into fewer, more modern, and energy efficient facilities. Consistent with guidance from NASA's Business Services Assessment, NASA updated its prioritization process for repair and recapitalization. The Agency is also developing an Agency Master Plan to guide NASA Center updates of their Master Plans that will help drive the Agency's consolidation and footprint reduction efforts and drive investment in enduring capabilities.

NASA has also identified investment strategies in backlogged maintenance and reliability Center maintenance efforts, such as condition-based maintenance to improve the condition of important building systems and facilities across the Agency, which will improve the reliability of NASA facilities to meet mission needs. Through investments in maintenance, demolition, repair, and recapitalization; NASA strives to right-size the Agency's infrastructure to more modern and efficient facilities that will continue to meet NASA mission objectives.

Key Unimplemented Recommendations:

Pursue all available options—administrative, legal, or political—to ensure NASA's SSFL soil cleanup is performed in an environmentally and financially responsible manner based on the intended future use of the property (IG-19-013)

The corresponding report (IG-19-013), identifies a variety of issues and concerns with implementing a soil cleanup at Santa Susana Field Laboratory (SSFL) as prescribed in the Administrative Order on Consent (AOC) utilizing the provisional Lookup Table (LUT) the State of California Department of Toxic Substance Control (DTSC) developed. Because of the significant increase in the soil volumes from NASA's 2013 Environmental Impact Statement (EIS) to the volumes reported in DTSC's Programmatic Environmental Impact Report (PEIR), NASA will supplement its soil evaluation in accordance with the National Environmental Policy Act (NEPA) to evaluate the issues identified by the OIG. The draft is expected to be available for public review in November 2019 and is scheduled to be completed by June 2020. NASA will continue to monitor DTSC's progress on its PEIR and final LUT for the cleanup phase.

NASA remains firmly committed to achieving a cleanup at SSFL that is protective of public health and the environment. NASA will continue to work with DTSC and all interested stakeholders to implement a cleanup that is based in science, technically achievable, protective of the surrounding community, and eliminates or greatly reduces significant damage to SSFL's habitat and cultural resources and the impacts to the community.

Ensure NASA policies and procedures for using the proceeds from facilities leased under National Historic Preservation Act authority appropriately aligns with Agency goals to minimize excess facilities (IG-19-002)

NASA's policy under the NASA Interim Directive 8800.114 for National Historic Preservation Act (NHPA) leases is consistent with the statute of NHPA, Section 111(b) (now 54 U.S.C. §306121(b)). The intent of Section 111 was to encourage Agencies to preserve historic properties that they steward and afford an Agency an opportunity to outgrant facilities they do not need for their missions as a means to support their continued preservation. Section 111 also provided the Agency the opportunity to invest NHPA lease proceeds toward the preservation of historic properties that would otherwise require diverting mission funds to the preservation of other historic properties stewarded by the Agency. As stewards of these historic properties, NASA continues to evaluate the viability of outgrants versus excess versus demolition of all of its facilities in an ongoing basis and has and will continue to demolish or divest of those properties that are deemed excess to the Agency's needs.

Evaluate Capability Leadership Model assessments and teams to better ensure independence (IG-17-015)
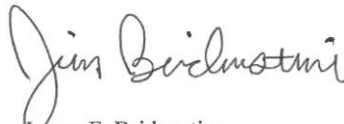
Capability Portfolio assessments need to be thorough and consistent to sustain the technical capabilities needed to successfully achieve mission objectives, inform Agency decisions, and reduce unneeded infrastructure and facilities. A significant milestone to addressing this was the recent approval of two Agency policy documents, NASA Policy Directive 8600.1, *Capability Portfolio Management,* and NASA Procedural Requirement 8600.1, *NASA Capability Portfolio Management Requirements*, which codify the principles, requirements, and processes necessary to inform Agency decisions to invest, divest, or consolidate unneeded infrastructure.

Perform a comprehensive review of Program-funded construction projects to ensure adequate analysis, including all life-cycle costs, is completed prior to project initiation (IG-17-021)

NASA Procedural Requirements (NPR) 8820, "Facility Project Requirements" mandates an analysis of life-cycle cost versus first cost to determine the best economic solution. NASA's Business Case Guide for Facilities Projects outlines the requirements to reflect OMB Circular A-94, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs" requirements. For discrete projects over

$10 million, the Life-Cycle Cost Analyses (LCAA) are submitted along with the budget narrative during development of the Congressional Justification, which is generally two years prior to the project initiation. Additionally, in accordance with OMB requirements and NASA's NPR, programs, and projects with a life-cycle cost of $250 million or greater shall be managed by program and project managers who have been certified in compliance with OMB's promulgated Federal acquisition program/project management certification requirements. NASA's NPR applies to all construction projects, both institutional or program funded.

If you have any questions regarding NASA's response to the 2019 Top Management and Performance Challenges, please contact Anthony Mitchell, Audit Liaison Project Manager, at (202) 358-1758.

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