National Aeronautics and
Space Administration

Office of Inspector General
Washington, DC 20546-0001

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TO: Charles F. Bolden, Jr.
Administrator

FROM: Paul K. Martin
Inspector General

SUBJECT: 2011 Report on NASA's Top Management and Performance Challenges

As required by the Reports Consolidation Act of 2000, this memorandum provides our views of the top management and performance challenges facing NASA and is to be included in the Agency's Performance and Accountability Report for fiscal year 2011.

In determining whether to report an issue as a top challenge, we consider the significance of the issue in relation to the Agency's mission; its susceptibility to fraud, waste, and abuse; whether the underlying problems are systemic; and the Agency's progress in addressing the issue. We previously provided a draft copy of our views to NASA officials and considered all comments received.

Through various initiatives and by implementing recommendations made by the Office of Inspector General (OIG) and other oversight bodies such as the Government Accountability Office, NASA is working to improve Agency programs and operations. However, in our opinion top challenges remain in the following areas:

- The Future of U.S. Human Space Flight
- Project Management
- Infrastructure and Facilities Management
- Acquisition and Contract Management
- Information Technology Security and Governance

This year we removed two issues that appeared on our 2010 list of top challenges: Financial Management and Human Capital. After receiving disclaimers of opinion on its financial statements for the previous 7 years, in 2010 NASA was able to develop sufficient financial evidence and documentation to allow auditors to issue a qualified opinion on the Agency's financial statements. For FY 2011, NASA received an unqualified audit opinion – its first since 2002. Although significant work remains in this area, we believe the Agency's progress over the past several years justifies removing financial management from the list of top Agency challenges.

Similarly, while NASA will always face challenges relating to its workforce, we believe that given the Agency's changing mission its main challenge with respect to Human Capital will be to ensure continued access to the highly skilled civilian and contractor workforce vital to the Agency's success. Accordingly, we discuss this issue as part of Challenge One – Future of U.S. Space Flight.

During FY 2012 the OIG will conduct work that focuses on NASA's efforts to meet these challenges. We hope that you find our views helpful. Please contact me if you have questions.

Enclosure

NASA's Top Management and Performance Challenges
November 2011

Introduction

Transition remained the key theme at NASA this past year as the Agency's focus shifted away from the Space Shuttle Program to the next phase in the Nation's more than 50 years of space exploration. With the final Space Shuttle mission ending successfully in July 2011, NASA began planning in earnest for the crewed space program called for in the National Aeronautics and Space Administration Authorization Act of 2010 (Authorization Act). At the same time, NASA continues to support the development of commercially operated cargo and crew transportation to the International Space Station (ISS). While the Authorization Act was intended to clarify the future direction of NASA's space program, much of 2011 was marked by congressional concern over the pace and fidelity with which NASA was implementing the law.

Moreover, for the first 6 months of fiscal year (FY) 2011, NASA operated under a continuing resolution that perpetuated language in the 2010 appropriations law prohibiting the Agency from cancelling contracts related to its former rocket and crew vehicle development program even though the program itself had been cancelled by the Authorization Act. As a result, NASA was in the difficult position of having to fund elements of a cancelled program and abide by restrictions that prohibited it from establishing new programs to fully implement the Act's directives. In January 2011, the Office of Inspector General (OIG) sent a letter to the Agency's congressional oversight and appropriations committees urging congressional action to address this situation. The restrictions were finally removed in April 2011.

Adding to the uncertainty of the past year, the viability of NASA's flagship science program – the James Webb Space Telescope (JWST) – has come under intense scrutiny. Although it was well known for some time that JWST was substantially over budget and behind schedule, a NASA review panel's November 2010 findings that the total cost of the Program would exceed $6.2 billion with an earliest possible launch date of September 2015 caused some to question whether the Program should continue. Indeed, the House Appropriations Committee in July 2011 recommended terminating all funding for JWST in NASA's FY 2012 budget. Although the corresponding Senate bill contained money to continue the Program, a final decision on whether and at what level Congress will fund JWST is pending. Moreover, the NASA Administrator has publicly stated that other NASA science and institutional programs will need to be cut in order to offset the funds needed to support JWST.

Finally, like other Federal Government agencies NASA faces significant budget reductions in coming years. For example, the House has proposed $16.8 billion for NASA in FY 2012, $1.6 billion below the 2011 funding level and $1.9 billion below the President's 2012 budget request. The Senate, on the other hand, proposed a FY 2012 funding level of $17.9 billion.

Against this backdrop, we have identified five overarching issues we believe pose the top management and performance challenges to NASA leadership in 2011:

- Future of U.S. Human Space Flight

- Project Management
- Infrastructure and Facilities Management
- Acquisition and Contract Management
- Information Technology Security and Governance

In deciding whether to identify an issue as a top challenge, we considered the significance of the issue in relation to the Agency's mission; its susceptibility to fraud, waste, and abuse; whether the underlying causes are systemic in nature; and the Agency's progress in addressing the challenge. Several of these challenges – specifically project management, acquisition and contract management, and infrastructure and facilities management – are long-standing concerns likely to remain top challenges for the foreseeable future. However, with focused and sustained efforts we believe that NASA can make significant strides in addressing all of the challenges we have identified.

This year we removed two issues that appeared on our 2010 list of top challenges: Financial Management and Human Capital. After receiving disclaimers of opinion on its financial statements for the previous 7 years, in 2010 NASA was able to develop sufficient financial evidence and documentation to allow auditors to issue a qualified opinion on the Agency's financial statements. For FY 2011, NASA received an unqualified or "clean" audit opinion – its first since 2002. Although significant work remains in this area, we believe the Agency's progress over the past several years justifies removing financial management from the list of top Agency challenges.

Similarly, while NASA will always face certain challenges relating to its workforce – for example, ensuring that its employees comply with their ethical responsibilities – we believe that given the Agency's changing mission its main challenge with respect to Human Capital will be to ensure continued access to the highly skilled civilian and contractor workforce vital to the Agency's success. Accordingly, we discuss this issue as part of Challenge One – Future of U.S. Space Flight.

1. Future of U.S. Human Space Flight

U.S. human space exploration – NASA's most visible mission since its creation more than 50 years ago – has evolved from the Apollo era to the Space Shuttle and ISS era. With the end of the Space Shuttle Program and the resulting reliance on the Russian Soyuz for astronaut access to the ISS, NASA is embarking on a series of new endeavors, including encouraging development of commercial companies seeking to provide cargo and crew transportation to the ISS and developing new systems and technologies for exploration beyond low Earth orbit.

International Space Station. The ISS will play a prominent role in NASA's human space flight activities throughout this decade. However, until commercial companies are capable of providing crew and cargo transportation services, NASA must rely on the Russian Soyuz to ferry astronauts to the ISS and on the Russians and other international partners for ISS cargo resupply missions. Although there are enough on-orbit supplies to sustain the ISS through summer 2012, Soyuz flights will be the only means to rotate crews and ensure a continued human presence on the ISS for at least the next several years.

Underscoring the tenuousness of the situation, the first vehicle to launch to the ISS in the post-Shuttle era – an unmanned Soyuz rocket carrying three tons of supplies – failed on launch in August 2011. The Russian space agency, Roscosmos, concluded that a blocked fuel line had caused the launch failure and said it plans to return the Soyuz rocket to manned flight in November 2011 with a 3-person crew that includes a NASA astronaut. Indeed, the successful launch of an unmanned Soyuz rocket on October 30 set the stage for this next manned flight. However, corrective actions involving all affected Soyuz flight hardware will impact the schedule of future ISS resupply and crew rotation flights.

A longer-term challenge with respect to the ISS is to ensure that NASA maximizes the productivity and use of the portion of the ISS that operates as a U.S. national laboratory. To that end, NASA has entered into a cooperative agreement – valued initially at $15 million per year – with the Center for the Advancement of Science in Space (CASIS) to manage the national laboratory's capabilities and ensure they are available to the broadest possible cross-section of U.S. scientific, technological, and industrial communities. In the years ahead, NASA must ensure that CASIS develops a varied research and development portfolio based on U.S. national needs for basic and applied research; establishes a marketplace to facilitate matching research pathways with qualified funding sources; and stimulates interest in using the national laboratory for research and technology demonstrations and as a platform for science, technology, engineering, and mathematics education. In addition, NASA needs to continue encouraging use of the ISS by other U.S. Government agencies, other nations, and the commercial sector, while seeking partnerships, cost sharing, and other arrangements to supplement NASA funding of ISS research and operations. The OIG is currently examining NASA's efforts to ensure full utilization of the ISS, including the selection and management of a balanced portfolio of research projects to increase the return on the Government's substantial investment.

Commercial Launch Providers. While NASA has over 50 years of experience with contractor-built, Government-owned space vehicles, the Agency has never procured transportation for its astronauts aboard a commercially developed vehicle. Over the past several years, NASA has begun to foster commercial industry with the expectation of developing safe, reliable, and affordable commercial space transportation systems capable of providing cargo and crew transportation services to the ISS and low Earth orbit.

NASA has made sustained progress toward its goal of obtaining commercial cargo and crew transportation services to low Earth orbit. With respect to cargo, NASA has been working to develop commercial providers' capabilities for the past several years and since 2005 has spent $500 million through its Commercial Orbital Transportation Services (COTS) Program. Two companies have entered into funded COTS agreements with NASA: Space Exploration Technologies Corporation (SpaceX) and Orbital Sciences Corporation (Orbital). In FY 2011, NASA requested an additional $312 million – a 62 percent increase above initial COTS estimates – to fund the efforts of these companies, reduce risk, and improve schedule. A series of technical delays postponed SpaceX's first COTS demonstration flight until December 2010, and the first demonstration flight that will actually travel to the ISS, also by SpaceX, is scheduled for early 2012. In October 2011, Orbital announced that delays in NASA's construction and certification of the Agency's Wallops Island launch complex could delay the company's first launch vehicle test flight originally planned for late December 2011 until late February or early March 2012. Orbital's first COTS demonstration mission to the ISS is scheduled to occur in the second quarter of 2012.

With respect to commercial crew transportation services, in April 2011 NASA announced a second round of Commercial Crew Development (CCDev) awards totaling $269.3 million to four companies – Blue Origin, Boeing, Sierra Nevada Corporation (Sierra Nevada), and SpaceX. NASA has since reported that these companies have successfully met all their initial milestones. Furthermore, NASA has amended its agreements with Boeing and Sierra Nevada by including optional milestones for specific tests of their systems intended to accelerate development efforts. If all milestones are completed successfully, the value of these agreements is $112.9 million and $105.6 million, respectively. Reflecting the new milestones, the manager for NASA's Commercial Crew Program has stated that Sierra Nevada's Dream Chaser spacecraft will make a high-altitude test flight next summer from either Edwards Air Force Base or the White Sands Missile Range.

In July 2011, NASA and United Launch Alliance (ULA) entered into an unfunded Space Act Agreement to share personnel, infrastructure, and information to accelerate the potential use of ULA's Atlas V launch vehicle as part of a commercial crew transportation system. Subsequently, NASA entered into unfunded Space Act Agreements with Alliant Techsystems (ATK) and Excalibur Almaz Incorporated (EAI) to collaborate on the development of ATK's commercial launch system known as Liberty and further the development of EAI's spacecraft concept for low Earth orbit crew transportation.

In September 2011, NASA released an outline of its two-phase acquisition strategy to achieve a certified crew transportation capability from private industry no later than the end of FY 2016. The draft request for proposal calls for a firm-fixed-price Commercial Crew Integrated Design Contract in the first phase to be awarded to one or more companies that will result in a complete end-to-end design compliant with NASA Crew Transportation System requirements, including spacecraft, launch vehicle, launch services, ground and mission operations, and recovery. The contract value could be up to $1.61 billion from July 2012 through April 2014. The Agency anticipates this funding would support one or more contractors. In the second phase, NASA will issue a separate, formal solicitation for follow-on contracts for development, test, evaluation, and certification activities with optional ISS service flights.

NASA's decision to move away from funded Space Act Agreements toward contracts based on the Federal Acquisitions Requirement (FAR), which would allow NASA more control over development, has drawn sharp criticism from some quarters over fears that this acquisition mechanism may cause significant delays and limit the flexibility of participating companies. In rolling out its new strategy, NASA stated that it will use a non-traditional contract approach that will not require certified cost and pricing data and Cost Accounting Standards requirements. In addition, NASA said its proposed procurement approach will allow the companies to tailor their technical approach to NASA's requirements and limit deliverables while NASA adjusts its level of insight and oversight over the contractors as projects move from design and development to certification of the vehicle for flight.

Nevertheless, some industry representatives have expressed concern that NASA's move away from Space Act agreements may be prohibitively expensive, create undue administrative burdens, and curtail the innovation and control they have over their system designs. Conversely, NASA believes the risk that commercial partners' may develop systems that do not meet the Agency's human rating requirements could cause costly and time-consuming redesigns and pose safety concerns, and therefore requires that NASA be more involved in the development of commercial transportation systems.

In a report we issued in June 2011, we identified a series of challenges NASA faces in certifying and acquiring commercial crew transportation services to low Earth orbit.[1] These include: (1) modifying NASA's existing safety and human-rating requirements for commercially developed systems; (2) managing the recently announced acquisition strategy for commercial crew transportation services; (3) implementing the appropriate insight/oversight model for commercial partner vehicle development; (4) relying on an emerging industry and uncertain market conditions to achieve cost savings; and (5) managing the relationship between commercial partners, the Federal Aviation Administration, and NASA. As NASA moves forward in this area, the Agency must strike a balance that will enable innovation and flexibility yet provide the appropriate amount of direct Government involvement to ensure the safety of NASA's astronauts.

At the same time NASA is fostering the development of commercial cargo and crew capabilities to the ISS, Congress has directed the Agency to develop its own launch system and crew vehicle to carry astronauts beyond Earth's orbit. Addressing both of these responsibilities simultaneously will continue to present a significant management challenge for NASA leadership.

NASA Transportation Systems. In September 2011, NASA announced the design it will pursue for its next generation Space Launch System (SLS). This new heavy-lift rocket will be capable of more than double the lift capacity of any operational launch vehicle that exists today and will be America's most powerful since the Saturn V rockets that carried Apollo astronauts to the Moon. With an evolvable architecture, the rocket will have an initial capacity of 70 metric tons and eventually be capable of 130 metric tons. Mounted atop the SLS will be the Multi-Purpose Crew Vehicle (MPCV), which is being developed using existing contracts and based on design requirements for the Constellation Program's Orion Crew Exploration Vehicle. The MPCV will serve as the primary crew vehicle for missions beyond low Earth orbit. In addition, the SLS and MPCV will serve as backup crew and cargo transportation to the ISS in the event that international partners and/or commercial space systems are unavailable.

In January 2011, NASA reported that the Reference Design Vehicles that had been chosen for the SLS and MPCV would be unable to meet all requirement and schedule goals or fit into the projected budget profiles contained in the Authorization Act.[2] For example, NASA reported that a 2016 first flight of the SLS, as required by the Act, does not appear to be possible within

[1] NASA OIG, "NASA's Challenges Certifying and Acquiring Commercial Crew Transportation Services" (IG-11-22, June 20, 2011).

[2] NASA, "Preliminary Report Regarding NASA's Space Launch System and Multi-Purpose Crew Vehicle Pursuant to Section 309 of the NASA Authorization Act of 2010 (P.L. 111-267)" (January 2011).

projected funding levels. Instead, NASA plans to conduct the first uncrewed SLS and MPCV test flights in 2017, with the first astronaut crew flying in 2021. In the decades that follow, NASA plans to undertake crewed and robotic missions to a near-Earth asteroid, the Moon, and eventually Mars.

Developing a launch system and crew vehicle, modifying the necessary supporting ground systems, and meeting the NASA Administrator's mandate that exploration systems be affordable, sustainable, and realistic are significant management challenges for NASA leadership. For example, an August 2011 independent cost assessment concluded that NASA's estimates for the SLS, MPCV, and associated ground support programs are reasonable for near-term budget planning but do not support establishment of long-term budgets or detailed baselines consistent with Agency program management requirements.

In an effort to reduce cost during the design phase, NASA focused on reduction of development and operations costs. For example, the SLS will use the same propulsion approach – liquid hydrogen and liquid oxygen – for both the core and upper stages and make use of existing Space Shuttle hardware and technological investments to the greatest extent practicable. Similarly, the MPCV will use much of the current Orion systems design. However, the early cost estimates for the initial SLS and MPCV capability may exceed $18 billion over the next 5 years, including approximately $10 billion for the SLS, $6 billion for the MPCV, and $2 billion for ground support and launch facility modernization at the Kennedy Space Center. The OIG is currently examining NASA's efforts to develop the MPCV as well as its plans to modify the Ares I mobile launcher for use with the SLS, and will continue to focus on these important issues.

Space Shuttle Transition and Retirement. After 30 years and 135 missions, NASA's Space Shuttle Program officially ended on August 31, 2011. The Space Shuttle Transition and Retirement Office will now lead all Space Shuttle-related work, including overseeing the preparation of the three retired Orbiters for public display and ensuring unneeded facilities and property are closed, sold, or made available to new users. As discussed above, NASA announced that the new SLS will incorporate technological investments from the Space Shuttle and Constellation programs in order to take advantage of proven hardware and manufacturing technology and reduce development and operations costs. Additionally, NASA plans to retain, for use by the SLS, elements of the Orbiters' main propulsion system, ground support equipment, and other hardware to reduce cost and schedule risks for the new program. These and other activities associated with the end of the Space Shuttle Program represent the largest such transition and retirement effort ever undertaken by NASA. The OIG will continue to examine NASA's management of this complex challenge.

Launch Vehicles. The cost and availability of certain classes of launch vehicles needed to support NASA's missions represents a continuing challenge for NASA. For the past decade, NASA and other parts of the U.S. Government have relied on the Atlas V and Delta IV rockets to launch their largest and most important spacecraft. However, retirement of the Space Shuttle and cancellation of the Constellation Program removed a considerable portion of the customer base for the manufacturer of these launch vehicles and has resulted in higher costs for Atlas V and Delta IV component suppliers. Similarly, the Department of Defense's decision to stop using the Delta II – the medium-class vehicle that has been NASA's launch vehicle of choice for nearly 60 percent of its science missions over the last decade – and the decision by ULA to cease their production has presented NASA with a near-term challenge of finding suitable, cost-effective launch service providers for a number of its science missions.[3] Although new launch vehicles in this class are currently under development, they are unlikely to be ready to launch NASA's science missions until late 2013 or early 2014.

In February 2011, the OIG reported on the projected costs and challenges NASA has faced in finding suitable launch vehicles for its science missions, in particular the medium-class Soil Moisture Active Passive (SMAP) mission scheduled to launch in November 2014.[4] The report highlighted the disparity in performance and launch services costs between currently available launch vehicles, such as Minotaur and Atlas V, and the estimated costs of launch vehicles under development. Because NASA had not selected a launch vehicle for the SMAP mission as of early November 2011, the project's launch is likely to be delayed.

The issue of increasing cost and availability of launch vehicles is not limited to the SMAP mission. For example, the costs to launch NASA's Mars Atmosphere and Volatile Evolution Mission to Mars in 2013 are $187 million. This compares to the $124 million that NASA negotiated 4 years ago to launch the Landsat Data Continuity Mission (scheduled to launch in December 2012) using the same Atlas V launch vehicle. Furthermore, these costs are predicted to continue increasing by as much as 30 percent for launches occurring in 2018. In addition, the Government Accountability Office (GAO) reported that the Joint Polar Satellite System (JPSS-1), and the Ice, Cloud, and Land Elevation Satellite (ICESat-2) missions are approaching their preliminary design reviews but have not yet identified a suitable launch vehicle.[5] Because changing launch vehicles after preliminary design review often results in substantial cost increases and schedule delays, the report states that NASA is likely to make a launch vehicle decision, prior to having certified as safe for flight, vehicles that are in development and accept any resulting cost and schedule impacts resulting from the certification process. While NASA has estimated the costs associated with the certification process and potential technical issues that could arise during that process, these costs are not covered under existing budgets.

The issues surrounding launch vehicle availability have been exacerbated by two recent failures of the Taurus XL rocket. On February 24, 2009, NASA's Orbiting Carbon Observatory was lost when the payload fairing, a clamshell-shaped cover that encloses and protects the satellite, failed to separate during the rocket's ascent. Similarly, the Glory satellite was lost on March 4, 2011, when the same fairing, which had been modified after the last failure, again failed to separate. After the March 2011 failure, NASA stopped payment on the contract for the Taurus XL rocket it had planned to use to launch the Orbiting Carbon Observatory-2 satellite in February 2013. Consequently, NASA has put this launch on hold, which will undoubtedly result in increased project costs.

In September 2010, NASA announced its NASA Launch Services (NLS) II indefinite-delivery-indefinite-quantity contracts as the primary means to acquire launch services through 2020.

[3] Medium-class missions are typically satellite payloads between 1,500 and 3,200 kilograms (3,300 to 7,040 pounds), respectively, launched to a 675-kilometer (approximately 405 miles) orbit around the Earth.

[4] NASA OIG, "Review of NASA's Acquisition of Commercial Launch Vehicles" (IG-11-012, February 17, 2011).

[5] GAO, "NASA: Medium Launch Transition Strategy Leverages Ongoing Investments but Is Not Without Risk" (GAO-11-107, November 22, 2010).

Under NLS II, NASA awarded contracts to Lockheed Martin for the Athena I and II, Orbital Sciences for the Pegasus XL and Taurus XL, SpaceX for the Falcon 1 and 9, and ULA for the Atlas V. In September 2011, the Agency modified the NLS II contract to make available the five remaining Delta II rockets in ULA's inventory. However, these vehicles can only be launched from Vandenberg Air Force Base in California because the Delta II launch pad at Cape Canaveral in Florida is no longer maintained.

To provide some stability for the launch vehicle industrial base and take advantage of new launch capability, NASA, the National Reconnaissance Office, and the U.S. Air Force recently signed two agreements. The first is a memorandum of understanding, signed in March 2011, intending to stabilize the current Evolved Expendable Launch Vehicle (Atlas V and Delta IV) industrial base. The second, signed in October 2011, is an agreement on a coordinated strategy to establish clear criteria for certification of commercial providers of launch vehicles used for national security space and civil space missions. The intent of this coordinated strategy is to further competition and provide a consistent path for new entrants to compete for U.S. Government missions. This approach is characterized by a risk-based certification framework – already in use by NASA – which provides a methodology for certification of launch vehicles based on the risk tolerance of each payload.

U.S. Space Industrial Base. The recent changes in the direction of NASA's human space flight program may adversely affect the U.S. space industrial base and associated supply chain. Retirement of the Space Shuttle, cancellation of the Constellation Program, and the debates over development of a new space transportation system and the amount of funding that should be dedicated to commercial partner activities could negatively impact the Agency's ability to retain the manufacturing and technological capabilities, skilled workforce, and supply chains necessary to meet NASA's missions. For example, in December 2009 the White House Office of Science and Technology Policy reported that Government and commercial long-term requirements are insufficient to drive significant private sector investment in new propulsion capabilities and technologies. Additionally, in 2010 a Department of Commerce survey of NASA's supply chain network found that an estimated 28,000 jobs may be lost nationwide as a result of Space Shuttle retirement, Constellation transition, and the projected gap in procurements for future human space flight systems.

Historically, the design, development, and production of space systems have involved low production quantities, a high degree of specialization, and dependence on a uniquely skilled and highly qualified workforce. But many smaller vendors involved in the process cannot easily accommodate changes in schedule, funding levels, or requirements for low-production items. In addition, domestic and foreign competition, variability of demand, and skills retention have significantly reduced the domestic supplier base available to NASA. In fact, many of NASA's long-standing industry partners have already faced steep layoffs as new partners struggle to cut costs and make emerging space systems more affordable. While the September 2011 announcement of plans to move forward developing the SLS may help mitigate some of these issues, NASA must address these significant challenges as it seeks to build new space capabilities.

2. Project Management

Effective project management is critical to NASA's ability to achieve its overall mission, but systemic weaknesses in this area have proven a long-standing challenge for the Agency. The OIG is focusing increased attention on this issue to help ensure that NASA is actively addressing the challenges associated with developing and operating its space and science missions. Specifically, the OIG is conducting a review of NASA's project management practices to identify the root causes affecting project managers' ability to meet cost, schedule, and performance expectations.

Cost and Schedule Estimates. Historically, NASA has struggled with establishing realistic cost and schedule estimates for the projects in its portfolio. Both the OIG and GAO have repeatedly cited cost growth and schedule slippage in the Agency's major projects. This is often due to the Agency's failure to address systemic project management challenges related to requirements growth, cost estimating, technology development, and partner performance.

For example, in March 2011 GAO released its assessment of 21 large-scale NASA projects with a combined life-cycle cost exceeding $68 billion. GAO found that 13 projects for which NASA established baselines prior to 2009 experienced an average development cost growth of almost 55 percent, with a total increase in development costs of almost $2.5 billion from their original baselines.[6] GAO attributed this cost and schedule growth in part, to the Agency's failure to adequately identify and provide funding to match technological complexities.

Perhaps no project is more emblematic of the scope of the Agency's project management challenges than the JWST, NASA's most expensive and technologically complex science project, is now projected to cost $8.8 billion and to launch in October 2018, significantly above its original life-cycle cost baseline estimate of $5 billion and later than the original launch date of June 2014. Similarly, in June 2011 the OIG reported on cost and schedule issues with NASA's Mars Science Laboratory (MSL) Project.[7] Because of management's failure to accurately estimate the resources required to address MSL's complex technical issues, the launch was delayed approximately 2 years to November 2011, development costs increased by 86 percent (from $969 million to the current $1.8 billion), and the project's life-cycle costs increased by 56 percent (from $1.6 billion to the current $2.5 billion).

Partner-related issues have also contributed to cost growth and schedule delays in NASA projects. For example, the National Polar-orbiting Operational Environmental Satellite System Preparatory Project (NPP), which the OIG reported on in June 2011, experienced a 54 percent increase in costs and a 5-year launch delay.[8] Originally planned for an October 2006 launch with a life-cycle cost of $560 million, NPP successfully launched on October 28, 2011, with life-cycle cost growth to $864 million. Although NASA met its schedule and technical requirements for producing the NPP spacecraft and the instruments for which it was responsible, the other partners involved in the project – the Department of Defense and the National Oceanic and

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[6] GAO, "NASA: Assessments of Selected Large-Scale Projects" (GAO-11-239SP, March 3, 2011).

[7] NASA OIG, "NASA's Management of the Mars Science Laboratory Project" (IG-11-019, June 8, 2011).

[8] NASA OIG, "NASA's Management of the NPOESS Preparatory Project" (IG-11-018, June 2, 2011).

Atmospheric Administration – were unable to deliver their scientific instruments to NASA in a timely manner, thereby resulting in additional costs to NASA. GAO reported similar challenges related to NASA's partnership with the Space Agency of Argentina, Comisión Nacional de Actividades Espaciales (CONAE), on the Aquarius mission. This project, whose goal is to measure sea surface salinity and provide the global view of salinity variability that is needed for climate studies, was delayed approximately 2 years and cost NASA $40 million more than the baseline estimate due to delays by CONAE in developing the spacecraft and propulsion system thrusters. Moving forward, NASA's challenge will be to strike a balance between collaborating with other Federal Government agencies and international partners while minimizing the resource impact on NASA should a partner fail to timely meet its responsibilities.

Project Management Principles and Tools. To execute projects within established cost and schedule estimates, NASA needs to maximize the use of sound project management principles in projects both large and small. These principles are codified in Agency-wide policies that establish the requirements by which NASA should formulate and implement space flight programs and projects. As discussed above, the JWST project illustrates NASA's difficulty in applying these principles to a major science project. However, the challenge for NASA in successfully applying these project management principles extends beyond its multi-billion dollar projects. For example, in September 2011 the OIG issued its review of the Advanced Radiation Instrumentation Project, a suite of instruments designed to monitor astronauts' exposure to radiation while aboard the ISS, that found managers did not follow established policies.[9] Consequently, the Project incurred significant cost increases, schedule delays, and was de-scoped to exclude some planned elements.

While effective project management historically has been a major challenge for NASA, the Agency has shown that it can use project management tools, such as earned value and risk management, to produce positive results. For example, in reviewing NPP we found that managers implemented an earned value management system to track the development of the instruments NASA was responsible for producing and implemented risk management procedures to identify, analyze, track, and communicate associated risks. As a result, NASA's instruments were ready in time for the original October 2006 launch, management proactively took steps to mitigate partner delays by performing risk reduction tests on individual instruments upon delivery as opposed to waiting until the integration phase as originally planned, and the final ground and integration testing was accomplished on schedule and within budget. Conversely, we found that MSL Project managers consistently underestimated costs and did not identify and assess all risks associated with problems and failures and consequently experienced significant cost growth and schedule delays. Going forward, NASA's challenge will be to consistently employ these and other tools to improve cost estimating on all Agency projects.

[9] NASA OIG, "A Review of NASA's Replacement of Radiation Monitoring Equipment on the International Space Station" (IG-11-027, September 29, 2011).

3. Infrastructure and Facilities Management

NASA is the ninth largest Federal Government property holder, controlling a network of approximately 5,400 buildings and structures that support Agency research, development, and flight activities. In total, the assets occupy 44 million square feet and represent more than $29 billion in current replacement value. The Authorization Act requires NASA to examine its structure, organization, and institutional assets and develop a strategy for the most efficient retention, sizing, and distribution of facilities and other infrastructure consistent with NASA's mission. NASA's ability to effectively manage its large and aging portfolio of facilities is a critical and long-standing challenge for the Agency.

Maintenance, Repair, and Use of Aging Facilities. For years, NASA has struggled with its aging and underutilized infrastructure and the related issue of managing its backlog of deferred maintenance projects. NASA officials report that more than 80 percent of the Agency's facilities are 40 or more years old and beyond their design life. Under its current policy, NASA is required to maintain these facilities to keep them operational or, if they are not being used, to ensure they do not pose a safety hazard. The Agency estimated its deferred maintenance costs for 2011 at $2.47 billion.[10]

The Aerospace Safety Advisory Panel cited NASA's aging facilities as an area of concern in its most recent annual report, and in a 2010 report the National Research Council cited a "steady and significant decrease in NASA's laboratory capabilities, including equipment, maintenance, and facility upgrades" that require more maintenance than funding permits. For several years, Congress has cited NASA's backlog of maintenance and repair projects as an area of concern. For example, NASA's 2008 Authorization Act directed the Administrator to "determine and prioritize the maintenance and upgrade backlog at each of NASA's Centers and associated facilities, and develop a strategy and budget plan to reduce that maintenance and upgrade backlog by 50 percent over the next 5 years." However, according to Agency officials, funding constraints over the years have resulted in little reduction in NASA's backlog of deferred maintenance projects.

In March 2011, we issued an audit report in which we reported that NASA's ability to plan for and achieve a reduction in its maintenance backlog is hindered by the lack of reliable facilities maintenance cost data.[11] At the time of our fieldwork, NASA used multiple and inconsistent mechanisms for capturing costs associated with facilities maintenance work. In addition, without proper preparation and use of planning documents, NASA maintenance managers could not effectively assess anticipated maintenance needs across the agency or effectively compete for funding with other Center support services. Similarly, an August 2011 OIG report examined the accuracy of data contained in NASA's primary system for compiling and analyzing the Agency's real property assets and found that the data relating to utilization, mission dependency, and

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[10] NASA, "Deferred Maintenance Assessment Report: FY11 NASA-Wide Standardized Deferred Maintenance Parametric Estimate (Full Assessment)," October 1, 2011.

[11] NASA OIG, "Audit of NASA's Facilities Maintenance" (IG-11-015, March 2, 2011).

condition were unreliable metrics for evaluating NASA's real property assets, largely because NASA Centers used inadequate processes to gather and update the information.[12]

The challenge for NASA leadership in this area is to reduce the backlog of essential maintenance projects. Failure to do so will further increase the risk that Agency facilities will not be available for future use or may create additional risks to the safety of personnel and equipment and the accomplishment of NASA's missions. Moreover, continuing to "kick the can down the road" is likely to result in higher costs to repair these facilities in the future.

Master Planning for Facilities Needs. To make the strategic decisions necessary to address its infrastructure challenges, NASA is developing its first integrated, Agency-wide real property Master Plan. NASA began developing this Master Plan in early 2011 and expects to complete it by the end of the year. NASA intends to use the Plan to coordinate resources across the Agency, link real property needs with projected funding to support NASA programs and strategic objectives, and gain efficiencies by eliminating facilities that no longer benefit the Agency.

The development of an Agency-wide Master Plan was the result of NASA's efforts to revise its facility strategy to reduce the Agency's infrastructure footprint. In response to the Authorization Act, NASA is preparing a strategy document that describes the facilities renewal approach adopted in 2009 by the Agency, known as the "similar/smaller strategy," with a goal to reduce each Center's current replacement value by 10 percent by 2020 and 15 percent by 2050.

The Agency faces significant challenges as it works to meet current and future mission requirements and to comply with the intent of the Authorization Act to downsize its infrastructure to fit current and future missions and expected funding levels. Given the importance of the Agency-wide Master Plan to this process, the OIG is conducting a review to determine (1) whether NASA has an effective overall Agency-wide Master Plan; (2) whether Center master plans align with the Agency's goal to reduce its real property footprint; and (3) whether NASA has an effective approach for prioritizing projects for construction of facilities funding.

Reducing Unneeded and Duplicative Infrastructure. NASA has more real property than necessary to meet its mission, and in the last 2 decades numerous studies have stressed the need for NASA to reduce its infrastructure. In the1990s, GAO issued several reports on NASA's challenges to achieving reductions and efficiencies in its infrastructure and noted that NASA was building new facilities faster than it was consolidating or closing older ones, resulting in major areas of duplication of capabilities. In May 2007, GAO reported that over 10 percent of NASA's real property assets were not being utilized at all or were underutilized.[13] In 2008, NASA's own Program Analysis & Evaluation (PA&E) Office identified 203 facilities that had no future mission requirement. Finally, in an August 2011 audit, we found numerous NASA facilities that had not been utilized, some for as long as 10 years.[14]

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[12] "NASA Infrastructure and Facilities: Assessment of Data Used to Mange Real Property Assets" (IG-11-024, August 4, 2011).

[13] GAO, "Federal Real Property: An Update on High-Risk Issues"(GAO-07-895T, May 24, 2007).

[14] NASA OIG, "NASA Infrastructure and Facilities: Assessment of Data Used to Manage Real Property Assets" (IG-11-024, August 4, 2011).

The challenge for NASA leadership in this area is to identify and reduce unneeded and duplicative property in light of the costs associated with facility disposal or consolidation, the varying mission requirements of each Center, and the political pressures to retain or build the mission capabilities of specific Centers. To determine which facilities NASA can eliminate in the future, NASA management must focus on identifying the key missions, technologies, and programs that NASA intends to pursue over the next 20 to 30 years. Beyond the strategic plan, NASA must identify strategic goals with enough specific detail to facilitate identifying unneeded facilities and eliminate the conservative "keep it in case we need it" approach to managing its facilities.

Given the likelihood of constrained budgets, it is imperative that NASA take action to evolve toward the most efficient facility structure for its future. To assist in this effort, in September 2011 the OIG initiated a review to examine NASA's efforts to identify and reduce the Agency's unneeded and duplicative research and development facilities, focusing initially on wind tunnels and test stands.

Leased Space at NASA Centers. NASA's excess of real property presents considerable challenges for the Agency in its efforts to address the maintenance needs of its aging facilities. Leasing offers the Agency a means to help address this challenge. Leasing should not be used as a rationale to retain unneeded or duplicative infrastructure; however, NASA could generate revenue to offset facilities operations and maintenance costs and potentially reduce some of its $2.47 billion deferred maintenance liability by leasing underutilized but essential facilities to external entities.

One tool available to NASA is Enhanced-Use Leasing (EUL), which allows NASA to retain and use the proceeds derived from the leasing of underutilized real property. In FY 2003, Congress granted EUL authority to Ames Research Center and Kennedy Space Center, allowing those Centers to out-lease underutilized real property and retain the proceeds for facilities projects. This authority includes a provision for in-kind payment in the form of facility upgrades or other services in lieu of cash. For example, Kennedy has an EUL with a Florida utility for a 60-acre site that supports a solar farm that is integrated into the Center's power grid and generates 1 percent of the Center's power needs. The FY 2008 Appropriations Act expanded NASA's EUL authority to all NASA Centers beginning December 31, 2008. However, the Act required the leases to be cash only and prohibited Centers from accepting in-kind payments. NASA officials have indicated that allowing all Centers to accept in-kind consideration would be helpful to their facilities management efforts.

The OIG initiated a review in July 2011 to examine the effectiveness of NASA's management of its lease agreements. In this review, we are assessing whether NASA is effectively identifying space available to lease, whether NASA's leasing activities are beneficial to NASA and the Government, whether NASA has improved internal controls to account for in-kind consideration for EULs, and whether NASA is recouping all appropriate costs under the terms of lease agreements.

4. Acquisition and Contract Management

Approximately 83 percent of NASA's $18.7 billion FY 2010 budget was spent on contracts to procure goods and services and provide funding to grant and award recipients. Accordingly, it is critical that NASA use the most advantageous acquisition and award strategies to promote competition and ensure the billions of dollars of taxpayer funds entrusted to it are spent wisely. However, systemic weaknesses in NASA's internal controls related to acquisition and contracting continue to create challenges for the Agency. The OIG will continue to focus resources on this issue to identify instances of fraud, waste, and abuse by contractors and awardees as well as weaknesses in the Agency's system of internal controls.

Contract Management. Given the large amount of taxpayer funds it spends on contract awards, Agency managers are constantly challenged to ensure that NASA pays contractors in accordance with contract terms and receives fair value for its money. Indeed, the OIG's investigative work continues to uncover fraud and overcharging by NASA contractors. For example, this past year a Michigan-based firm agreed to pay $800,000 to resolve allegations that it fraudulently obtained a contract with NASA's Plum Brook Station by misrepresenting its eligibility for a Service-Disabled Veteran-Owned Small Business set-aside. Similarly, a joint investigation with other government agencies identified a group of communications service providers who had improperly billed NASA and other customers over an extended period of time for telephone systems and equipment that did not function properly and for maintenance on those systems after they had been replaced. This case resulted in a $13 million repayment by the contractors to the United States.

One area in which NASA has been particularly challenged with regard to safeguarding against fraud is its Small Business Innovation Research (SBIR) Program. Between 2004 and 2008, NASA awarded an average of $112 million annually to small businesses under this Program to stimulate technological innovation, increase participation by small businesses in federally funded research and development, and increase private-sector commercialization of innovations derived from federally funded research and development efforts. In multiple investigations over the years, the OIG has indentified significant fraud, waste, and abuse in NASA's SBIR Program. For example, this past year an OIG investigation resulted in the criminal convictions of a University of Florida professor and his wife who had submitted fraudulent proposals to obtain more than $3 million in SBIR contracts with NASA and the Air Force. Although the defendants claimed their company would provide NASA with research from scientists and engineers working in a state-of-the-art analysis and data communication laboratory, in reality they simply submitted the work of graduate and doctoral students at the University, without the students' knowledge or approval. In another case, a small business submitted the same or very similar research proposals to multiple Federal agencies and received more than $373,000 in SBIR contract awards for the same or similar work.

Based on these and other similar OIG investigations, the OIG conducted an audit in 2011 examining the internal controls in NASA's SBIR Program.[15] We found that while NASA's methods of choosing SBIR award recipients appeared objective and merit-based, its oversight

[15] NASA OIG, "Review of NASA's Management of Its Small Business Innovation Research Program" (IG-11-010, January 12, 2011).

and monitoring of awards was deficient. Specifically, SBIR awards in 2008 contained an estimated $2.7 million in unallowable and unsupportable costs, including travel and equipment expenses. We also found that because NASA had not implemented appropriate internal controls in the SBIR Program, some SBIR award recipients may have received multiple SBIR awards from different Federal agencies for the same research, or NASA may have received highly questionable research products for its money. As part of our audit work, we developed a data-mining tool that NASA and other Federal agencies with SBIR programs are using to help identify SBIR fraud. We also made several recommendations to the SBIR Program to implement new processes or procedures to improve verification of contractor performance and protect against potential fraud earlier in the review and selection process. Based on recent discussions with Program personnel, we believe the Agency is making strides toward implementing these recommendations.

Grant Management. NASA faces the ongoing challenge of ensuring that the approximately $550 million in grant funds it awards annually are administered appropriately and that recipients are accomplishing stated goals. Over the past 5 years, the OIG has conducted 37 grant fraud investigations resulting in 3 prosecutions and $10.1 million in restitution and recoveries. In a recent case, an OIG investigation found that a grant to Morehouse College had been improperly used to fund an employee's personal travel and to purchase equipment and services unrelated to the purpose of the grant. As a result of this investigation, Morehouse College agreed to pay $1.2 million in a civil settlement to the Government.

During FY 2010, NASA awarded $1.7 billion in procurement actions to educational and other nonprofit institutions, including $557 million (33 percent) in grant awards. This financial assistance was awarded to recipients to facilitate research and development projects; to fund scholarships, fellowships, or stipends to students, teachers, or other faculty; and to fund educational research performed by educational institutions or other non-profit organizations. In September 2007, the OIG reported weaknesses in the Agency's administration and management of its education and training grants. Specifically, the OIG found that grant recipients had misspent grant funds because of the Agency's lack of oversight at the recipient level. Four years later, in a September 2011 report, the OIG identified weaknesses in NASA's oversight of its grant award process and continued weaknesses in the monitoring of grantee performance. The lack of proper oversight contributes to a heightened risk that grant objectives will not be met and grant funds may be misused.

NASA is faced with the challenge of enhancing its level of oversight to its grant recipients while balancing resource limitations and budget constraints. We will continue to focus OIG resources in this area as the Agency takes steps to address our recommendations and enhance its processes for managing its grant awards.

5. Information Technology Security and Governance

NASA information technology (IT) systems and networks control spacecraft, collect and process scientific data, and enable NASA personnel to collaborate with their colleagues around the world. Over the past decade, NASA has become dependent on computerized information systems to carry out daily operations and to process, maintain, and report essential information. Although most NASA IT systems contain data that may be widely shared, some contain sensitive information which, if released or stolen, could result in significant financial loss or adversely affect national security. Accordingly, it is imperative that NASA properly protect its IT systems and networks.

IT Security Weaknesses. Over the past several years, OIG reviews have identified a recurring theme of poor management processes and inadequate operational and technical controls that affect NASA's ability to protect the information and information systems vital to its mission.

As part of our FY 2011 Federal Information Security Management Act (FISMA) audit, we found that NASA had not fully implemented key requirements needed to adequately secure Agency information systems and data. For example, NASA has not fully developed a comprehensive governance structure and Agency-wide risk management strategy, and the Office of the Chief Information Officer (OCIO) could not provide us with evidence that the Agency has an active risk assessment process specific to information security. Until NASA improves its IT security practices by completing a comprehensive IT security risk assessment, the Agency is vulnerable to computer incidents that could have a severe or even catastrophic effect on Agency assets and operations.

We also found that the OCIO has not effectively managed corrective action plans to prioritize mitigation of IT security weaknesses. This occurred because the OCIO did not have a formal policy for managing the plans and did not follow recognized best practices when it purchased an information system intended to facilitate Agency-wide management of IT corrective action plans. We found that the information system was significantly underutilized and therefore was not an effective tool for managing corrective action plans.

Through our audits and assessments during the past year, the OIG has found significant and recurring internal control weaknesses in NASA's IT security control monitoring and cyber-security oversight. For example, although NASA has made progress in transitioning to a continuous monitoring program, the Agency still needs to (1) create and maintain a complete, up-to-date record of IT components connected to its networks; (2) define the security configuration baselines that are required for its system components and develop an effective means of assessing compliance with those baselines; and (3) use credential scanning as part of vulnerability management on all its IT systems. We also found that NASA's network defenses and incident detection capability could neither prevent nor detect sophisticated but increasingly common types of cyber attacks that target sensitive data on the Agency's computer networks.

Specifically, we found that six computer servers associated with IT assets that control NASA spacecraft and contain critical data had vulnerabilities that would allow a remote attacker to take control of or render them unavailable. Moreover, once inside the Agency network, the attacker could use the compromised computers to exploit other weaknesses we identified, a situation that could severely degrade or cripple NASA operations. Finally, NASA has not established an alternate or backup Agency-wide incident detection capability for its Security Operations Center. If the Security Operation Center became unavailable, NASA's ability to detect and promptly respond to cyber attacks against Agency computer systems and networks could be severely degraded.

Attacks on IT Infrastructure. Attacks on NASA's IT infrastructure occur regularly. In 2009 and 2010, NASA reported 5,621 computer security incidents that resulted in the installation of malicious software on Agency systems or unauthorized access to its computers. Such incidents disrupt Agency operations and can result in the loss or theft of sensitive data from NASA computer systems.

NASA remains a target both because of the large size of its networks and because its information is highly sought after by criminals attempting to steal technical data or further other criminal activities. Moreover, the attacks are becoming more sophisticated and harder to detect and remediate. For example, an OIG investigation initiated in September 2008 led to the prosecution of a U.S. citizen who had gained the highest level of access to two NASA web servers that contained scientific weather data used by more than 3,000 individuals each day. As a result of the intrusion, the server had to be taken off line for 19 days resulting in at least $66,000 in mitigation and repair costs. In other recent OIG investigations, we identified Chinese, Swedish, and British citizens as the individuals responsible for compromising various NASA IT systems.

As the threat expands and the sophistication of the attacks increases, NASA will continue to be challenged to ensure that its IT security is sufficiently robust.

NASA IT Governance. Achieving the Agency's IT security goals will require sustained improvements in NASA's overarching IT management practices and governance. Effective IT governance is the key to accommodating the myriad interests of internal and external stakeholders and making decisions that balance compliance, cost, risks, and mission success. Federal law and NASA policy designate the Headquarters-based Chief Information Officer as the NASA official responsible for developing IT security policies and procedures and implementing an Agency-wide IT security program. However, we have found that the Chief Information Officer has limited ability to direct NASA's Mission Directorates to fully implement IT security programs. As a result, key Agency computer networks and systems operated by the Mission Directorates do not consistently comply with Agency IT policy.

In October 2011, NASA adopted an IT governance model to streamline decision making for and prioritization of strategic IT investments across the Agency. However, our review of NASA's IT governance model reveals limited involvement of Mission Directorate senior officials in NASA's in IT security decisions. Moreover, the model does not incorporate IT security policy as a key element when evaluating significant IT investments. Until NASA incorporates IT security policy into its IT governance model and fully implements related IT security programs, the Agency will continue to be at risk for security incidents that can have a severe adverse effect on Agency operations and assets.