National Aeronautics and Space Administration

FY2018
AGENCY FINANCIAL REPORT

www.nasa.gov

COVER IMAGE CAPTIONS AND CREDITS

FRONT COVER

Main Image

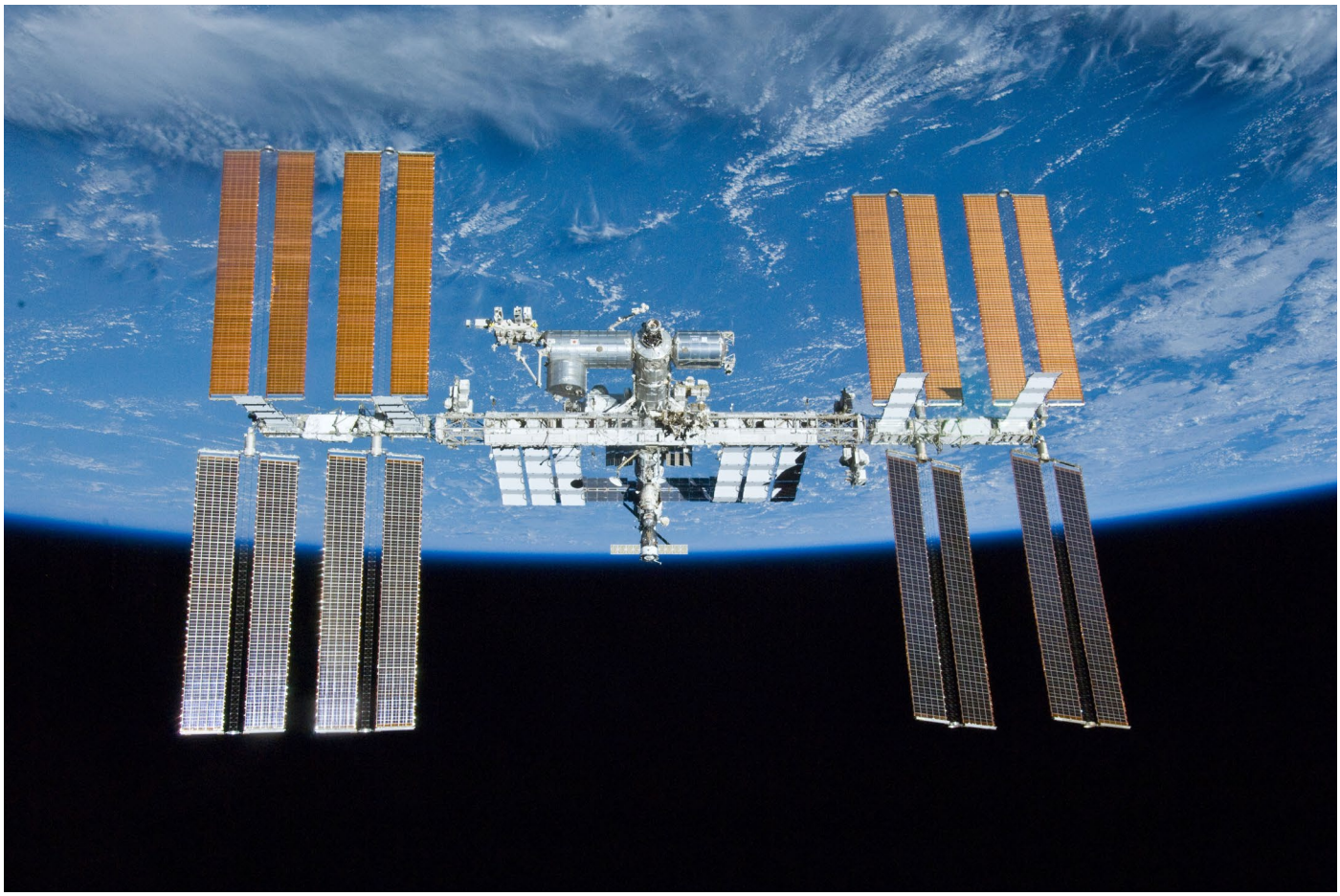
Artist's concept of the Earth seen at night from the International Space Station (ISS). Photo Credit: NASA

Bottom Images (clockwise)

(top) NASA introduced to the world on August 3, 2018, the first U.S. astronauts who will fly on American-made, commercial spacecraft to and from the International Space Station – an endeavor that will return astronaut launches to United States (U.S.) soil for the first time since the space shuttle's retirement in 2011. The agency assigned nine astronauts to crew the first test flight and mission of both Boeing's CST-100 Starliner and SpaceX's Crew Dragon. The astronauts are, from left to right: Sunita Williams, Josh Cassada, Eric Boe, Nicole Mann, Christopher Ferguson, Douglas Hurley, Robert Behnken, Michael Hopkins and Victor Glover. Photo Credit: NASA

(right) NASA's historic Parker Solar Probe mission will revolutionize our understanding of the Sun, where changing conditions can propagate out into the solar system, affecting Earth and other worlds. Parker Solar Probe will travel through the Sun's atmosphere, closer to the surface than any spacecraft before it, facing brutal heat and radiation conditions and ultimately providing humanity with the closest-ever observations of a star. Photo Credit: NASA

(bottom) NASA astronaut Ricky Arnold is pictured during a spacewalk he conducted with fellow NASA astronaut Drew Feustel (out of frame) on June 14, 2018. During the six-hour, 49-minute spacewalk the duo installed high-definition cameras to provide enhanced views of commercial crew spacecraft, including the SpaceX Crew Dragon and the Boeing Starliner, as they approach and dock with the International Space Station. Photo Credit: NASA



Back dropped by the blackness of space and the Earth's horizon is the International Space Station (ISS). The ISS is a unique place – a convergence of science, technology and human innovation that demonstrates new technologies and makes research breakthroughs not possible on Earth. Photo Credit: NASA

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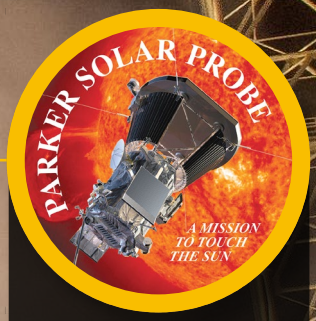
PARKER SOLAR PROBE

A Mission to Touch the Sun

The United Launch Alliance Delta IV Heavy rocket launched NASA's Parker Solar Probe to touch the Sun, on Sunday, August 12, 2018 from Launch Complex 37 at Cape Canaveral Air Force Station, Florida. Parker Solar Probe is humanity's first-ever mission into a part of the Sun's atmosphere called the corona. Here it will directly explore solar processes that are key to understanding and forecasting space weather events that can impact life on Earth.

At closest approach, Parker Solar Probe will hurtle around the Sun at approximately 430,000 miles per hour (mph) or 700,000 kilometers per hour (kph). That's fast enough to get from Philadelphia to Washington, District of Columbia (DC) in one second. Photo Credit: NASA/Bill Ingalls



Mission Logo:

The Parker Solar Probe is named after Eugene Parker who first theorized that the sun constantly sends out a flow of particles and energy called the solar wind. Credits: NASA/Applied Physics Laboratory (APL)

MESSAGE FROM THE ADMINISTRATOR

November 15, 2018

The National Aeronautics and Space Administration (NASA) is proud to present our Fiscal Year 2018 Agency Financial Report. This document is an annual accounting of our financial and programmatic performance status relative to the Agency's mission and goals, as identified in our 2018 Strategic Plan. As responsible stewards of the American taxpayers, NASA is committed to delivering credible, quality data and information on the Agency's fiscal operations. We follow standard financial reporting practices, ensuring appropriate controls, and efficient and effective management of appropriated Agency funds.

Everyday, NASA is pushing boundaries in aeronautics, space exploration, science, and technology. The accomplishments made as an Agency over the past 60 years are stepping stones to greater developments that will lead us to new possibilities. Over this past year, we continue to press forward, achieving milestones that have never before been explored. Although NASA studies our planet, Sun, solar system and beyond, America's space program is closer to home than you may think. Through NASA's Technology Transfer program, NASA-originated technology is often modified for commercial products and services benefiting the public on Earth.

NASA continues to make steady progress toward the first missions of the Orion spacecraft and the Space Launch System (SLS) rocket that will lead the next steps of human exploration to the Moon and beyond, extending human exploration farther into space than ever before. Exploration Mission-1 will be the first integrated test of Orion, SLS, and the supporting ground systems launching from Kennedy Space Center in Cape Canaveral, Florida, in 2020 and will pave the road for future missions with astronauts.

In August of this year, NASA launched the Parker Solar Probe to travel through the Sun's atmosphere, closer to the surface than any spacecraft before it, facing extreme heat and radiation, and ultimately providing scientists with the closest ever observation of a star. The success of this launch was a major accomplishment for the Agency and promises to provide new insights into the mysteries of the Sun. In addition, the James Webb Space Telescope (Webb) will soon be the world's premier space science observatory. Webb will solve mysteries of our solar system, look beyond to distant worlds, and probe the mysterious structures and origins of our universe and our place in it. In September 2018, communication tests on Webb successfully connected the spacecraft and the telescope using temporary ground wiring that enabled them to communicate as they would in flight.

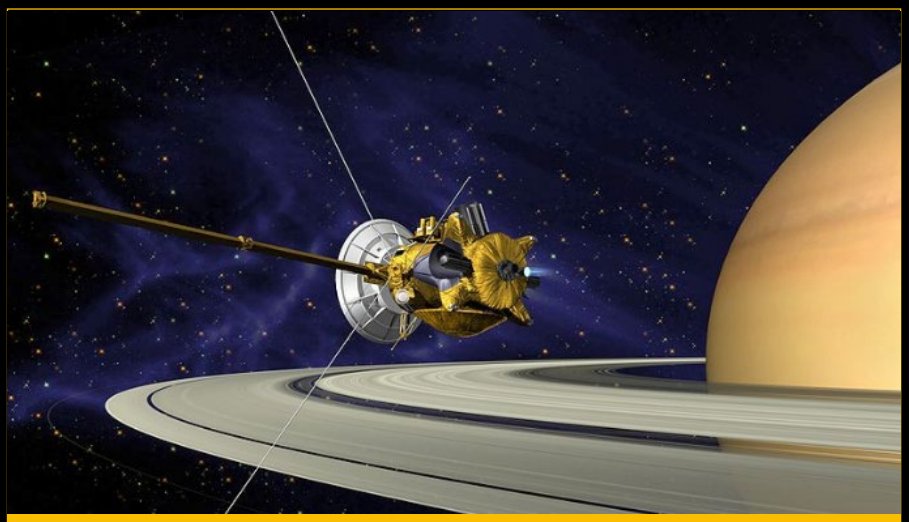
Over the next several years, NASA has its sights set on returning to the Moon and preparing for Mars. The Agency is exploring new business opportunities and strategies by building relationships with commercial partners to improve the utility of every dollar that we spend. This is truly an exciting time for NASA, and I am humbled to be a part of all that is to come. It is with honor and gratitude that I recognize the efforts of the women and men that make NASA great and make all that we do possible.

Sincerely,

James F. Bridenstine
Administrator

MISSION ACCOMPLISHED

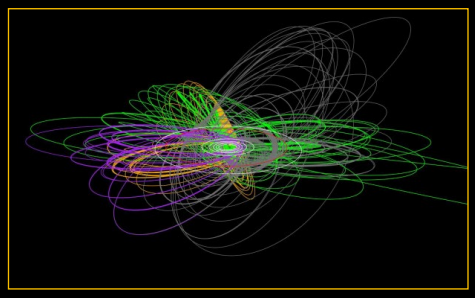
CASSINI: 1997-2017



PLAY VIDEO

NASA's Cassini spacecraft made its final approach to Saturn and dove into the planet's atmosphere on Friday, September 15, 2017 but the science provided by this enduring spacecraft will live on. Video Credit: NASA

Cassini's Epic Journey
This picture traces Cassini's orbits from Saturn orbit insertion, on July 1, 2004; through the planned end of the mission, on September 15, 2017.



After two decades in space, NASA's Cassini spacecraft reached the end of its remarkable journey of exploration. Having expended almost every bit of the rocket propellant Cassini carried to Saturn, operators deliberately plunged the spacecraft into the planet to ensure Saturn's moons will remain pristine for future exploration — in particular, the ice-covered, ocean-bearing moon Enceladus, but also Titan, with its intriguing pre-biotic chemistry.

Beginning in 2010, Cassini began a seven-year mission extension in which it completed many moon flybys while observing seasonal changes on Saturn and Titan. The plan for this phase of the mission was to expend all of the spacecraft's propellant while exploring Saturn, ending with a plunge into the planet's atmosphere.

In April 2017, operators placed Cassini on an impact course that unfolded over five months of daring dives — a series of 22 orbits that each passed between the planet and its rings. Called the Grand Finale, this final phase of the mission brought unparalleled observations of the planet and its rings from closer than ever before.

On September 15, 2017, the spacecraft made its final approach to the giant planet Saturn. But this encounter was like no other. This time, Cassini dived into the planet's atmosphere, sending science data for as long as its small thrusters could keep the spacecraft's antenna pointed at Earth. Soon after, Cassini burned up and disintegrated like a meteor.

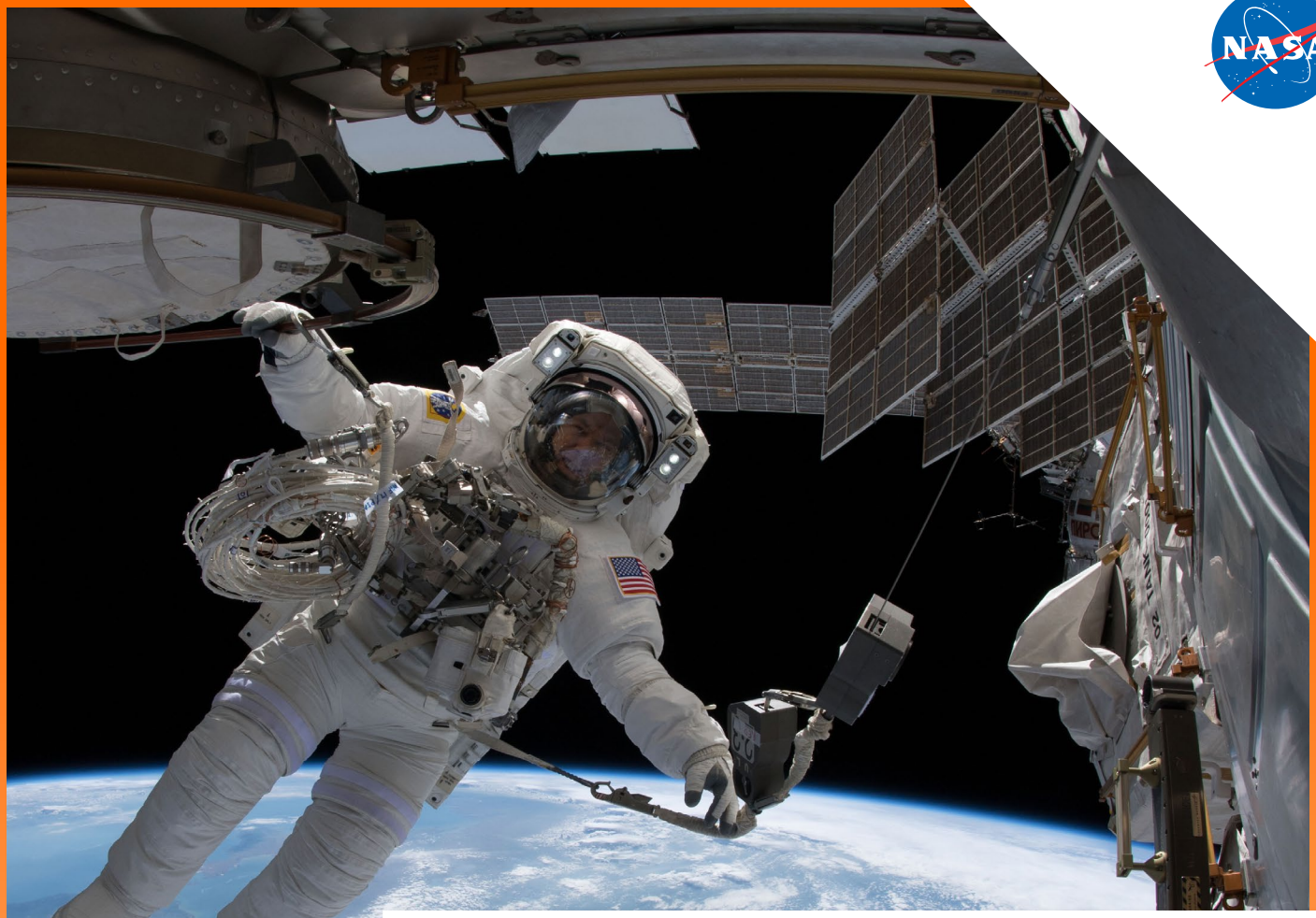
To its very end, Cassini was a mission of thrilling exploration. Launched on October 15, 1997, the spacecraft entered orbit around Saturn on June 30, 2004 Pacific Daylight Time (PDT), carrying the European Huygens probe. After its four-year prime mission, Cassini's tour was extended twice. Its key discoveries included the global ocean with indications of hydrothermal activity within Enceladus, and liquid methane season on Titan.

Although the spacecraft may be gone, its enormous collection of data about Saturn – the giant planet itself, its magnetosphere, rings and moons — will continue to yield new discoveries for decades.

MISSION OVERVIEW

Orbits 294
Titan Flybys 127
Enceladus Flybys 23
Icy Satellite Flybys 15

Learn more about Cassini's spacecraft, journey, and discoveries at https://saturn.jpl.nasa.gov or watch the Emmy award winning program, Cassini's Grand Finale, at https://www.youtube.com/watch?v=xrGAQCq9BMU



SECTION 1

MANAGEMENT'S DISCUSSION AND ANALYSIS

NASA astronaut Ricky Arnold is pictured during a spacewalk he conducted with fellow NASA astronaut Drew Feustel (out of frame) on June 14, 2018. During the six-hour, 49-minute spacewalk, the duo installed high-definition cameras to provide enhanced views of commercial crew spacecraft, including the SpaceX Crew Dragon and the Boeing Starliner, as they approach and dock with the ISS. Photo Credit: NASA

WELCOME TO NASA

NASA produces an Agency Financial Report (AFR) and Annual Performance Report (APR). The APR is provided as part of NASA's annual Volume of Integrated Performance (VIPer). The VIPer is a consolidated document reporting prior year performance with an updated performance plan for the current fiscal year, and a proposed performance plan for the requested budget fiscal year. The VIPer is published in conjunction with the President's Budget Request, due in February 2019.

This AFR provides an overview of NASA's major programmatic and financial results for FY 2018. It integrates NASA's financial and program performance to demonstrate stewardship and accountability, highlighting FY 2018 achievements and challenges.

NASA demonstrates stewardship of its resources and accountability for results through compliance with the Chief Financial Officers Act (CFO Act) and the Government Performance and Results Act Modernization Act of 2010[a] (GPRAMA). Financial aspects of the Agency's business operations are accounted for according to U.S. generally accepted accounting principles (GAAP). GAAP, for Federal entities, are the standards prescribed by the Federal Accounting Standards Advisory Board (FASAB).

NASA presents both performance and financial results of operations by strategic goals as identified in the 2018 Strategic Plan[b]. Highlights of key program activities contributing to each strategic goal are provided in the Mission Performance section (starting on page 13). A high-level summary of the linkage between program results and the cost of operations is provided in the Statement of Net Cost (SNC), found in the Financial section (starting on page 47). The SNC presents comparative net cost of operations during

The first U.S. astronauts who will fly on American-made, commercial spacecraft to and from the ISS, wave after being announced on Friday, August 3, 2018 at NASA's Johnson Space Center (JSC) in Houston, Texas. The astronauts are, from left to right: Victor Glover, Mike Hopkins, Bob Behnken, Doug Hurley, Nicole Aunapu Mann, Chris Ferguson, Eric Boe, Josh Cassada, and Suni Williams. The agency assigned the nine astronauts to crew the first flight tests and missions of the Boeing CST-100 Starliner and SpaceX Crew Dragon. Photo Credit: NASA/Bill Ingalls

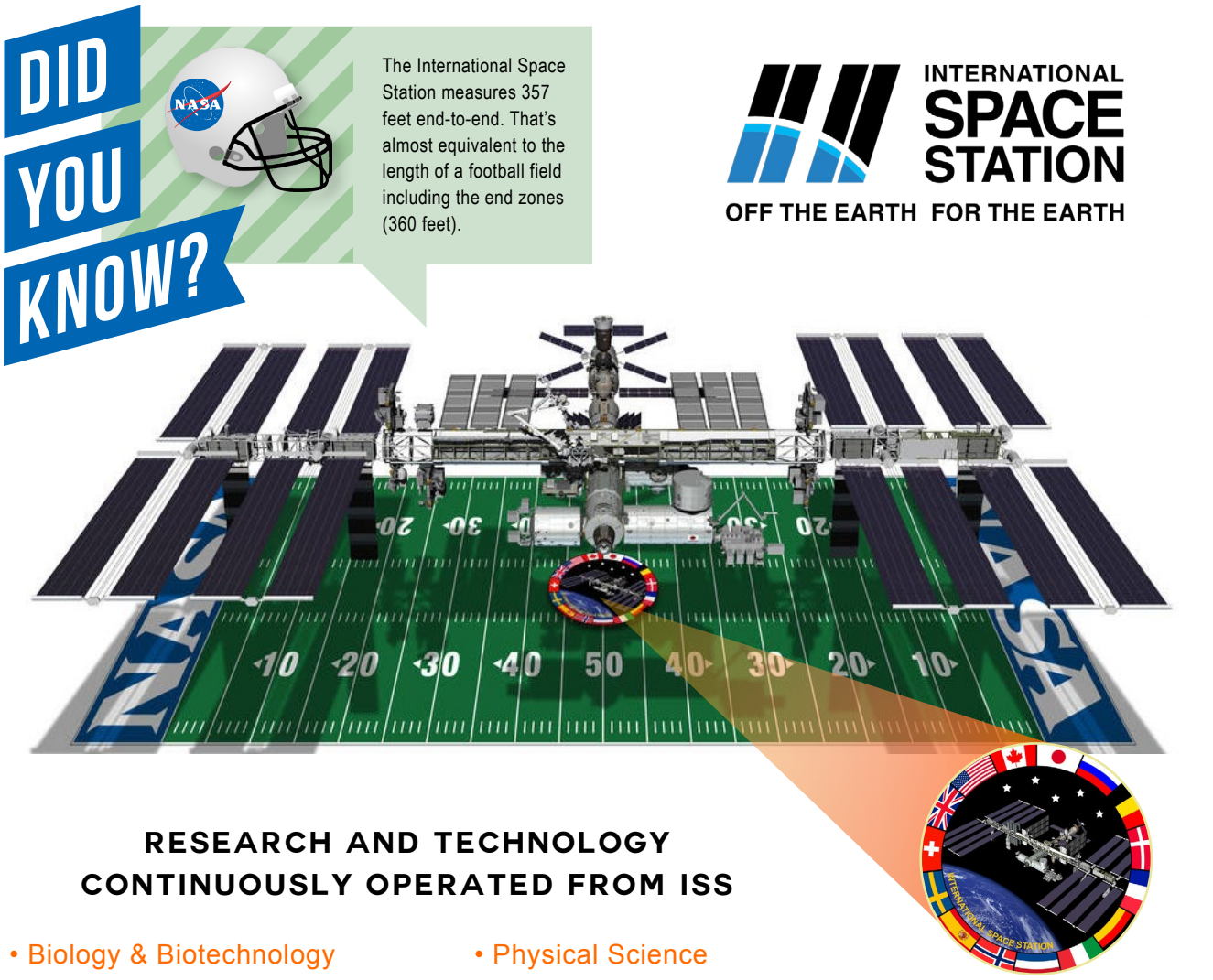
[a] Government Performance and Results Act Modernization Act of 2010 (GPRAMA)
https://obamawhitehouse.archives.gov/omb/performance/gprm-act

[b] 2018 Strategic Plan
https://www.nasa.gov/sites/default/files/atoms/files/nasa_2018_strategic_plan.pdf

FY 2018 and FY 2017 by strategic goal and for the Agency as a whole. In addition, the Financial Highlights, in the Financial Performance section (starting on page 29), explains any significant changes in NASA's financial condition from FY 2017 to FY 2018.

Financial systems that meet requirements of the Federal Financial Management Improvement Act (FFMIA) are vital to NASA's financial management program. The AFR describes NASA's compliance with the FFMIA, as well as the built-in checks and balances required by the Office of Management and Budget's (OMB) Circular No. A-123, *Management's Responsibility for Enterprise Risk Management and Internal Control*, which places responsibility for internal controls over financial reporting on Agency management for the purpose of safeguarding assets and improving efficiency and effectiveness of operations.

Finally, the AFR presents the Agency's audited FY 2018 and FY 2017 financial statements and disclosures, the related independent auditors' audit opinion, and other information. The FY 2018 AFR can be found on NASA's website at https://www.nasa.gov/news/budget.



The International Space Station logo featuring flags from 15 nations involved: USA, Canada, Japan, Russia, Belgium, Denmark, France, Germany, Italy, Netherlands, Norway, Spain, Sweden, Switzerland & United Kingdom

VISION

Discover and expand knowledge for the benefit of humanity

MISSION

Lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and bring new knowledge and opportunities back to earth

Support growth of the nation's economy in space and aeronautics, increase understanding of the universe and our place in it, work with industry to improve America's aerospace technologies, and advance American leadership

ACHIEVING OUR VISION & MISSION

NASA inspires the world with our exploration of new frontiers, our discovery of new knowledge, and our development of new technology. Our work benefits Americans and all humanity. Since NASA's inception in 1958 to present day, the Agency's history is written with each unique scientific and technological achievement. We have landed people on the Moon, visited every planet in the solar system, touched the Sun, and solved some of the core mysteries of our home planet.

Today, our Nation's economic prosperity, National security, and cultural identity depend on our leadership in aeronautics, space exploration, and science. NASA accepts the challenge to continue our legacy of achievement and greatly expand the benefits we provide to mankind. Our success will be determined largely by the planning and investments we undertake today. This commitment is what drives our Vision, Mission, and overarching approach that form the core of our 2018 Strategic Plan.

NASA's historic and enduring purpose is aligned to four major strategic themes including DISCOVER, EXPLORE, DEVELOP, and ENABLE. The four themes are intended to characterize the four Strategic Goals that frame our Strategic Plan, which correspond to our missions of scientific discovery of the Earth, of other worlds, and of the cosmos as a whole.

In addition, the plan corresponds to the missions of exploration in our solar system with humans and robotic probes that expand the frontiers of human experience; and missions of development that advance new technologies in aeronautics and space systems that allow the American industry to create and expand a nascent space marketplace to serve the needs of space exploration, both here on Earth and in near-Earth environments.

NASA also maintains its continuity of purpose over time by serving the American public and supporting a number of National priorities, characterized by six major elements:

- Fostering New Discoveries and Expanding Human Knowledge
- Global Engagement and Diplomacy
- Interactions with the Nation's Security and Industrial Base Posture
- Economic Development and Growth
- Addressing National Challenges
- Leadership and Inspiration

AGENCY PRIORITY GOALS

Agency Priority Goals (APG) are a performance accountability structure of the GPRAMA that provide a mechanism to focus leadership priorities. NASA has identified five APGs for the FY 2018 - 2019 cycle. Related Performance Goals are assessed quarterly to measure each APG's progress toward achieving long-term Strategic Goals and Strategic Objectives. Additional information on NASA's Agency Priority Goals can be found at https://www.performance.gov/.

Commercial Crew

Goal leader: Philip McAlister, Director of Commercial Spaceflight Development Division

Facilitate the development of and certify U.S. industry-based crew transportation systems while maintaining competition, returning ISS crew transportation to the United States. By September 30, 2019, the Commercial Crew Program, along with its industry partners, will complete at least one Certification Review, following un-crewed and crewed test flights to the ISS.

Exploration

Goal leader: William Hill, Deputy Associate Administrator (AA) of Exploration Systems Development

Achieve critical milestones in the development of new systems for the human exploration of deep space. By September 30, 2019, NASA will conduct the Ascent Abort-2 test of the Orion Launch Abort System, perform the green run hot-fire test of the Space Launch System's Core Stage at the Stennis Space Center, and roll the Mobile Launcher to the Vehicle Assembly Building to support the start of Exploration Mission-1 stacking operations.

International Space Station

Goal leader: Sam Scimemi, Director of International Space Station Division

Use the International Space Station (ISS) as a testbed to demonstrate the critical systems necessary for long-duration missions. Between October 1, 2017 and September 30, 2019, NASA will initiate at least eight in-space demonstrations of technology critical to enable human exploration in deep space.

James Webb Space Telescope

Goal leader: Greg Robinson, Program Director of James Webb Space Telescope Program

Revolutionize humankind's understanding of the Cosmos and humanity's place in it. The James Webb Space Telescope (Webb) will study every phase in the history of our universe, ranging from the first luminous glows after the Big Bang, to the formation of other stellar systems capable of supporting life on planets like Earth, to the evolution of our own solar system.

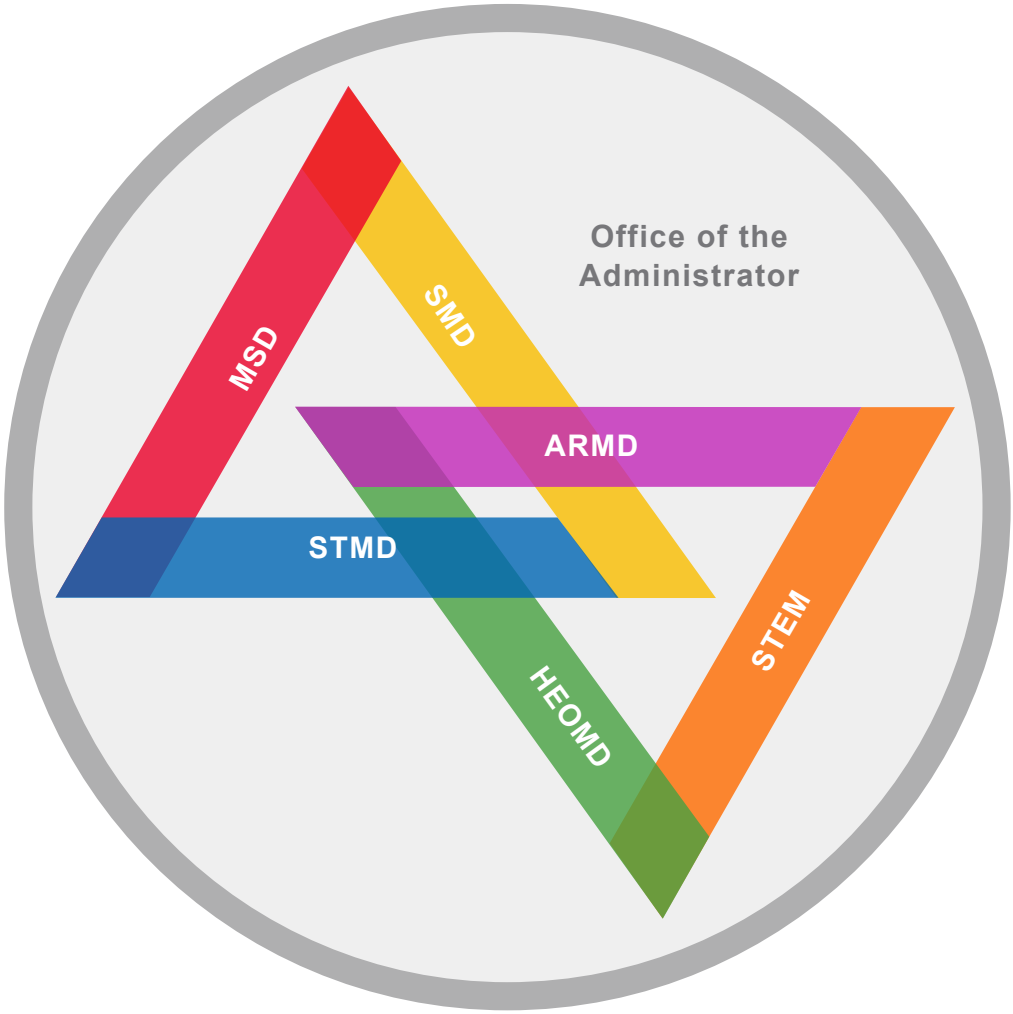
Mars 2020

Goal leader: Jim Watzin, Program Director of Mars Exploration Program

Seeking signs of life on Mars: Explore a habitable environment, search for potential biosignatures of past life, collect and document a cache of scientifically compelling samples for eventual return to Earth, and contribute to future human exploration of Mars. By August 5, 2020, NASA will launch the Mars 2020 rover.

ORGANIZATIONAL STRUCTURE

NASA's organizational structure comprises a top level leadership structure overseeing a matrix relationship between Mission Directorates, Mission Support offices, and Centers. This structure ensures the Agency can have both a holistic and narrowly-focused approach to business management, safety oversight, and achievement of mission and operational goals, as described in the NASA Organization (NASA Policy Directive 1000.3E). The Administrator and senior officials lead the Agency by providing top-level strategies and direction. Mission directorate and mission support offices at Headquarters manage decisions on programmatic investments and guide the operations of the Centers. NASA's Centers and facilities manage and execute the mission work — engineering, operations, science, and technology development — and supporting activities.



- Office of the Administrator
- Aeronautics Research Mission Directorate (ARMD)
- Human Exploration and Operations Mission Directorate (HEOMD)
- Mission Support Directorate (MSD)
- Office of Science, Technology, Engineering and Mathematics (STEM) Engagement
- Science Mission Directorate (SMD)
- Space Technology Mission Directorate (STMD)

For more information about NASA's organizational structure, go to: https://www.nasa.gov/about/org_index.html

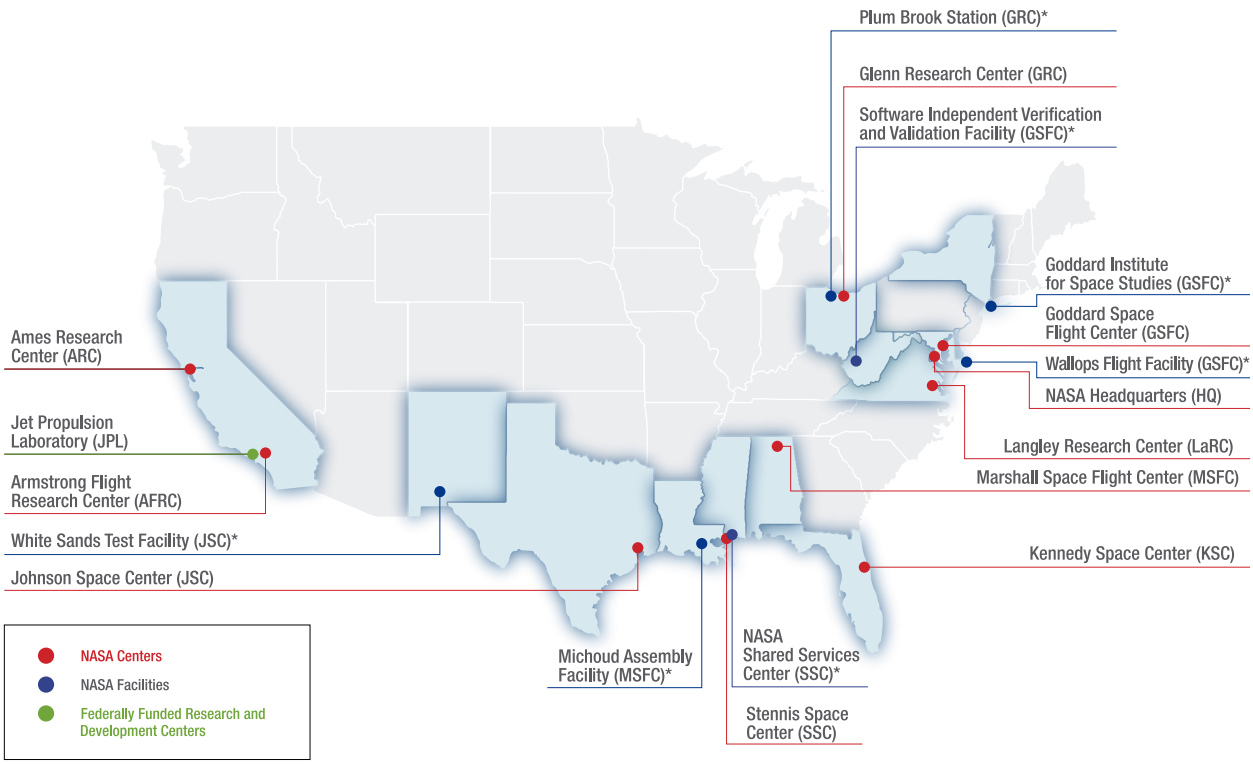
REORGANIZATION PLAN

The FY 2019 President's Budget Request announced a planned restructuring of NASA organizational structure to better align with the new national space exploration policy, and support an innovative and sustainable program for exploration. Reorganization plans under consideration include:

- Combine Space Technology Mission Directorate (STMD) and advanced technology work from the Advanced Exploration Systems program to create a new mission directorate known as Exploration Research and Technology
- Eliminate the current Human Exploration and Operations Mission Directorate (HEOMD) and Space Technology Mission Directorate (STMD) to create two new exploration-focused mission directorates known as Exploration Operations Mission Directorate, which will focus on the ISS, commercial low Earth orbit operations, and crosscutting support areas required to support exploration, such as communications, and rocket propulsion and Exploration Systems and Technology Mission Directorate, which will focus on deep space mission elements and technology development needs for sustainable human exploration
- Eliminate the current Human Exploration and Operations Mission Directorate (HEOMD) and Space Technology Mission Directorate (STMD) to create a single "super" exploration-focused mission directorate by pulling together all the exploration-focused areas from the current HEOMD and STMD

CENTERS AND FACILITIES

NASA's Headquarters, located in Washington, DC, provides the overall guidance and direction to the agency under the leadership of the Administrator. A skilled and diverse group of technical and business professionals conduct day-to-day activities throughout our ten field Centers and a variety of unique facilities.



*Acronym indicates the managing NASA Center for the Facility

NASA TECHNOLOGY TRANSFER PROGRAM

"Bringing NASA Technology Down to Earth"

For over 50 years the NASA Technology Transfer Program has partnered with private industry companies to modify and transfer NASA-originated technology for the development of commercial products and services that can benefit the public on Earth. These products and services are commonly referred to as Spinoff Technologies.

Since 1976, NASA has released an annual premier publication titled *Spinoff* that profiles new NASA technologies that have been transformed for commercial use in the public sector. Below are three of our favorite Spinoff Technologies highlighted in the 2018 publication of *Spinoff*.

DID YOU KNOW ?

Radar Device Detects Heartbeats

NASA often analyzes weak signals hidden in noise, like alternations in a satellite's path that indicate gravity fluctuations in a planet. With government funding, the Jet Propulsion Laboratory adopted the technology to create FINDER, which stands for Finding Individuals for Disaster and Emergency Response. FINDER uses radar technology to detect the breathing and heartbeats of victims trapped under rubble. A Maryland based company, R4 Inc, continues to develop the technology, making it lighter-weight and more rugged. FINDER was successful in April of 2015, when it was used to rescue four men trapped under debris from a 7.8-magnitude earthquake in the village of Chautara, in Nepal.

Design Software Transforms How Jetliners are Built

In late 1990, NASA developed Pegasus 5 - software that made use of processing power capabilities to dramatically transform how airplanes and spacecraft are designed and built. This technology enables designers to do the bulk of their work on computers, reducing expensive and time consuming wind tunnel models and tests. Pegasus 5 has been used to develop or upgrade essentially every major NASA spacecraft in the last 15 years including NASA's next crewed spacecrafts, Orion and SLS. Meanwhile, Boeing is using the software technology in the private sector to develop and support commercial airplanes, as well as military aircraft and spacecraft.

Sterilizing Fogger Cleans Ambulances

An innovative new product known as AMBUstat, a small fogger designed with NASA's help, aims to sterilize the rig and gear of an ambulance to make it safer for the patients and paramedics. The product uses atomic oxygen and oxidation, chemicals often used at NASA in space environment testing to research how materials on spacecraft react when they're in the environment of the upper atmosphere of planetary bodies. When combined with any infectious material, atomic oxygen removes hydrocarbon, making it an extremely effective sterilizing agent.

For more information on the NASA Technology Transfer Program and Spinnoffs visit us at:

PLAY VIDEO

Although NASA studies our planet, Sun, solar system and beyond, America's space program is closer to home than you may think. You can find thousands of NASA-influenced technologies right in your backyard. Our new interactive website lets users explore how NASA appears in everyday life.

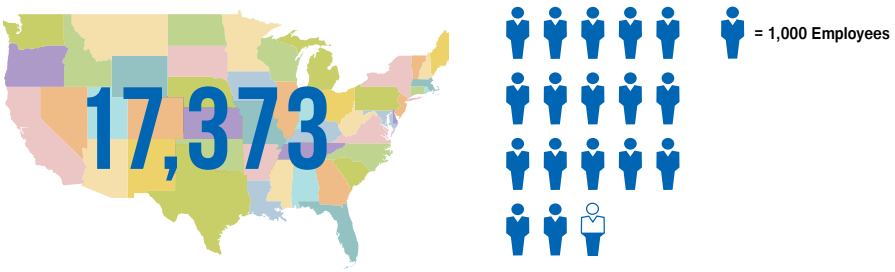
NASA Home & City features about 130 spinoff technologies in a virtual space, allowing users to tour through buildings and rooms to discover common items that NASA inspired or helped improve. These spinoffs are commercial products that apply NASA technology originally developed to study and explore space. For more information visit: https://homeandcity.nasa.gov/

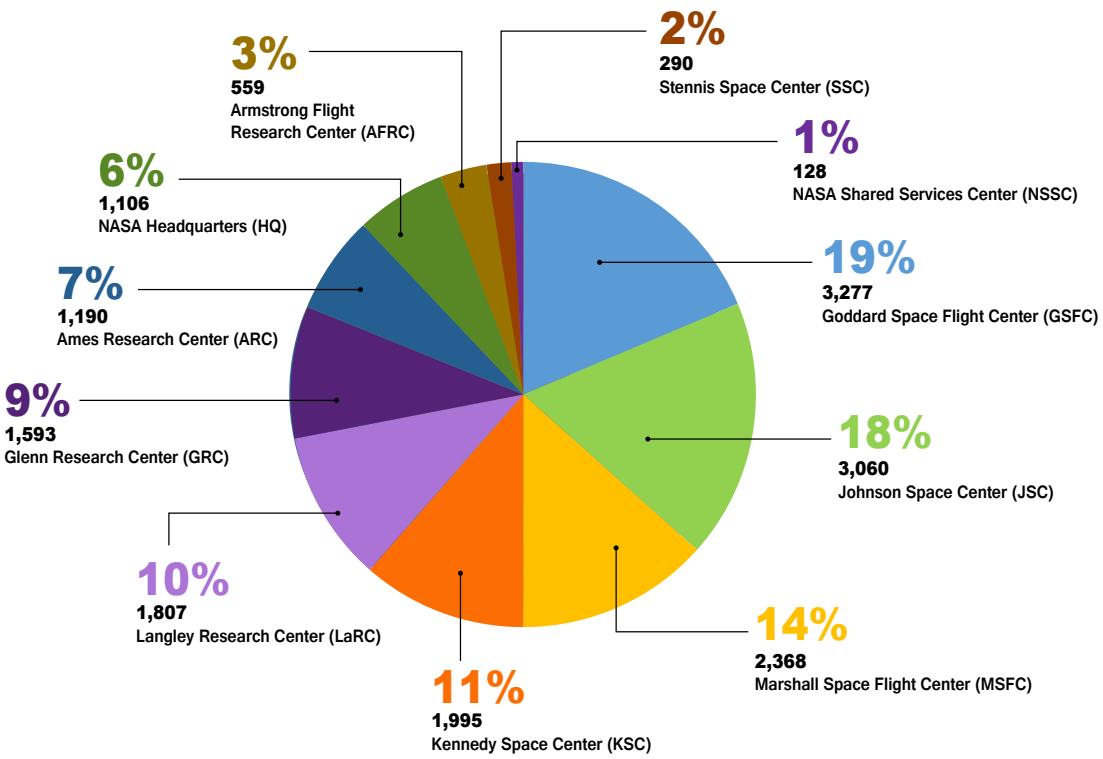
2018 NASA Spinoff: https://spinoff.nasa.gov/Spinoff2018/pdf/Spinoff2018.pdf

Twitter: https://twitter.com/NASASpinoff Facebook: https://www.facebook.com/NASAspinoff/ Website: https://spinoff.nasa.gov/

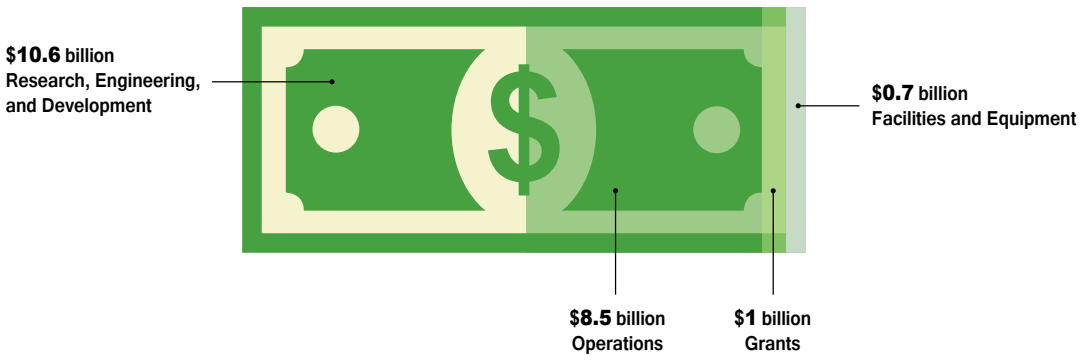
NASA BY THE NUMBERS

NASA's Civil Service Workforce





$20.8 Billion Budget in FY 2018



More information about NASA's workforce is available at https://wicn.nssc.nasa.gov/

NASA CELEBRATES

Katherine Johnson's 100th Birthday

Katherine Johnson is a pioneer for African-American women in STEM.

PLAY VIDEO

On August 26, 2018 as part of NASA's celebration of Katherine Johnson's 100th birthday, NASA employees received a special message from administrator Jim Bridenstine to mark the occasion. With slide rules and pencils, Katherine, a legendary NASA mathematician – and the other human computers who worked at the agency – helped our nation's space program off the ground, but it was their confidence, bravery and commitment to excellence that broke down racial and social barriers that continue to inspire to this day. Video Credit: NASA

To learn more about Katherine and other trailblazing 'human computers,' visit: https://www.nasa.gov/modernfigures

NOTABLE MISSIONS

The main scientific objective of project Mercury was to determine man's capabilities in a space environment and in those environments to which he will be subject upon going into and returning from space.

Place a man into Earth orbit, observe his reactions to the space environment and safely return him to Earth. The Mercury flight plan during the first orbit was to maintain optimum spacecraft attitude for radar tracking and communication checks.

The primary objective of Apollo 11 was to complete a national goal set by President John F. Kennedy on May 25, 1961: perform a crewed lunar landing and return to Earth.

Apollo 13 was supposed to land in the Fra Mauro area. An explosion on board forced Apollo 13 to circle the moon without landing. The Fra Mauro site was reassigned to Apollo 14.

MISSION PERFORMANCE

13

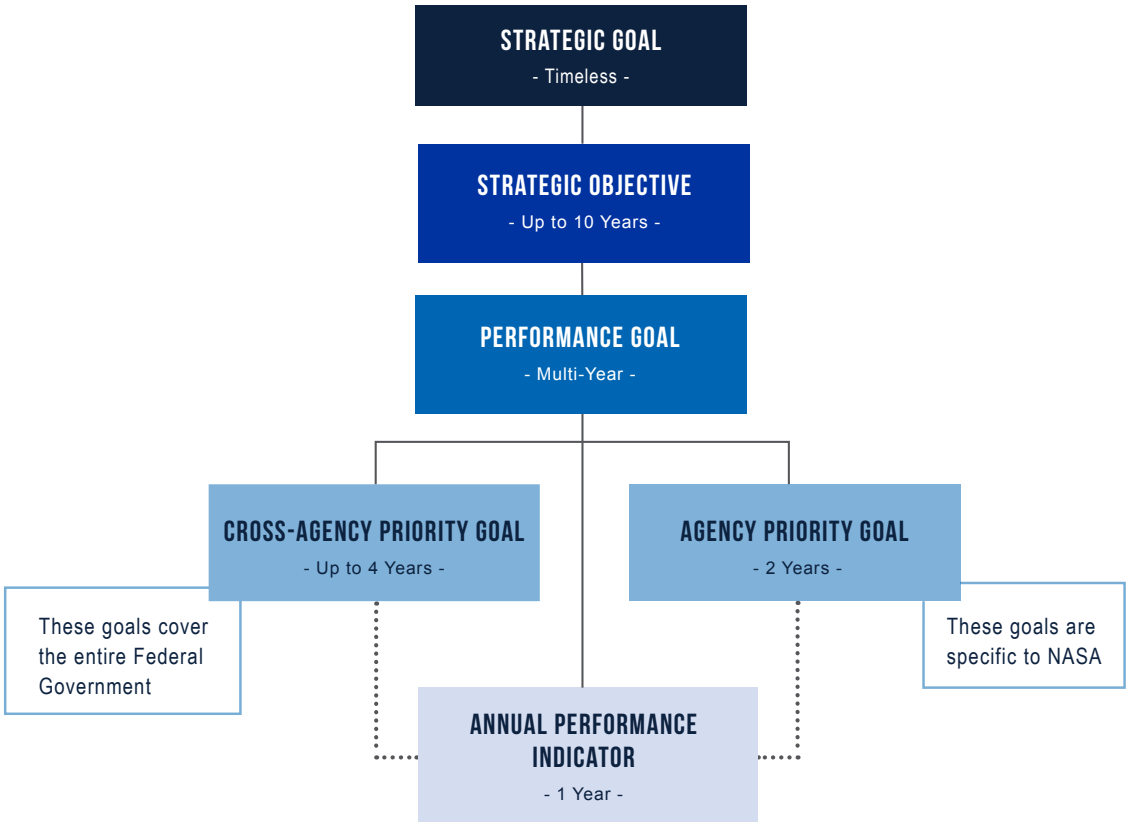
The NASA/German Research Centre for Geosciences Gravity Recovery and Climate Experiment Follow-On (GRACE-FO) spacecraft launched onboard a SpaceX Falcon 9 rocket, on Tuesday, May 22, 2018, from Space Launch Complex 4E at Vandenberg Air Force Base in California. GRACE-FO consists of two identical spacecraft that fly about 220 kilometers (137 miles) apart in a polar orbit 500 kilometers (310 miles) above Earth. GRACE-FO maps Earth's gravity field by making accurate measurements of the distance between the two satellites, using a Global Positioning System (GPS) and a microwave ranging system. It is providing scientists from all over the world with an efficient and cost-effective way to map Earth's gravity field with unprecedented accuracy. Photo Credit: NASA

STRATEGIC PERFORMANCE FRAMEWORK

The Government Performance and Results Act Modernization Act (GPRAMA) of 2010 requires a strategic performance framework that is structured to improve focus on agency priorities with measurable outcomes that support data-driven decision making. The framework is representative of a hierarchy that flows top-down, from Strategic Goals to Annual Performance Indicators. This relationship is representative of a parent-child connection, and described in detail in the Performance Assessment section, on page 19.

Strategic Goals identify the Agency's mission and address relevant National needs, challenges and opportunities. Strategic Objectives are long-term ambitions that provide detailed plans in support of achieving the Strategic Goals. Performance Goals (PG) are multi-year tasks that align to the Strategic Objectives; and Annual Performance Indicators (API) are near-term activities that include targets and time-frames to define the level of performance required to achieve each PG. NASA has identified Strategic Goals, Strategic Objectives, PGs, and APIs that are in accordance with our framework and comprehensive of all agency activities.

Below is a visual illustration of the NASA Strategic Performance Framework. For the purpose of this publication we are specifically providing end-of-year assessments on PGs and APIs that support the achievement of our Strategic Objectives. For additional information on NASA's Cross-Agency Priority Goals (CAP) and Agency Priority Goals (APG) go to https://www.performance.gov/.



NASA'S PERFORMANCE FRAMEWORK BREAKDOWN

4	13	68	129
Strategic Goals	Strategic Objectives	Performance Goals	Annual Performance Indicators

STRATEGIC GOALS AND OBJECTIVES

As detailed in NASA's 2018 Strategic Plan our four Strategic Goals and thirteen Strategic Objectives outline the Agency's vision and mission for the future and are deliberately chosen to support a new era of space exploration; and continue America's preeminence in space, exploration, science, technology, and aeronautics.

DISCOVER Expand human knowledge through new scientific discoveries

EXPLORE Extend human presence deeper into space and to the moon for sustainable long-term exploration and utilization

DEVELOP Address national challenges and catalyze economic growth

ENABLE Optimize capabilities and operations

1 DISCOVER

1.1 Understand the Sun, Earth, Solar System and Universe

1.2 Understand Responses of Physical and Biological Systems to Spaceflight

2 EXPLORE

2.1 Lay the Foundation for America to Maintain a Constant Human Presence in Low Earth Orbit Enabled by a Commercial Market

2.2 Conduct Exploration in Deep Space, Including to the Surface of the Moon

3 DEVELOP

3.1 Develop and Transfer Revolutionary Technologies to Enable Exploration Capabilities for NASA and the Nation

3.2 Transform Aviation Through Revolutionary Technology Research Development, and Transfer

3.3 Inspire and Engage the Public in Aeronautics, Space and Science

4 ENABLE

4.1 Engage in Partnership Strategies

4.2 Enable Space Access and Services

4.3 Assure Safety and Mission Success

4.4 Manage Human Capital

4.5 Ensure Enterprise Protection

4.6 Sustain Infrastructure Capabilities and Operations

Commercial Launch Partners

An Orbital ATK rocket rolls out to launch Pad-0A at NASA's Wallops Flight Facility on May 17, 2018, in advance of a May 21 launch from Wallops Island, Virginia. The Antares will launch a Cygnus spacecraft on a cargo resupply mission to the ISS. Photo Credit: Aubrey Gemigangi / NASA

9th **Contracted cargo delivery with Orbital ATK**

7,400 **Pounds of cargo delivered on this mission**

NASA's ambitious commercial space program has enabled a successful partnership with two American companies to successfully resupply the ISS, and more missions to deliver scientific investigations and cargo are planned.

This partnership is changing the way NASA does business, helping build a strong American commercial space industry, and freeing the agency to focus on developing the next-generation rocket and spacecraft that will allow us to travel farther in space than ever before.

> *"The industry itself is a NASA success story and an American victory. Because of NASA's investments in the American launch industry, space launch now represents a net export for our country. In fact, from 2011-2017, the United States grew its market share of commercial launch from zero percent to 54 percent in the global economy. In 2018, the United States could reach 65 percent.*
>
> *When multiple commercial launch providers compete to earn business, they have a strong incentive to innovate on design, engineering, manufacturing, and operations to improve services and reduce costs. We have seen this already with the advent of reusable rockets, improved engines, and so much more."*
>
> — ***Jim Bridenstine***
> September 18, 2018

STRATEGIC GOALS AND HIGHLIGHTS

17

This image of the southern Greenland town of Narsaq was taken during an Operation IceBridge flight on April 26, 2018. Operation IceBridge, NASA's longest-running airborne mission to monitor polar ice change, concluded this year's springtime survey of Arctic sea and land ice on May 2, 2018. The flights, which began on March 22, covered the western basin of the Arctic Ocean and Greenland's fastest-changing glaciers. Photo Credit: Joe MacGregor / NASA

PERFORMANCE ASSESSMENT CRITERIA

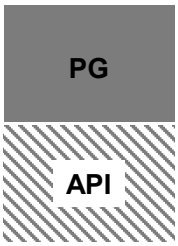
NASA uses a color-coded scoring system to rate progress toward achieving Performance Goals (PG) and Annual Performance Indicators (API). A set of success criteria have been predetermined for both PGs and APIs and are measured for completeness based on the rating factors below.

NASA determines the final ratings based on a series of internal assessments monitoring program and project performance. In addition, external entities including scientific peer review committees and aeronautic technical evaluation bodies validate a select set of the final ratings.

In some cases PGs and APIs have a status of "unrated" (gray rating). This is due to timing disconnects between the AFR deliverable date and internal reporting schedules. Final assessments and additional information will be provided in the FY 2018 Annual Performance Report (APR) as part of the NASA FY 2020 Volume of Integrated Performance (VIPer), which will be published in early February, 2019.

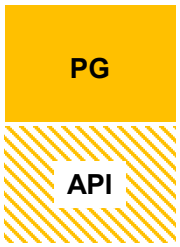
Green
On Target

Complete or expects to complete on target and/or on schedule



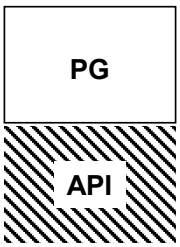
Gray
Unrated

Currently unavailable due to schedule disconnects



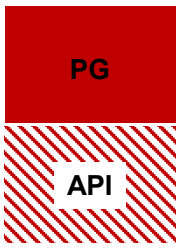
Yellow
Below Target

Expects to complete slightly to moderately below target and/or behind schedule



White
Withdrawn

Canceled due to elimination of activities



Red
Off Target

Not complete or do not expect to complete on target and/or on schedule

Note:

PG - Performance Goal Assessment Results

API - Annual Performance Indicator Assessment Results

FY 2018 PERFORMANCE ASSESSMENTS

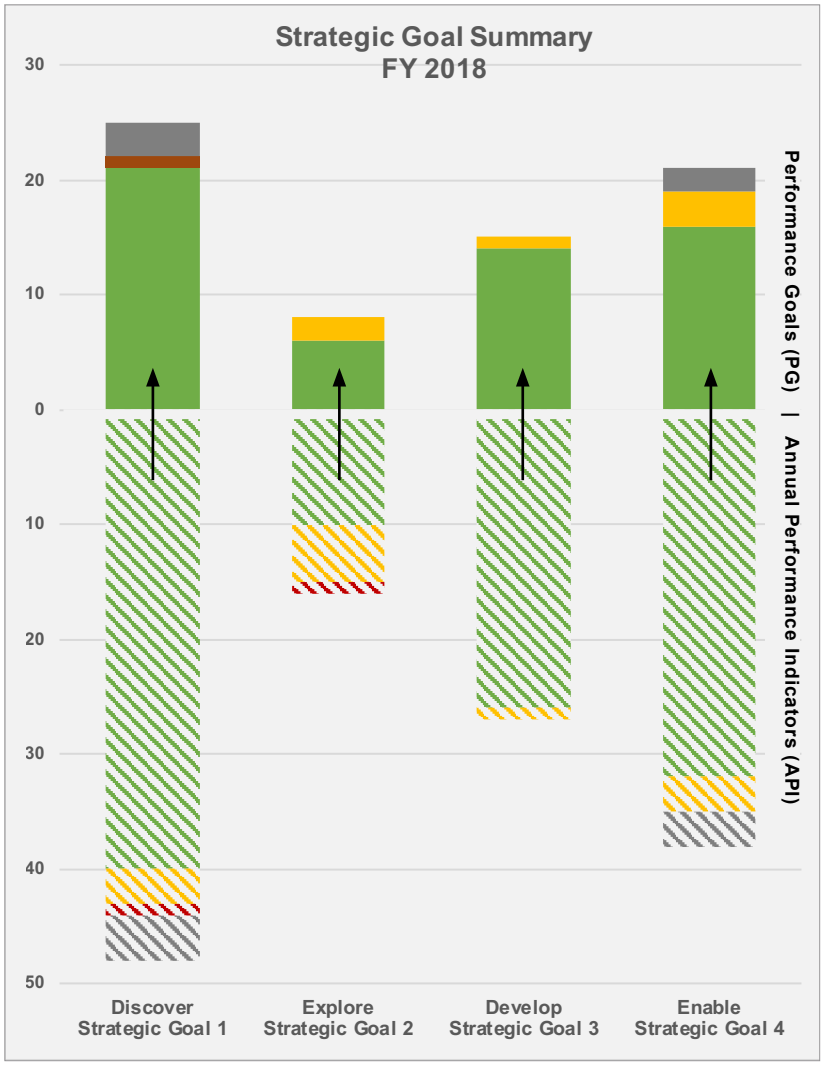
STRATEGIC GOAL SUMMARY | Performance Assessment

In this section of the document we will provide the FY 2018 performance assessment results for the identified Performance Goals (PG) and Annual Performance Indicators (API) by Strategic Objective and individual Strategic Goals.

NASA's performance management system follows the NASA Strategic Performance Framework, as discussed on page 14. PGs represent the actions of a program or project over multiple years. They typically run the four year life-cycle along the Strategic Plan. As depicted in the Framework, PGs are the "parent" to the APIs, while APIs represent the "child" in the relationship and run a one year cycle. All PGs are associated with at least one lower-level API or more. However, individual APIs can only be associated with one upper-level PG.

The following graphs include the FY 2018 summary assessment by Strategic Goal, and individual Strategic Goal assessments by Strategic Objective. The graphs are set-up to show the parent-child relationship by displaying the API results with a diagonal-stripe color pattern, on the bottom half of the graph; and the PG results are displayed with a solid color pattern, on the top half of the graph. The arrows in the graph represent the upward flow of data from API to PG.

The FY 2018 summary assessment shows that in most areas NASA is on target or moderately on target (green) in meeting its APIs and PGs. While schedule delays and cost growth on the James Webb Space Telescope (Webb) program present challenges (Strategic Objective 1.1), NASA has demonstrated success in many other areas including meeting the goals for biological and physical research on the International Space Station (ISS) (Strategic Objective 1.2), and achieving key milestones for the Mobile Launcher on the Exploration Ground Systems (EGS) program (Strategic Objective 2.2).



This is NASA's first year of reporting under the 2018 Strategic Plan, therefore historical and trending data are unavailable at this time. Below is a statistical breakdown, summarizing our FY 2018 performance.

- **Strategic Goal 1**
  84% On Target / 4% Off Target
- **Strategic Goal 2**
  75% On Target / 0% Off Target
- **Strategic Goal 3**
  93% On Target / 0% Off Target
- **Strategic Goal 4**
  76% On Target / 0% Off Target

STRATEGIC GOAL 1

DISCOVER
Expand Human Knowledge Through New Scientific Discoveries

NASA's James Webb Space Telescope (Webb) sits folded up in the cleanroom outside of Chamber A at NASA's Johnson Space Center in Houston, Texas. Webb will be undergoing cryogenic testing in this large thermal vacuum chamber. Photo Credit: Desiree Stover / NASA

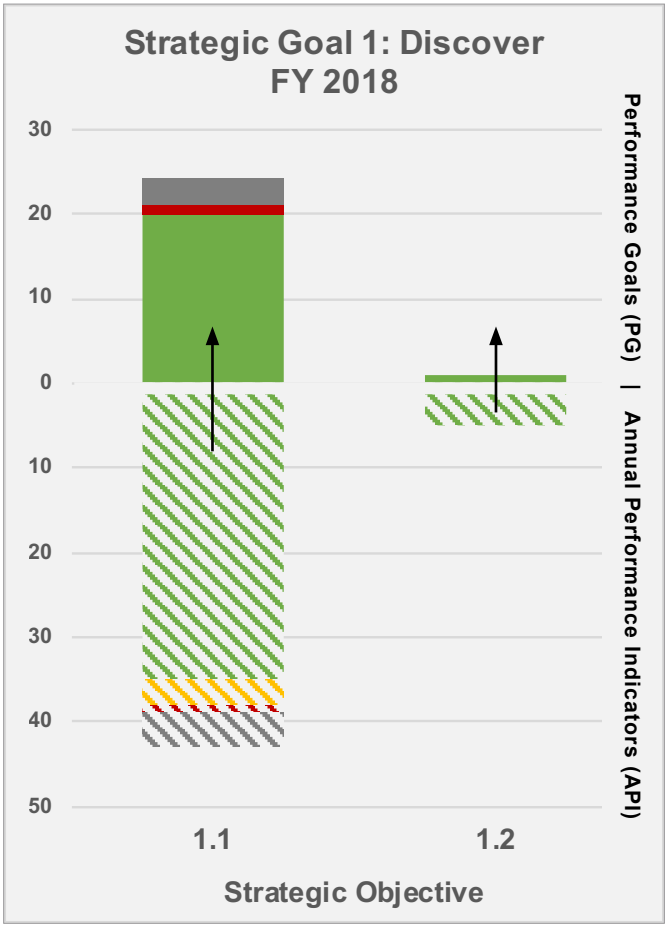
OVERVIEW

For 60 years, NASA's discoveries have been inspiring the world, rewriting textbooks, and transforming knowledge of humanity, the planet, the solar system, and the universe. Together, scientific discovery and human exploration improve and safeguard life on Earth.

Scientific research is also opening the pathway for exploration and robotic-human partnerships. NASA's Webb is poised to be the premier observatory of the next decade — unlocking the mysteries of the universe for humankind. The ISS is an orbital outpost for humanity. It is a blueprint for global cooperation and scientific advancement, a catalyst for growing new commercial marketplaces in space, and a test bed for demonstrating new technologies. It extends where humankind lives and is the springboard for NASA's next great leaps in human space exploration, including future missions to the Moon and beyond.

Finally, NASA acts as a champion of free and open access to scientific data. The Agency's work incorporates and builds upon the work of others in a spirit of global engagement and diplomacy.

STRATEGIC GOAL 1 | Performance Assessment



1.1 Understand the Sun, Earth, Solar System and Universe

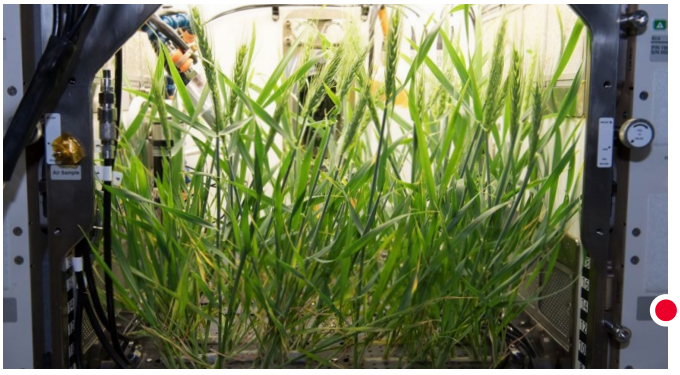
1.2 Understand Responses of Physical and Biological Systems to Spaceflight

Performance Highlight

In 2018, the ISS has seen a variety of new science on-board. The Cold Atom Laboratory, which arrived on the ISS in May, will achieve temperatures of -459.67 degrees Fahrenheit to enable the observation of unique quantum phenomena. The Advanced Plant Habitat tests the conditions that can affect plant growth in space, including microgravity and light intensity. The Advanced Combustion via Microgravity Experiments (ACME) research series, which will look into improving fuel efficiency and pollution reduction on Earth as well as fire safety in space, completed its first investigation in August 2018. The ISS Program met all of its goals for biological and physical research in FY 2018, earning green ratings for both the API and the PG. These ratings are represented in Strategic Objective 1.2. For more information on ACME, please go to: https://www.nasa.gov/mission_pages/station/research/experiments/1908.html.

Performance Challenge

The James Webb Space Telescope (Webb), NASA's next large astrophysics telescope, recently experienced a schedule delay resulting in an off target performance assessment (red) for it's API. An Independent Review Board found that the delay, which is due to a combination of human error and system complexities, would likely increase the cost of developing the telescope from $8 billion to approximately $8.8 billion. The estimated increase is subject to congressional approval before officially accepted. The schedule delay has pushed Webb's launch date to March 2021. As a result, the related PG has also been assessed as being off target (red), as noted in Strategic Objective 1.1.



ADVANCED PLANT HABITAT

Advanced Plant Habitat (APH), a recent addition to the ISS, is the largest growth chamber aboard the orbiting laboratory. Roughly the size of a mini-fridge, the habitat is designed to test which growth conditions plants prefer in space and provides specimens a larger root and shoot area. Its monitoring and environmental control systems regulate temperature, oxygen, and carbon dioxide levels, and the system settings can be adjusted for growing different types of plants. Photo Credit: NASA

STRATEGIC GOAL 2

EXPLORE

Extend Human Presence Deeper Into Space and to the Moon for Sustainable Long-term Exploration and Utilization

The Moon begins to rise behind the Atacama Rover Astrobiology Drilling Studies (ARADS) rover during the 2017 season of field tests in Chile's Atacama Desert. The Milky Way is visible in the night sky. The ARADS project is designing tools and techniques that could be used to search for life on Mars or other places in the Solar System. The team's prototype rover combines the ability to move across the surface, drill down to collect soil samples, and feed them to several life-detection instruments on board. The extreme conditions of Chile's Atacama Desert provide one of the most Mars-like environments on Earth, where the team can test and refine these technologies and methods. Photo Credit: CampoAlto / Victor Robles / NASA

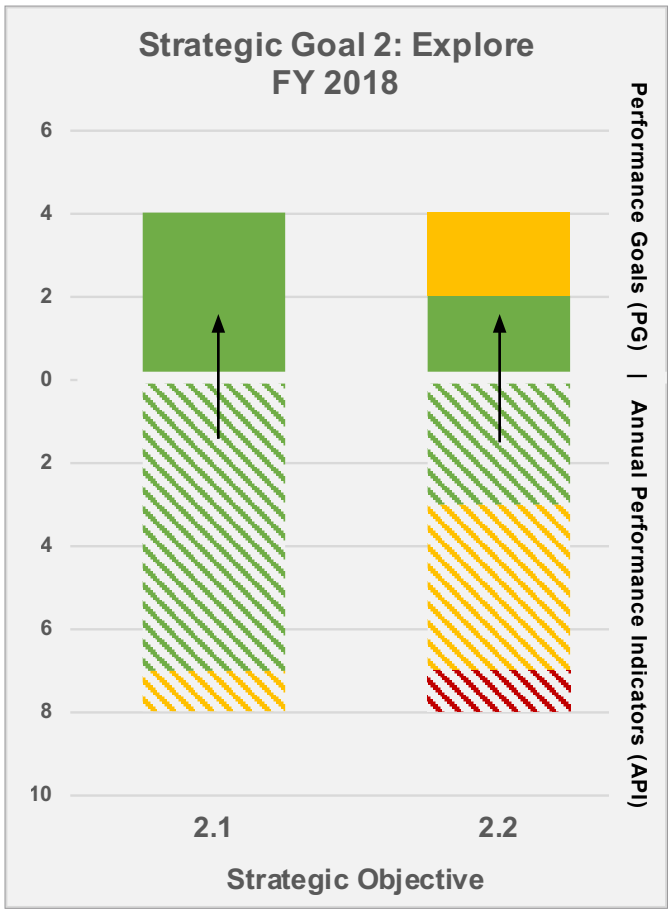
OVERVIEW

America is a Nation of explorers. In everything we do — science, technology, commerce, the arts, sports — we strive to reach higher, farther, deeper, or faster than ever before in order to create a better future for the generations to come.

NASA is also laying the foundation for America to sustain a constant commercial, human presence in low Earth orbit. From there, we will turn our attention back toward our celestial neighbors. At the same time, to support a broader strategy to explore and utilize the Moon and its surface, NASA is establishing a Lunar Orbital Platform-Gateway in cis-lunar space, to include a power and propulsion element by 2022, and habitation, airlock, and the required logistics capabilities soon after.

The United States will seek international partnership on a shared exploration agenda and spearhead the next phase of human space exploration. NASA will promote permanent human presence in space in a way that enables the 21st century space economy to thrive.

STRATEGIC GOAL 2 | Performance Assessment



2.1 Lay the foundation for America to Maintain a Constant Human Presence in Low Earth Orbit Enabled by a Commercial Market

2.2 Conduct Exploration in Deep Space, Including to the Surface of the Moon

Performance Highlight

The Exploration Ground Systems (EGS) program's Mobile Launcher rolled out to Launch Pad 39B at Kennedy Space Center (KSC) in late August for testing, spending a few days at the launch pad for testing before returning to the Vehicle Assembly building. This was a key milestone for the Mobile Launcher and after the successful completion, NASA gave the associated API a green rating, represented in Strategic Objective 2.2. The last time a mobile launcher traveled to a launch pad at KSC was in 2011. This time, the Mobile Launcher was being tested to support the future launch in 2020 of NASA's Space Launch System (SLS) on Exploration Mission (EM)-1.

Performance Challenge

The SLS core stage under development at the Michoud Assembly Facility (MAF) is facing a challenging schedule before the Exploration Mission (EM)-1 launch in 2020. The core stage, which is being built by the Boeing Company, is expected to be delivered to the Stennis Space Center (SSC) in mid-2019 and will spend six months there for testing. This is a small schedule change from the original plan, resulting in a below target performance assessment (yellow) for the SLS's API for FY 2018. After testing at SSC, the SLS core stage will go to KSC for six months of testing and integration with other SLS stages. The schedule challenges that the core stage faces are not surprising, given that this is the first production of the SLS. NASA does not expect this delay to affect the overall production schedule for SLS. However, we assessed the associated PG, for Strategic Objective 2.2, as below target due to additional schedule delays on the Orion project, which produces the crew capsule.

THE EXPLORATION GROUND SYSTEMS PROGRAM

The Exploration Ground Systems (EGS) program is one of three NASA programs based at NASA's Kennedy Space Center in Florida. EGS was established to develop and operate the systems and facilities necessary to process and launch rockets and spacecraft during assembly, transport and launch. EGS's mission is to transform the center from a historically government-only launch complex to a spaceport that can handle several different kinds of spacecraft and rockets — both government and commercial. Photo Credit: NASA

STRATEGIC GOAL 3

DEVELOP Address National Challenges and Catalyze Economic Growth

This updated future aircraft design concept from NASA research partner Lockheed Martin is a good example of how simulations and wind tunnel tests, conducted over time, generate data that tell researchers how to improve a design to achieve goals. The goals for a future supersonic aircraft are to produce a much lower-level sonic boom and to reduce emissions. The ultimate goal is to achieve a low enough boom that a current ruling prohibiting supersonic flight over land might be lifted. Photo Credit: Lockheed Martin / NASA

OVERVIEW

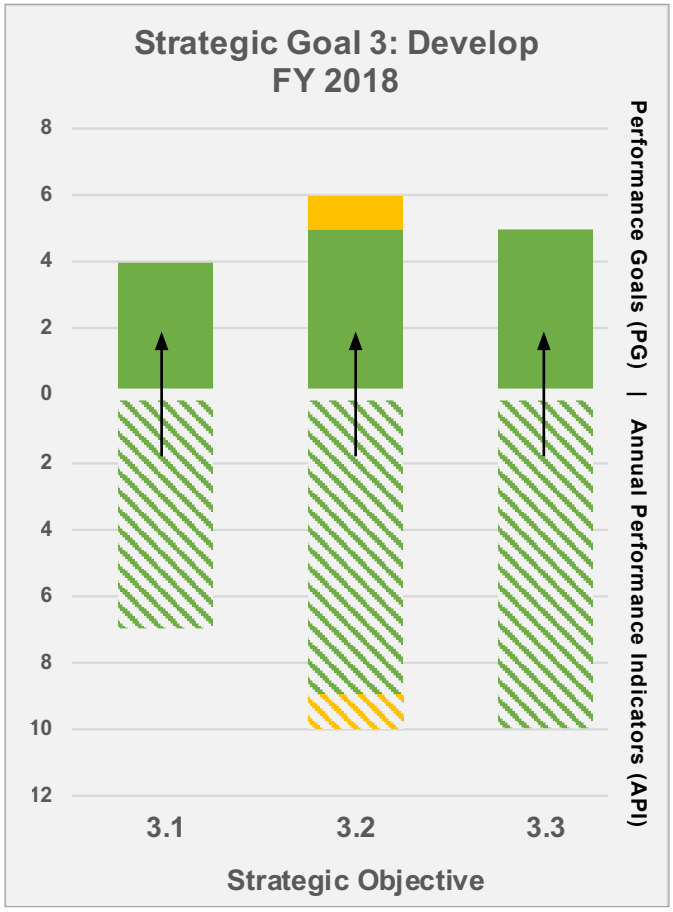
Originally tied to keeping the Nation secure and advancing U.S. leadership in aeronautics, communications satellites, and Earth remote sensing, NASA's mandate is broader today.

NASA drives economic development and growth; the National Aeronautics and Space Act of 1958 calls out this important theme, and the Agency generally invests more than 80 percent of its funds in U.S. industry and academia to carry out its missions of scientific discovery and exploration. In doing so, NASA engages and inspires young people to become scientists, technologists, engineers, and mathematicians.

This ensures that the Nation's vast intellectual and industrial base — shared by many other Government agencies, including the departments of Defense, Commerce, Transportation, and Interior — has a continuous supply of bright minds and skilled hands.

Today, NASA technology is found aboard every U.S. aircraft and inside every air traffic control facility in the country. This infusion can be attributed to one of the most productive public-private partnerships in U.S. history, as NASA continues to team with industry, academia, and other Government agencies.

STRATEGIC GOAL 3 | Performance Assessment



3.1 Develop and Transfer Revolutionary Technologies to Enable Exploration Capabilities for NASA and the Nation

3.2 Transform Aviation Through Revolutionary Technology Research Development, and Transfer

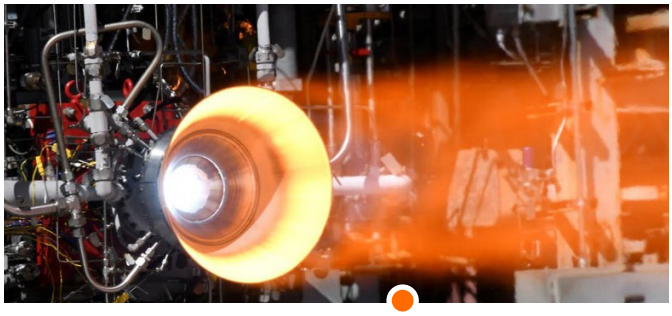
3.3 Inspire and Engage the Public in Aeronautics, Space and Science

Performance Highlight

NASA has continued advancements on promising technology solutions that could reduce the time and expense involved in building rocket engine parts. The Low Cost Upper Stage-Class Propulsion Development project is using Additive Manufacturing, also known as three dimensional (3-D) printing, to develop high-pressure, high-temperature combustion chambers and nozzles with copper and nickel alloys. In spring 2018, MSFC conducted a hot-fire test on a combustion chamber made using a combination of 3-D printing techniques. The successful test earned a green rating for both the API and the PG. These ratings are represented in Strategic Objective 3.1.

Performance Challenge

NASA conducted two series of ground vibration tests on a test article for the Passive Aeroelastic Tailored (PAT) wing. The experimental PAT wing has a unique design that could maximize structural efficiency, reduce aircraft weight, and increase fuel efficiency. Static load testing, which was originally planned for FY 2018, has been delayed to early FY 2019 due to early fabrication issues and delivery delays. As a result and indicated in the graph for Strategic Objective 3.2, NASA assessed both the API and related PG as being behind target (yellow). However, this schedule delay has little impact on the overall plan; no additional actions are planned at this time.



LOW COST UPPER STAGE-CLASS PROPULSION

NASA is making space exploration more affordable and viable by developing and utilizing innovative manufacturing technologies. Technology development efforts in propulsion at NASA are committed to continuous innovation of design and manufacturing technologies for rocket engines in order to reduce the cost of NASA's journey to Mars. The Low Cost Upper Stage-Class Propulsion (LCUSP) effort will develop and utilize emerging Additive Manufacturing (AM) to significantly reduce the development time and cost for complex rocket propulsion hardware. Photo Credit: NASA

STRATEGIC GOAL 4

ENABLE Optimize Capabilities and Operations

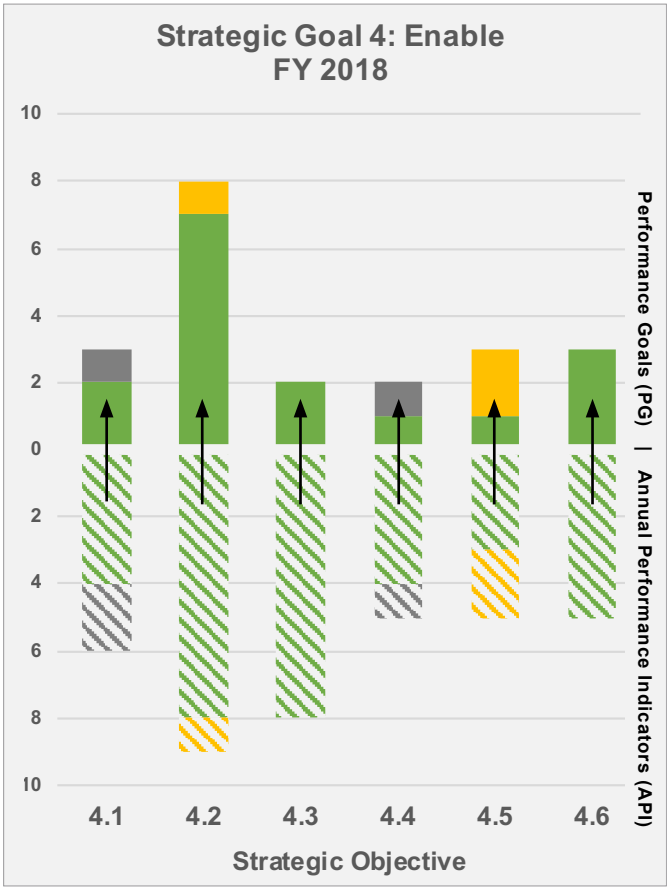
The Orion crew module pressure vessel for Exploration Mission-2 (EM-2) is in a work stand called the birdcage inside the Neil Armstrong Operations and Checkout Building high bay at NASA's KSC in Florida, on September 11, 2018. The pressure vessel was transported in its Crew Module Transportation Fixture by super-wide transport truck from Michoud Assembly Facility near New Orleans. The pressure vessel is Orion's primary structure that holds the pressurized atmosphere astronauts will breathe and work in while in the vacuum of deep space. Photo Credit: Frank Michaux / NASA

OVERVIEW

The Agency understands that a skilled, valued, and diverse workforce is central to creating and maintaining the capabilities to explore the solar system and beyond and for understanding our home planet. NASA will continue to maintain and ensure the availability and safety of critical capabilities and facilities necessary for advancing our space-, air-, and Earth-based activities. This hybrid goal includes both strategic objectives and management focused objectives.

Recognizing the growth of technologies and innovations increasing outside the Agency, NASA is instituting a robust partnership and acquisition strategy focused on leveraging and collaborating with the private sector and academia in order to benefit from their innovations. NASA's role in global engagement extends directly from the Space Act in areas such as data-sharing agreements and joint science and technology flight projects. More than two-thirds of NASA's science missions have foreign partners.

STRATEGIC GOAL 4 | Performance Assessment



4.1 Engage in Partnership Strategies

4.2 Enable Space Access and Services

4.3 Assure Safety and Mission Success

4.4 Manage Human Capital

4.5 Ensure Enterprise Protection

4.6 Sustain Infrastructure Capabilities and Operations

Performance Highlights

Between 2014 and 2018, NASA increased the percentage of individuals with disabilities in its workforce by 14.7 percent. NASA also increased representation in its senior-level positions, increasing the percentage of women in those positions by 4.6 percent, African Americans by 8.6 percent, Asian Americans and Pacific Islanders by 3.6 percent, and Hispanics by 18.5 percent. NASA's scores on the Office of Personnel Management's (OPM) Inclusion Index of the Federal Employee Viewpoint Survey (FEVS) rose from 77.6 percent in the 2017 FEVS results to 78.2 percent in the 2018 results. NASA's continued improvements in building a diverse workforce resulted in green ratings for both the API and the PG. These ratings are represented in Strategic Objective 3.3.

Performance Challenge

NASA achieved an overall rating of "Managing Risk" as of reporting for the third quarter of FY 2018 in the Office of Management and Budget's (OMB) Cybersecurity Risk Management Assessment. This rating indicates that the Agency has established cybersecurity policies, procedures, and tools and actively manages risks. While NASA achieved this rating overall, some underlying capabilities are not yet operating at this level. As a result, NASA assessed the API and related PG as being below target (yellow) as shown in the graph for Strategic Objective 4.5. NASA plans to have each of its cybersecurity domains rated as "Managing Risk" by the end of FY 2020, in alignment with OMB targets.

NASA'S WORKFORCE

Jessica Watkins and Loral O'Hara used to be interns at NASA's Jet Propulsion Laboratory (JPL); now they're astronauts. The two former interns joined the agency's newest class of astronaut candidates in 2017, and were among 12 selected for the coveted spots. Photo Credit: David DeHoyo / NASA

ICESat-2

The Ice, Cloud and land Elevation Satellite-2 (ICESat-2) will measure the height of a changing Earth, one laser pulse at a time, 10,000 laser pulses a second. Slated for launch in 2018, ICESat-2 will carry a photon-counting laser altimeter that will allow scientists to measure the elevation of ice sheets, glaciers, sea ice and more - all in unprecedented detail.

Our planet's frozen and icy areas, called the cryosphere, are a key focus of NASA's Earth science research. ICESat-2 will help scientists investigate why, and how much, our cryosphere is changing in a warming climate. The satellite will also measure heights across Earth's temperate and tropical regions, and take stock of the vegetation in forests worldwide.

Artist's impression of ICESat-2 in orbit above Earth. Image Credit: NASA

Technicians and engineers clean and take samples from the payload fairing that will protect NASA's Ice, Cloud and land Elevation Satellite-2, or ICESat-2. Photo Credit: Randy Beaudoin / NASA

FINANCIAL PERFORMANCE

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NASA Administrator Jim Bridenstine (second from left) tours the Orion test crew capsule for the Ascent Abort-2 (AA-2) test, with Orion AA-2 Crew Module Manager Dr. Jon Olansen, left, NASA JSC Director Mark Geyer and Orion Program Manager Mark Kirasich, right, on Thursday, August 2, 2018 at NASA's JSC in Houston, Texas. Photo Credit: NASA/Bill Ingalls

FINANCIAL PERFORMANCE

Financial Highlights

Overview of Financial Position

NASA's Balance Sheet provides a comparable snapshot of the Agency's financial position as of September 30, 2018 and September 30, 2017. It displays amounts in three primary categories.

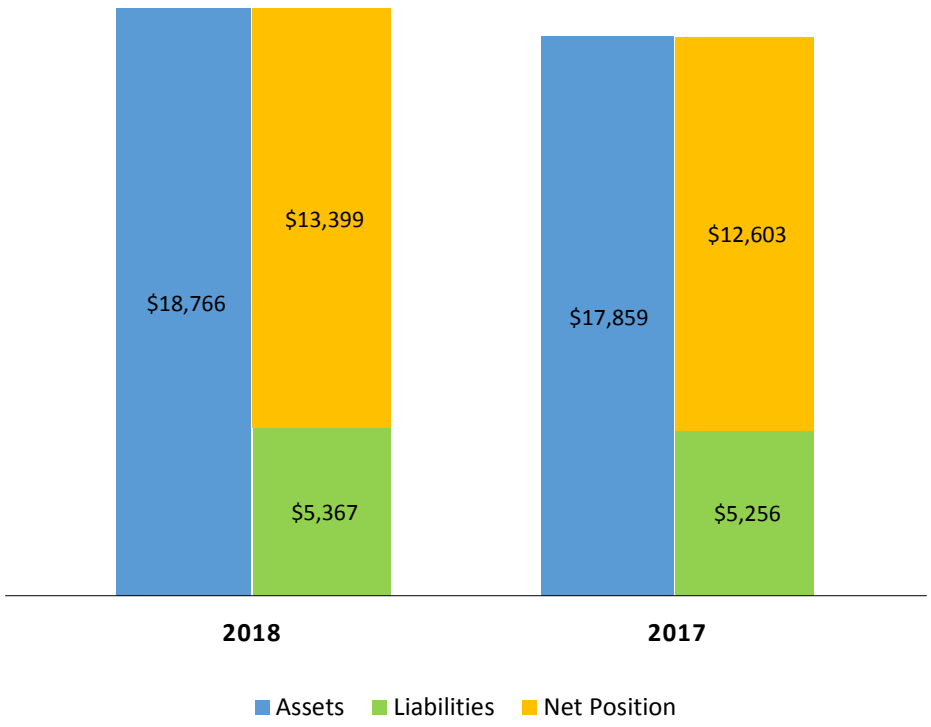
+ ASSETS: the current and future economic benefits owned or available for use by NASA.

– LIABILITIES: the debts owed by NASA but not yet paid.

NET POSITION: the activity between revenue and other financing sources, and costs incurred since inception.

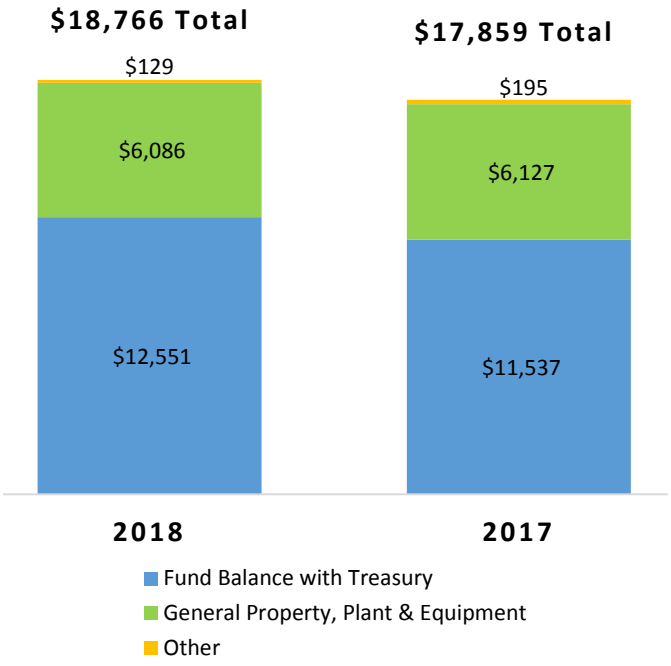
Balance Sheet Components FY 2018 and FY 2017

(in Millions of Dollars)

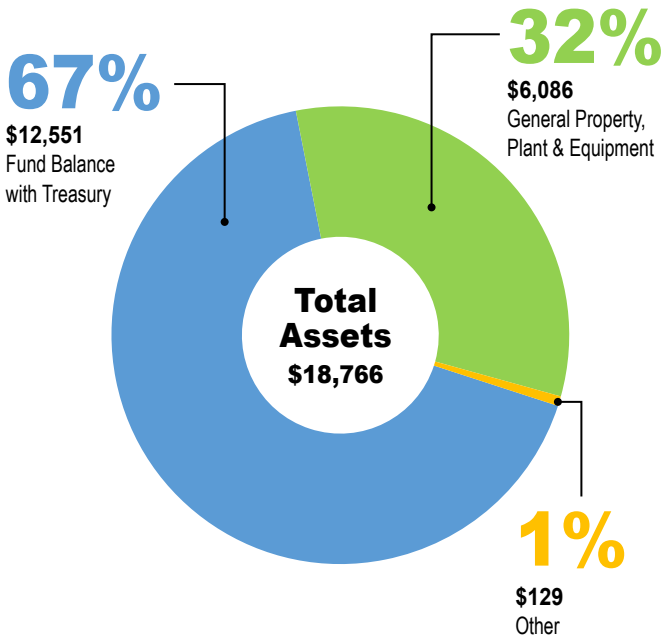


Total Assets were the largest of the three categories (Total Liabilities plus Total Net Position will always equal Total Assets). NASA's asset balance, as of September 30, 2018, was $18.8 billion, five percent higher than FY 2017.

Assets by Type Comparison
FY 2018 and FY 2017 (in Millions of Dollars)



Assets by Type for FY 2018
(in Millions of Dollars)



The Agency's Fund Balance with Treasury (FBWT) and its General Property, Plant and Equipment (G-PP&E) were the two primary components of the total asset balance.

FBWT, which represents NASA's cash balance with the U.S. Department of the Treasury, was the largest asset at $12.6 billion, 67 percent of total assets. This cash balance included Congressional appropriated funds available for NASA's mission work (for example, employee labor or purchased goods or services from contractors) that have not yet been paid.

NASA's G-PP&E had a net book value of $6.1 billion as of September 30, 2018, 32 percent of total assets. The balance has decreased slightly since FY 2017, primarily due to ongoing depreciation of existing assets.

The Other category represents the amount of Investments, Accounts Receivable, and Other Assets as of September 30, 2018. The decrease of $66 million, or 34 percent, is primarily due to collection of accounts receivable and a reduction in reimbursable activity for the Geostationary Operational Environmental Satellite (GOES).

Total Liabilities, as of September 30, 2018, were $5.4 billion, two percent higher than FY 2017. Environmental and Disposal Liabilities, Accounts Payable, and Other Accrued Liabilities represent the majority of NASA's liabilities.

Environmental and Disposal Liabilities of $1.7 billion represent the estimated cost to clean up both known and projected environmental hazards. The estimated liability has remained consistent compared to FY 2017.

Accounts Payable, which represents amounts owed to other entities, was $1.4 billion, a decrease of $1 million compared to FY 2017.

Other Accrued Liabilities with public entities were $1.6 billion, an increase of $106 million, or seven percent, compared to FY 2017. The change is primarily due to an increase in activity for the Europa Clipper mission, leading up to its planned launch in the 2020s.

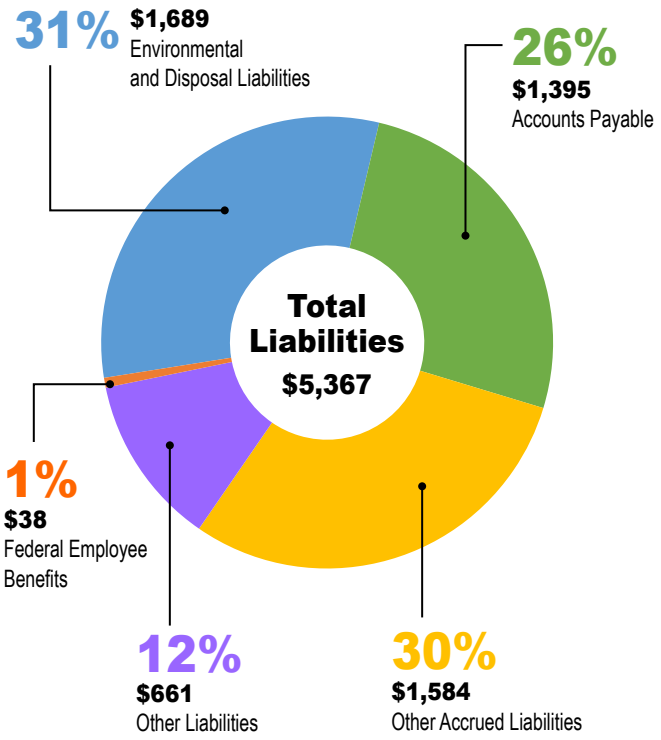
Other Liabilities, which represents various amounts including Advances from Others, Unfunded Annual Leave, and Accrued Funded Payroll, were $661 million, an increase of $8 million, or one percent, compared to FY 2017.

Federal Employee Benefits are amounts the Department of Labor estimates on behalf of NASA for future workers' compensation liabilities for current employees.

Total Net Position comprised of Unexpended Appropriations and Cumulative Results of Operations ("net worth"), increased by $796 million, six percent higher than FY 2017. Unexpended Appropriations, at $9.3 billion, increased by 10 percent from FY 2017. Cumulative Results of Operations, at $4.1 billion, decreased by one percent from FY 2017. The change to Net Position is due to the increase in budget authority received without a correlating increase in disbursements.

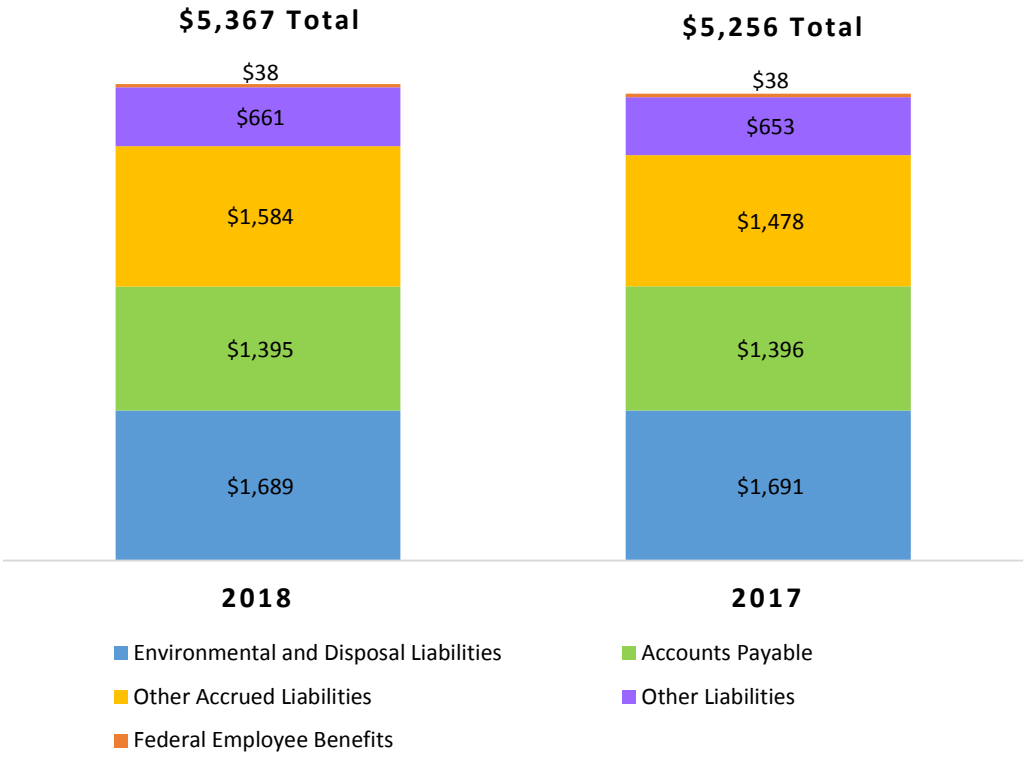
Liabilities by Type for FY 2018

(in Millions of Dollars)



Liabilities by Type Comparison FY 2018 and FY 2017

(in Millions of Dollars)



Sources of Funding

The Statement of Budgetary Resources provides information on the budgetary funding available to NASA. NASA's resources consist primarily of funds received from two sources:

- Appropriations from Congress for the current fiscal year and unobligated balances from prior fiscal years.
- Revenue from agreements with other governmental organizations or private entities.

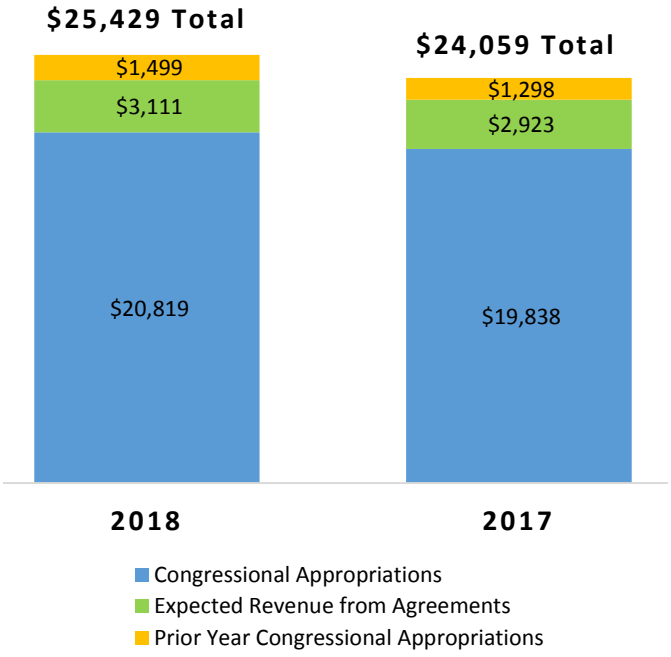
In FY 2018, the total funds available for use by the Agency were $25.4 billion - an increase of $1.3 billion, or 5 percent, compared to FY 2017. The change is primarily due to the $1 billion increase in Congressional Appropriations received in FY 2018, compared to FY 2017, for:

- **the continued design and technology development of the Europa Clipper;**
- **the build of the second Mobile Launch Platform; and,**
- **Construction and Environmental Compliance and Repair.**

The $20.8 billion in appropriations from Congress for FY 2018 accounted for 82 percent of the total funds available for use by the Agency. Congress designates the funding available to the Agency for a specific NASA mission. Appropriations that remained available from prior years totaled $1.5 billion, six percent of NASA's available resources in FY 2018.

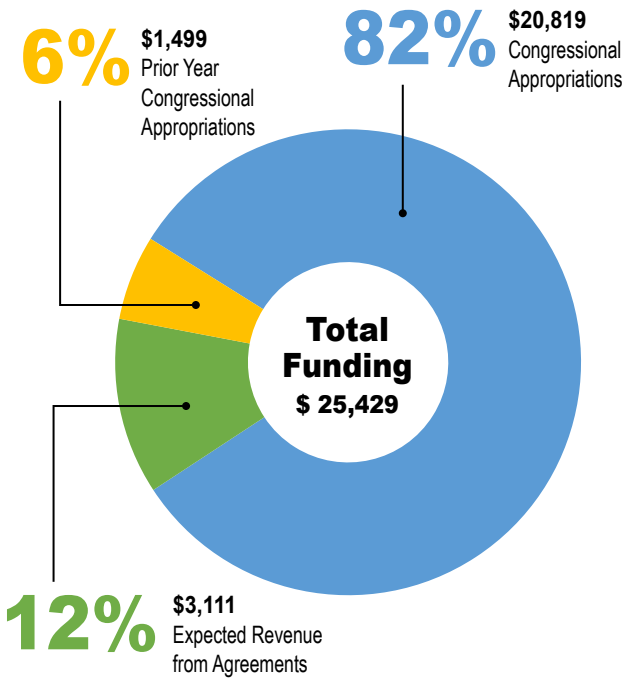
NASA's FY 2018 funding also included $3.1 billion comprised of revenue expected from agreements, 12 percent of NASA's available resources in FY 2018. Earned and expected revenue is received under NASA's authority to provide goods, services, or use of facilities to other entities on a reimbursable basis. In FY 2018, NASA obligated $23.4 billion for programmatic and institutional use of the $25.4 billion available. An obligation binds the Government to make an expenditure (or outlay) of funds, and reflects a reservation of budget authority that will be used to pay for a contract, labor, or other items. The remaining $2 billion may be obligated until the funds are no longer available for NASA missions.

Sources of Funding Comparison FY 2018 and FY 2017 (in Millions of Dollars)



Sources of Funding for FY 2018

(in Millions of Dollars)



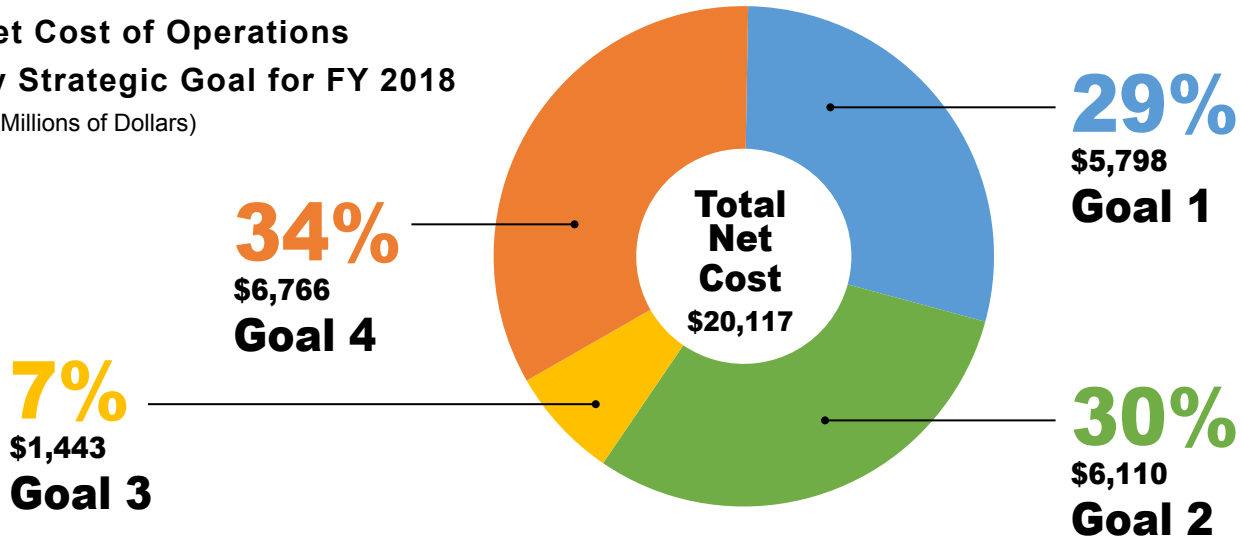
NASA Administrator Jim Bridenstine speaks with NASA and Canadian Space Agency astronaut candidates following a live episode of the Administrator's monthly chat show, *Watch This Space*, in the Webb Auditorium at NASA Headquarters in Washington, D.C. NASA's newest astronaut candidate class has started their two years of training, after which the new astronaut candidates could be assigned to missions performing research on the ISS, launching from American soil on spacecraft built by commercial companies, and launching on deep space missions on NASA's new Orion spacecraft and SLS rocket. Photo Credit: NASA/Joel Kowsky

RESULTS OF OPERATIONS

Net Cost of Operations

The Statement of Net Cost presents NASA's net cost of operations by strategic goal. NASA's strategic goals are described in the Mission Performance section of the Agency Financial Report (page 13). The Net Cost of Operations represents gross cost incurred less revenue earned for work performed for other government organizations or private entities. As of September 30, 2018, NASA's gross costs were $22.3 billion, an increase of $605 million from FY 2017. Earned Revenue from other governmental organizations or private entities was $2.2 billion, a decrease of $101 million from FY 2017, leaving NASA with a FY 2018 net cost of $20.1 billion, an increase of $706 million from FY 2017.

Net Cost of Operations by Strategic Goal for FY 2018
(in Millions of Dollars)



- Strategic Goal 1: Expand human knowledge through new scientific discoveries.
- Strategic Goal 2: Extend human presence deeper into space and to the moon for sustainable long-term exploration and utilization.
- Strategic Goal 3: Address national challenges and catalyze economic growth.
- Strategic Goal 4: Optimize capabilities and operations.

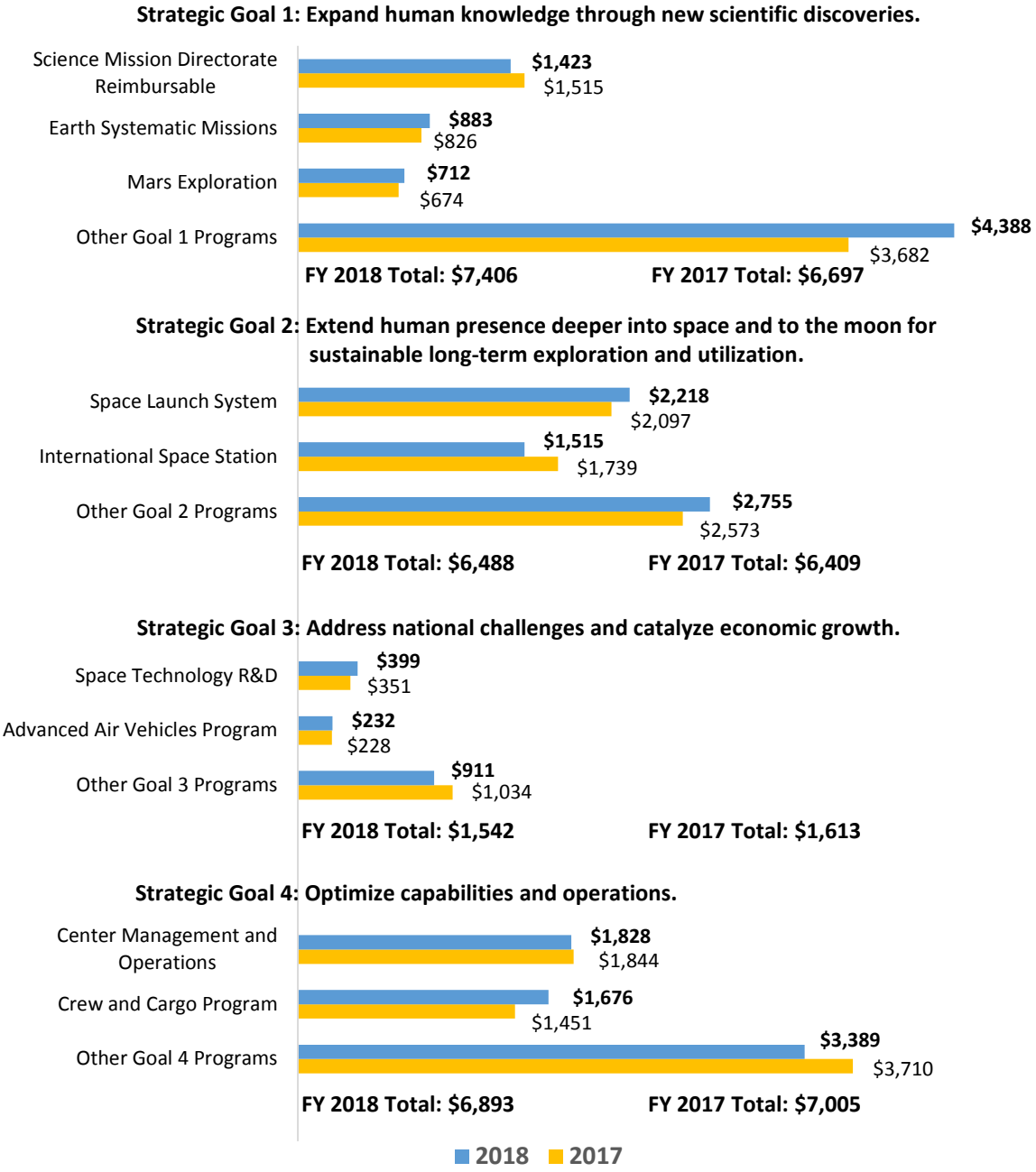
Gross Costs of Operations

NASA's day-to-day operations are performed at NASA and contractor facilities around the globe and in space. Gross costs of operations is presented in the following table, detailing select NASA programs that support each strategic goal. Gross costs of operations include expenses incurred for NASA's research and development (R&D) investments that are expected to maintain or increase national economic productive capacity or yield other future benefits. Refer to the Required Supplementary Stewardship Information section (page 70) of this report for further discussion. A discussion of activities and costs that were reimbursed primarily by other government organizations or private entities (for example, earned revenue) is also provided (pages 36-38).

Comparative Gross Costs of Operations by Strategic Goal FY 2018 and FY 2017

(in Millions of Dollars)

FY 2018 Total: $22,329 **FY 2017 Total: $21,724**



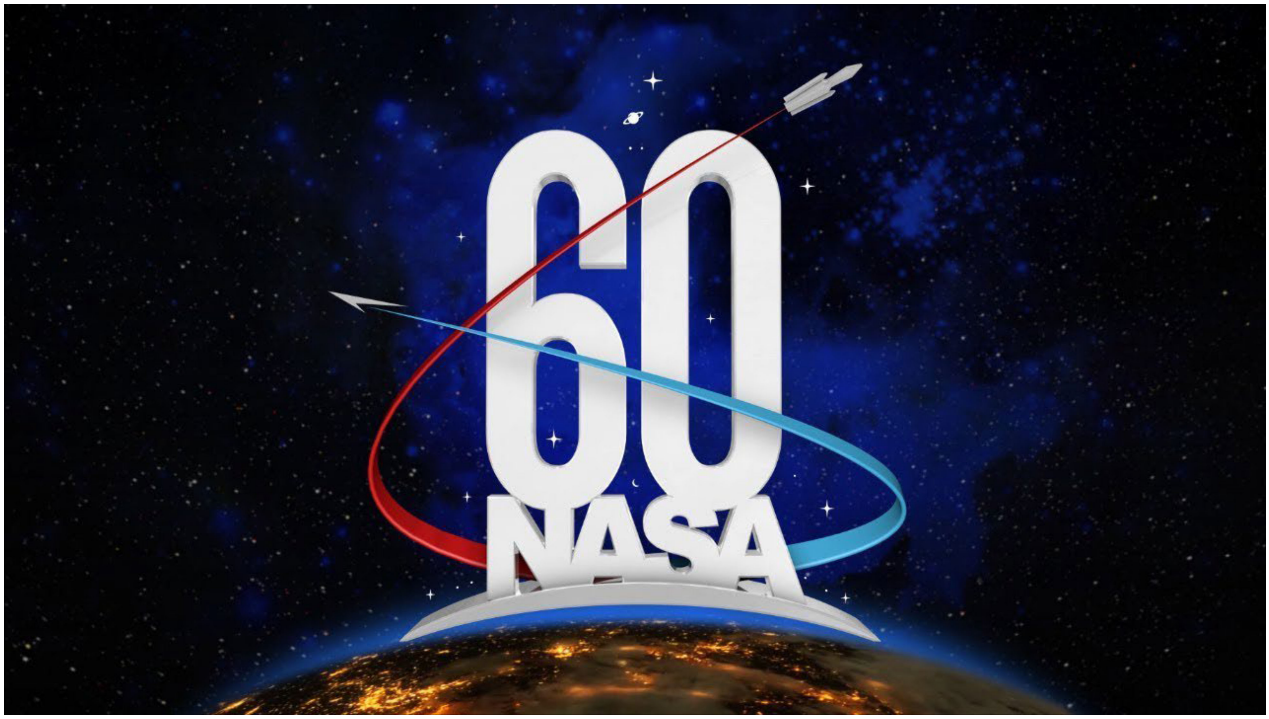
Strategic Goal 1: Expand human knowledge through new scientific discoveries.

Gross Costs for Strategic Goal 1 were $7.4 billion, an increase of $709 million, or 11 percent from FY 2017 costs. The costs for this strategic goal represent 33 percent of total Agency gross cost. The three primary programs that support this goal were Science Mission Directorate Reimbursable, Earth Systematic Missions, and Mars Exploration, which contributed to nearly half of the cost of Strategic Goal 1. The primary reimbursable activities are described in the earned revenue discussion on page 38.

- The Science Mission Directorate reimbursable account incurred costs of $1.4 billion, $92 million less compared to FY 2017, due to reduced reimbursable task activities in two Special Reimbursable Projects: Joint Polar Satellite System (JPSS) and Geostationary Operational Environmental Satellite-R Series (GOES-R).

- The Earth Systematic Missions program incurred costs of $883 million, $57 million higher compared to FY 2017. Costing fluctuations are to be expected in large programs developing multiple spacecraft. Within the past year, the NASA-Indian Space Research Organisation Synthetic Aperture Radar (NISAR), Sentinel-6, and ICESat-2 ramped up costs as the projects continued in development. ICESat-2 launched on September 15, 2018, near the end of the fiscal year. Once a spacecraft launches and enters its operational phase, costs typically decline to a steady-state level.

NASA: 60 Years in 60 Seconds



PLAY VIDEO

Congress passed the National Aeronautics and Space Act, on July 16, 1958, and President Eisenhower signed it into law on July 29. NASA opened for business on October 1, 1958, with T. Keith Glennan as our first administrator. Our history tells a story of exploration, innovation, and discoveries. The next 60 years, that story continues.

Learn more: https://www.nasa.gov/60

- Mars Exploration continues to make progress towards landing another rover on the surface of Mars. Mars Exploration incurred costs of $712 million, $38 million higher compared to FY 2017. The Mars 2020 project ramped up in cost by nearly $69 million from FY 2017 as assembly continues in preparation for launch in the year 2020. At the same time, the current fleet of Mars rovers and orbiters continues to provide valuable science data despite a decline in costs of approximately $30 million.

- Other NASA programs that contribute to Strategic Goal 1 include Outer Planets, Earth Science Research, and the James Webb Space Telescope.

Strategic Goal 2: Extend human presence deeper into space and to the moon for sustainable long-term exploration and utilization.

Gross Costs for Strategic Goal 2 were $6.5 billion, an increase of $79 million, or one percent over FY 2017 costs. The costs for this strategic goal represent 29 percent of total Agency gross cost. Over half of the costs incurred for Strategic Goal 2 are in support of the Space Launch System (SLS) and International Space Station (ISS) programs.

- The SLS program had costs of $2.2 billion, $121 million higher compared to FY 2017. These costs are mainly associated with the complex delivery and integration of the SLS core stage, Launch Vehicle Stage Adapter, Orion Stage Adapter, avionics and flight software, and motor segments. These elements included both flight articles as well as structural test articles. Additionally, funds were expended for Exploration Upper Stage development that was initiated in FY 2016, and continued into FY 2017 and FY 2018 as enacted by Congress.

- The ISS program had cost of $1.5 billion, $224 million lower compared to FY 2017. The lower cost is mainly associated with expensing assets that were determined to be non-capital assets in FY 2017.

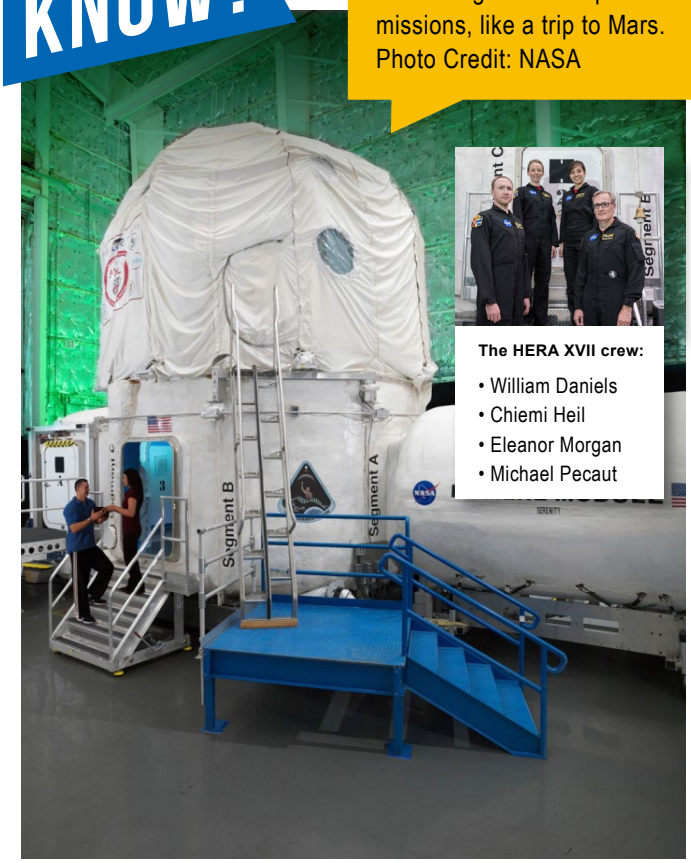
- Other NASA programs that contribute to Strategic Goal 2 include Exploration Ground Systems, Advanced Exploration Systems and the Human Research Program.

Strategic Goal 3: Address national challenges and catalyze economic growth.

Gross Costs for Strategic Goal 3 were $1.5 billion, a decrease of $71 million, or four percent from FY 2017 costs. The costs for this strategic goal represent seven percent of total Agency gross cost. The largest

Exploring an Asteroid Without Leaving Earth

On June 18, 2018, four crew members completed 45 days living in the Human Research Exploration Analog (HERA) at JSC to learn how isolation and close quarters affect individual and group behavior during a simulated journey to an asteroid. This study prepares us for long duration space missions, like a trip to Mars. Photo Credit: NASA



The HERA XVII crew:

- William Daniels
- Chiemi Heil
- Eleanor Morgan
- Michael Pecaut

NASA programs supporting Strategic Goal 3 were Space Technology Research & Development and the Advanced Air Vehicles programs, which contributed to nearly half of the cost of Strategic Goal 3.

- The Space Technology Research & Development program incurred costs of $399 million, $48 million higher compared to FY 2017. Beginning in FY 2016, projects were moved from Exploration Technology Development into the Space Technology Research and Development (STR&D; formerly Crosscutting Space Technology Development). Funds not obligated prior to this merger were obligated and costed within the newly merged account. There is a corresponding reduction in costs within the Exploration Technology Development account when comparing FY 2017 to FY 2018 that correlates with the increase within STR&D from FY 2017 to FY 2018 as projects continue to utilize their prior year funds. In addition, the Space Technology account received $73.5 million in additional appropriations in FY 2018 which was largely applied toward congressionally directed items within STR&D.

- The Advanced Air Vehicles program had costs of $232 million, $4 million higher compared to FY 2017. The change in the costs is insignificant and represents a constant level of activity year-over-year.

- Other NASA programs that contribute to Strategic Goal 3 include Integrated Aviation Systems, Airspace Operations and Safety, and Transformative Aeronautics Concepts programs.

Strategic Goal 4: Optimize capabilities and operations.

Gross Costs for Strategic Goal 4 were $6.9 billion, a decrease of $112 million, or two percent from FY 2017 costs. The costs for this strategic goal represent 31 percent of total Agency gross cost. The largest NASA programs supporting Strategic Goal 4 were Center Management and Operations, and Crew and Cargo Program, which contributed to nearly half of the cost of Strategic Goal 3.

- The Crew & Cargo Program had costs of $1.7 billion, $225 million higher compared to FY 2017. These costs are primarily due to development efforts with commercial crew providers ramping up in preparation for their first Post Certification Missions planned for FY 2019. Additionally, development efforts also continue to ramp up with the new Commercial Resupply Services Phase 2 (CRS2) contractor, Sierra Nevada, in preparation for their first flight planned for FY 2020.

Earned Revenue

Total earned revenue, which represents work performed by NASA for other government organizations or private entities, was $2.2 billion through the fourth quarter of FY 2018, a decrease of $101 million from FY 2017. Two programs accounted for over half of NASA's earned revenue in FY 2018: Joint Polar Satellite System (JPSS) and Geostationary Operational Environmental Satellites (GOES). NASA supports both programs in partnership with the National Oceanic and Atmospheric Administration (NOAA). JPSS-1 launched in November of 2017 and JPSS-2 has a launch readiness date of 2022. The most recent launch in the GOES series was GOES 17 (formerly GOES-S) on March 1, 2018.

LIMITATIONS OF THE FINANCIAL STATEMENTS

The principal financial statements have been prepared to report the financial position and results of operations of NASA, pursuant to the requirements of 31 U.S.C. 3515(b). While the statements have been prepared from the books and records of NASA in accordance with GAAP for Federal entities and the formats prescribed by OMB, the statements are in addition to the financial reports used to monitor and control budgetary resources, which are prepared from the same books and records. The statements should be read with the realization that they are for a component of the U.S. Government, a sovereign entity.

SYSTEMS, CONTROLS, AND LEGAL COMPLIANCE

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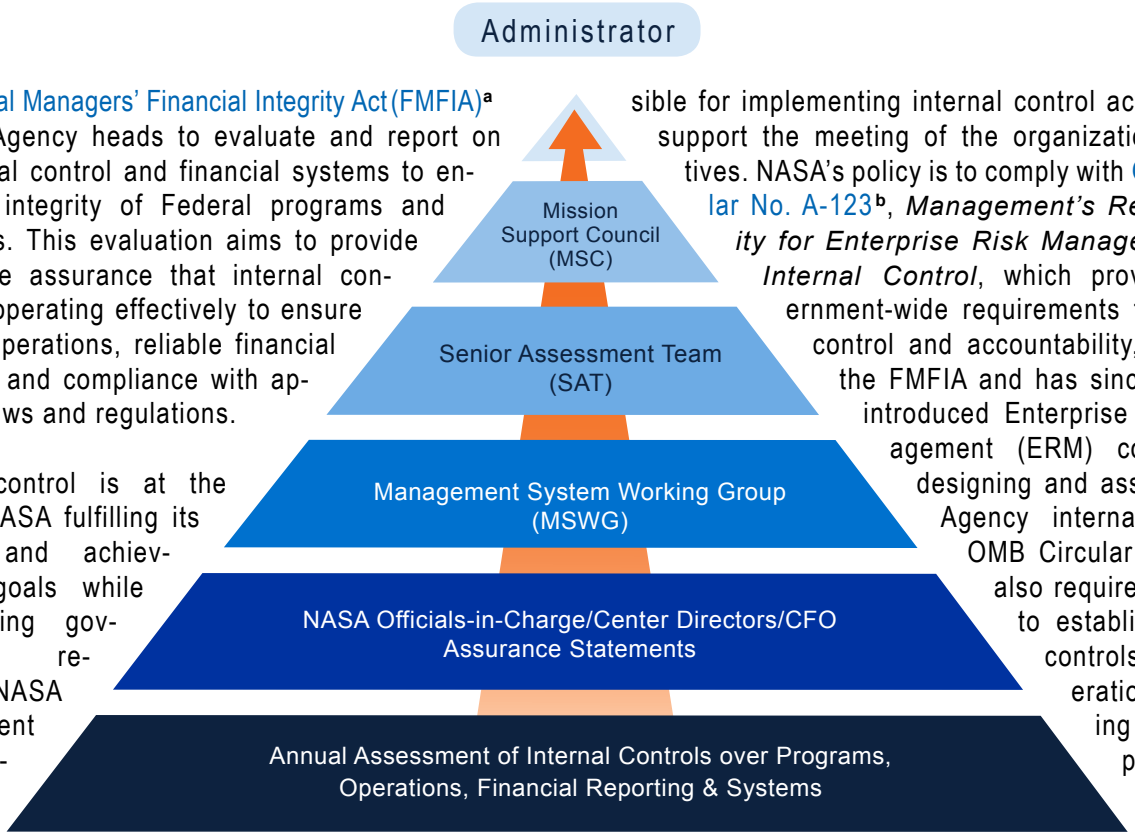
NASA, Boeing and United Launch Alliance personnel discuss procedures for an upcoming water deluge test on the Crew Access Tower at Space Launch Complex 41 on Cape Canaveral Air Force Station in Florida. The test gathered data on how launch site and astronaut crews would exit in the event of an emergency from the white room at the end of the crew access arm to the emergency escape system on the pad. Boeing's Starliner will launch on a United Launch Alliance Atlas V rocket to the ISS as part of NASA's Commercial Crew Program. Photo credit: NASA/Kim Shiflett

INTERNAL CONTROL FRAMEWORK



The Federal Managers' Financial Integrity Act (FMFIA)[a] requires Agency heads to evaluate and report on the internal control and financial systems to ensure the integrity of Federal programs and operations. This evaluation aims to provide reasonable assurance that internal controls are operating effectively to ensure efficient operations, reliable financial reporting, and compliance with applicable laws and regulations.

Internal control is at the core of NASA fulfilling its mission and achieving its goals while safeguarding governmental resources. NASA management is responsible for implementing internal control activities that support the meeting of the organization's objectives. NASA's policy is to comply with OMB Circular No. A-123[b], *Management's Responsibility for Enterprise Risk Management and Internal Control*, which provides Government-wide requirements for internal control and accountability, based on the FMFIA and has since FY 2015 introduced Enterprise Risk Management (ERM) concepts in designing and assessing the Agency internal controls. OMB Circular No. A-123 also requires agencies to establish internal controls over operations, reporting and compliance.

NASA FMFIA ANNUAL STATEMENT OF ASSURANCE PROCESS

NASA evaluates internal control across the Agency at various levels of the organization to ensure significant risks are identified, and related internal controls that address those risks are tested and evaluated. NASA evaluates the effectiveness of the internal controls over operations, management systems, and reporting with consideration of reviews and other relevant sources of information. NASA's executive leadership provides annual certifications reporting on the effectiveness of internal controls that are implemented to meet objectives. In addition, the NASA Office of the Chief Financial Officer (OCFO) deploys an extensive annual testing and assessment methodology that evaluates internal controls over financial reporting. NASA considers ERM activities, reviews the Agency risk profile and considers fraud risk along with providing assurance on internal controls.

The FMFIA assurance statement is primarily based on self-certifications submitted by NASA Officials-in-Charge. These certifications are based upon organizational self-assessments guided by the Government Accountability Office's (GAO) *Standards for Internal Control in the Federal Government* (known as the Green Book[c]). The self-assessments are informed by various sources of information such as internal reviews of controls, as well as recommendations for improvements from external audits, investigations, and reviews conducted by the Office of Inspector General (OIG) and the GAO. The Mission Support Council (MSC), the organization responsible for oversight of NASA's Internal Control Program, advises the Administrator on the Statement of Assurance. The Senior Assessment Team (SAT), which is an arm of the MSC, helps guide the internal control evaluation and reporting process.

The Management System Working Group (MSWG) performs the first level evaluation of annual results and serves as the primary advisory body for NASA internal control activities. The MSWG analyzes the annual assessment results and reports issues that may significantly impact the effective design and operation of internal controls to the SAT. The graphic above depicts the Agency's Annual Statement of Assurance process and organizational players.

LINKS (page 40)

[a] The Federal Managers' Financial Integrity Act (FMFIA)
https://obamawhitehouse.archives.gov/omb/financial_fmfia1982

[b] OMB Circular No. A-123, *Management's Responsibility for Enterprise Risk Management and Internal Control*
https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2016/m-16-17.pdf

[c] Green Book
https://www.gao.gov/assets/670/665712.pdf

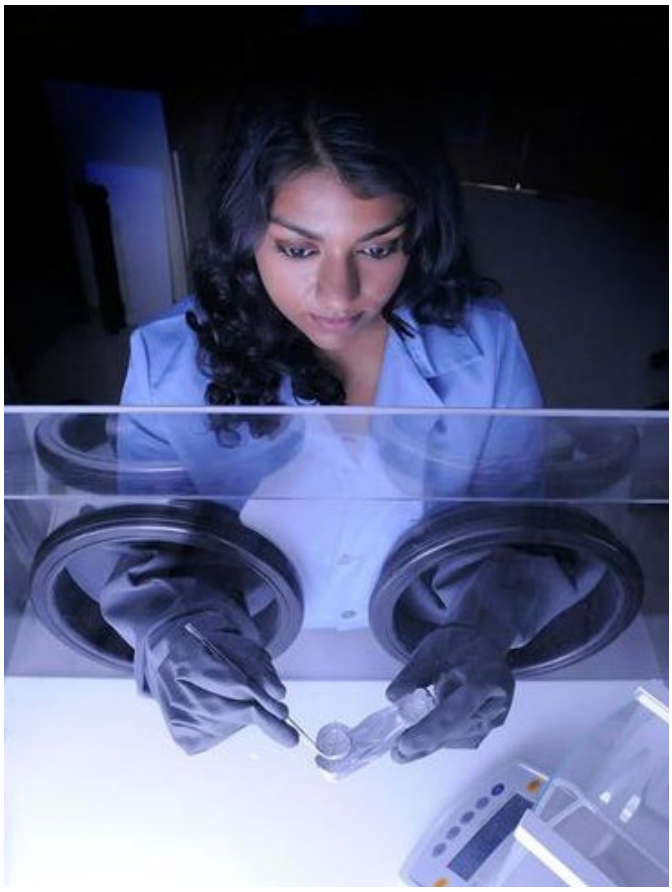
AH, THAT NEW CAR SMELL

NASA Technology Protects Spacecraft from Outgassed Molecular Contaminants

For some people, the best part about buying a new car is its factory-fresh new car smell, a distinctive aroma created when the chemicals and residual solvents used to manufacture dashboards, car seats, carpeting and other vehicle appointments outgas and fill the cabin. While the scent may be alluring to some, many researchers believe exposure to these gases isn't particularly healthy — so unhealthy, in fact, that some recommend that drivers keep their new cars ventilated while driving.

Outgassed solvents, epoxies, lubricants, and other materials aren't especially wholesome for contamination-sensitive telescope mirrors, thermal-control units, high-voltage electronic boxes, cryogenic instruments, detectors and solar arrays, either. As a result, NASA engineers are always looking for new techniques to prevent these gases from adhering to instrument and spacecraft surfaces and potentially shortening their lives.

A group of technologists has created a low-cost, easy-to-apply solution, which is more effective than current techniques. Made of zeolite, a mineral widely used in industry for water purification and other uses, and a colloidal silica binder that acts as the glue holding the coating together, the new molecular absorber is highly permeable and porous — attributes that trap the outgassed contaminants. Because it doesn't contain volatile organics, the material itself doesn't cause additional outgassing.



Goddard technologist Nithin Abraham, a member of the team that has developed a low-cost, low-mass technique for protecting sensitive spacecraft components from outgassed contaminants, studies a paint sample in her laboratory. Photo Credit: NASA/Pat Izzo

"It looks promising," Principal Investigator Sharon Straka said. "It collects significantly more contaminants than other approaches."

MANAGEMENT ASSURANCES

Administrator's Statement of Assurance

November 15, 2018

NASA management is responsible for establishing and maintaining effective internal control that meets the objectives of the Federal Managers' Financial Integrity Act (FMFIA) in accordance with the Government Accountability Office's *Standards for Internal Control in the Federal Government* and National Aeronautics and Space Administration (NASA) policy. NASA's Certification of Reasonable Assurance is based upon management's knowledge gained from daily operations, monitoring activities, self-assessments, and other internal controls over the effectiveness and efficiency of operations and compliance with applicable laws and regulations in accordance with OMB Circular A-123, *Management's Responsibility for Enterprise Risk Management and Internal Control* and NASA requirements. In 2015 and 2016, respectively, GAO and OMB added requirements to integrate Enterprise Risk Management (ERM) and internal control in Federal agencies. This includes annually reporting on ERM and requires considering risk activities, risk profile, and fraud risk along with providing assurance on internal control. As a result, managers and employees throughout the Agency are actively engaged in identifying or updating key control objectives, assessing risks, implementing controls or other mitigating strategies, conducting reviews, and taking corrective actions as necessary.

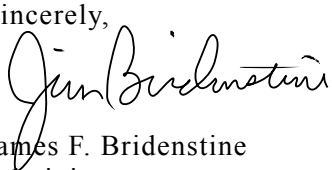
In addition, NASA relies on FMFIA requirements and OMB guidance to evaluate and assure the reliability of its internal controls over its financial management systems as well as Digital Accountability and Transparency Act of 2014 (DATA Act) submissions.

NASA conducted its fiscal year (FY) 2018 annual assessment of the effectiveness of management's internal controls over financial and operations and compliance with applicable laws and regulations in accordance with FMFIA and OMB's A-123. Based on the results of this evaluation, NASA provides reasonable assurance that its system of internal control over the effectiveness and efficiency of operations and compliance with laws and regulations as of September 30, 2018, was operating effectively and no material weaknesses were found in the design or implementation of internal controls.

In conclusion, NASA makes an unmodified statement of assurance that its internal controls for FY 2018 were operating effectively.

NASA remains committed to ensuring a sound system of internal control exists over operations, reporting, and financial management systems and will continue to monitor and enhance its quality assurance activities.

Sincerely,



James F. Bridenstine
Administrator

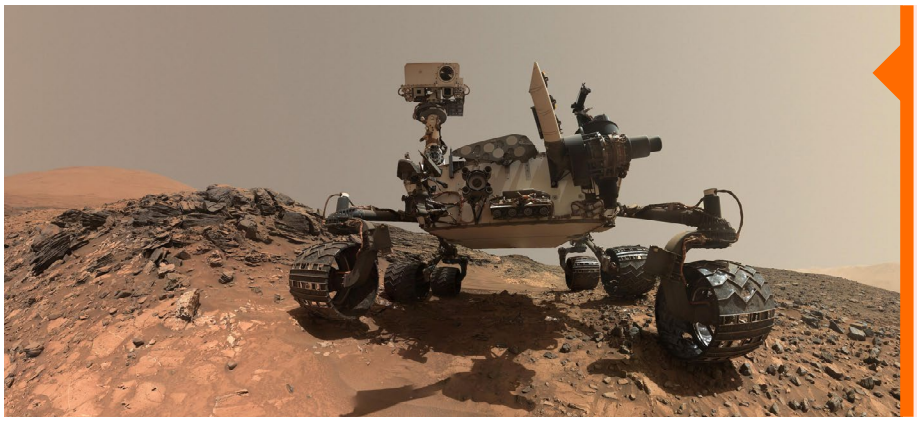
FINANCIAL SYSTEMS STRATEGIES

NASA's financial system strategy is to establish an overarching roadmap that aligns with the Agency's mission and the strategic goal to 'serve the American public and accomplish our Mission by effectively managing our people, technical capabilities, and infrastructure'. This alignment is accomplished by utilizing a standard software development model with release planning and providing oversight/ understanding of new external and internal requirements from stakeholders. The goal is to lead innovative financial systems initiatives that improve and enable integrated solutions while seeking opportunities to enhance business processes and system efficiencies. Since initial implementations, all of the tools below have been enhanced and expanded for changing policies, standards, OMB requirements, and internal assessments to ensure sound internal and system controls. As a result of NASA's efforts to continually enhance Financial and Budgetary tools/ systems, an unmodified audit opinion on financial statements has been achieved for the last eight years, and resulted in improved budgetary deliverables in accordance with previously utilized congressional direction.

NASA's Core Financial (CF) and budget management systems include the Systems Applications & Products (SAP) Enterprise Resource Planning (ERP) and the e-budget suite of tools. The CF system has served as NASA's financial accounting system of record since 2003, and the e-budget tools have supported budget formulation and Congressional presentation/justification since 2007. To accomplish supporting mission success, NASA replaced PRISM with SAP's end-to-end Procurement for Public Sector (PPS) module in 2017. PRISM was near end-of-life support and contained inefficient functionality gaps, so NASA integrated a contract writing application (PPS) as part of the SAP application, which provides the foundation for NASA's ability to achieve its financial management objectives and management of our budget. PPS brings a contract management solution providing an Agency tool supporting paperless contracting, contract writing, data management, and procurement workload management.

Transactions within the integrated modules and interfaces are recorded on a real-time basis. The CF system is supported by other commercial off-the-shelf (COTS) software, NASA developed applications, and interfaces with systems managed by other Federal agencies. NASA's goal is also to transform the information technology (IT) infrastructure and application capabilities and services to meet evolving stakeholder needs and support mission success. To accomplish meeting stakeholder needs, NASA continues efforts to expand implementation of eInvoicing capabilities to meet OMB's directive M-15-19, *Improving Government Efficiency and Saving Taxpayer Dollars Through Electronic Invoicing.*

Establish an overarching roadmap that aligns with the Agency's mission and the strategic goal to 'serve the American public and accomplish our Mission by effectively managing our people, technical capabilities, and infrastructure'.



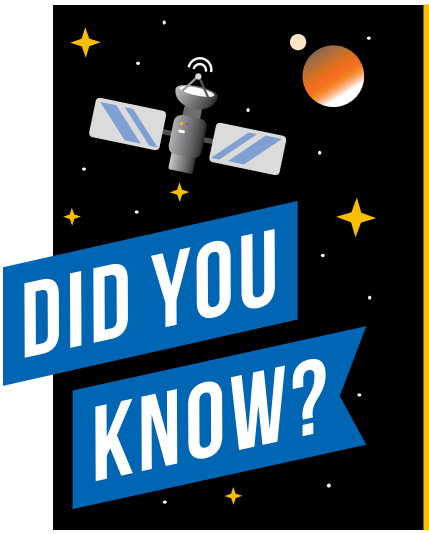
NASA's Curiosity rover has found new evidence preserved in rocks on Mars that suggests the planet could have supported ancient life, as well as new evidence in the Martian atmosphere that relates to the search for current life on the Red Planet. While not necessarily evidence of life itself, these findings are a good sign for future missions exploring the planet's surface and subsurface. Photo Credit: NASA/JPL-Caltech/MSSS

This expansion includes improved accounts payable business processes, a single Agency-wide electronic solution, and significantly reduced manual invoice data entry. NASA is on target to meet the FY 2018 timeline to implement expanded eInvoicing.

Additionally, NASA collected information on stand-alone Budget and Financial systems and applications portfolios. The objective was to collect information about these unique financial applications and systems so their capabilities could be leveraged to improve business and management practices. This continuing initiative has reduced systems and applications footprint, improved efficiencies, and provided cost savings to the Agency.

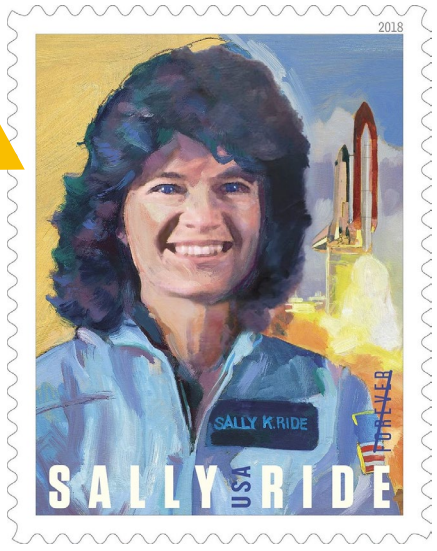
NASA also continues to automate the Continuous Monitoring Program (CMP), which provides the overall framework of management controls used to assess and evaluate internal controls, compliance with generally accepted accounting principles (GAAP), and evidence that balances and activities reported in the financial statements are auditable, accurate and complete. Automating the CMP provided centralized development, maintenance, and standardization across NASA and led to improved efficiency.

In this view, Saturn's icy moon Rhea passes in front of Titan as seen by NASA's Cassini spacecraft. Some of the differences between the two large moons are readily apparent. While Rhea is a heavily-cratered, airless world, Titan's nitrogen-rich atmosphere is even thicker than Earth's. Photo Credit: NASA/JPL-Caltech/Space Science Institute



Sally Ride Forever Stamp

In March 2018, the USPS announced their plans to dedicate a Forever Stamp in honor of Sally Ride for inspiring the nation, her significant contributions to science, and encouraging children to study science, technology, engineering and mathematics. On June 18, 1983, NASA Astronaut Sally Ride became the first American woman in space, when she launched with her four crewmates aboard the Space Shuttle Challenger on mission Space Transportation System-7 (STS-7).



LOOKING FORWARD

45

Webb's Engineering Design Unit (EDU) primary mirror segment, coated with gold by Quantum Coating Incorporated. Photo Credit: NASA

LOOKING FORWARD

NASA is proud and stands strong in leading the mission to explore the unknowns of the universe. We are excited to develop new advances in aerospace, science and technology on behalf of the American people. The Agency is preparing to once again land Americans on the surface of the Moon and someday on Mars by building a sustainable presence in cis-lunar space. To achieve this ambitious mission we must take advantage of the opportunities to partner with private sector companies to be more efficient and effective in our approach.

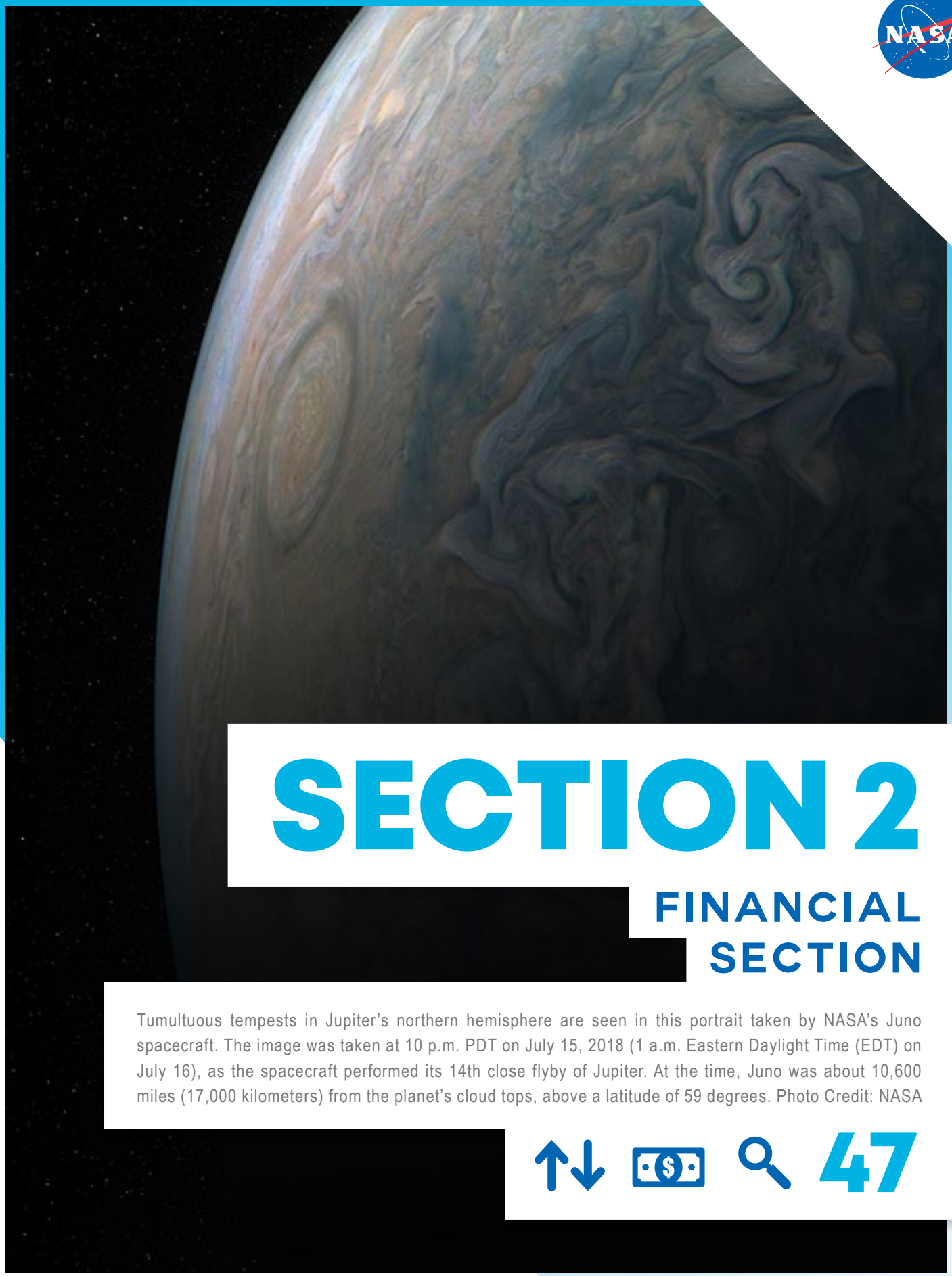
NASA's next steps in human spaceflight is the establishment of U.S. preeminence in cis-lunar space through the operations and the deployment of a U.S.-led Gateway. "The Gateway" is a permanent spaceship orbiting the Moon, to serve as a home base for human and robotic missions. Together with the Space Launch System (SLS) and Orion, the Gateway is essential to the advancement and sustainability of our human space exploration goals, and is the unifying point in our architecture for human cis-lunar operations, lunar surface access, and missions to Mars.

As we return to the Moon and push human exploration farther into the solar system, we want to expand our reach from low-Earth orbit to deep space. Through partnerships both domestic and international, NASA will bring innovation and new approaches to the advancement of our human spaceflight goals and enhance the economic development of space.

In addition to human exploration, NASA continues to break new ground and overcome challenges everyday with the on-going development of the James Webb Space Telescope (Webb), expected to launch in March 2021. Webb will be the premier observatory of the next decade, serving thousands of astronomers worldwide. It will study every phase in the history of our Universe, ranging from the first luminous glows after the Big Bang, to the formation of solar systems capable of supporting life on planets like Earth, to the evolution of our own Solar System.

At NASA we will always strive to accomplish our mission with the utmost care, recognizing that we are stewards of taxpayer dollars, critical human capital, and one-of-a-kind facilities. With guidance and recommendations from The National Academies Decadal Survey and the National Space Council, NASA will lead a new era of space technologies and advancements for our Nation. We will continue to serve as a unique national resource of engineers, scientists, technologists, and business professionals. Our goal is to enable all of NASA's space-based, air-based, and Earth-based research and innovation activities producing the best return on the Nation's investment.

The SpaceX Dragon cargo spacecraft approaches the ISS on April 17th, 2015 after launching three days earlier from Cape Canaveral Air Station in Florida. It carries some two tons of science experiments, equipment, and supplies for the Expedition 43 team onboard the station. This mission included medical, psychological and biomedical studies with NASA Astronaut, Scott Kelly. Photo Credit: NASA



SECTION 2

FINANCIAL SECTION

Tumultuous tempests in Jupiter's northern hemisphere are seen in this portrait taken by NASA's Juno spacecraft. The image was taken at 10 p.m. PDT on July 15, 2018 (1 a.m. Eastern Daylight Time (EDT) on July 16), as the spacecraft performed its 14th close flyby of Jupiter. At the time, Juno was about 10,600 miles (17,000 kilometers) from the planet's cloud tops, above a latitude of 59 degrees. Photo Credit: NASA

INTRODUCTION TO THE PRINCIPAL FINANCIAL STATEMENTS

The principal financial statements are prepared to report the financial position and results of operations of the National Aeronautics and Space Administration (NASA), pursuant to the requirements of 31 U.S.C.3515 (b).

Consolidated Balance Sheet

provides information on assets, liabilities, and net position as of the end of the reporting period. Net position is the difference between assets and liabilities. It is a summary measure of the Agency's financial condition at the end of the reporting period.

Consolidated Statement of Changes in Net Position

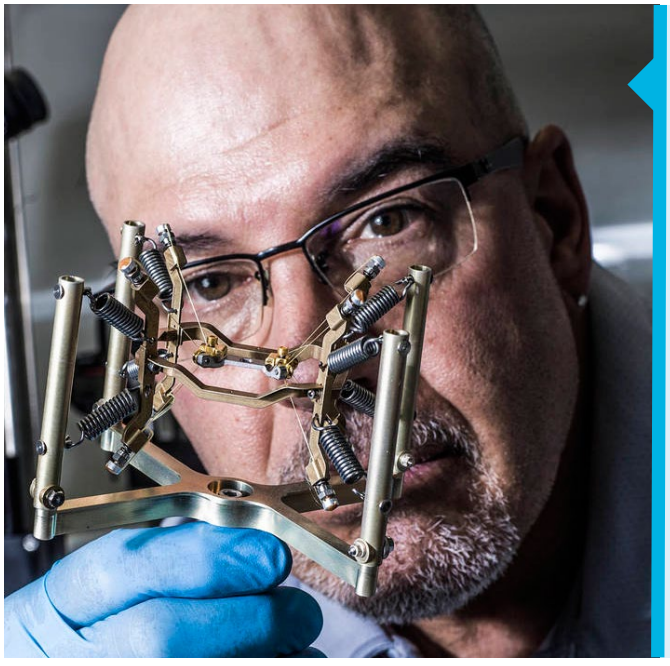
reports the beginning balance of net position, current financing sources and use of resources, unexpended resources for the reporting period, and ending net position for the current period.

Consolidated Statement of Net Cost

reports net cost of operations during the reporting periods by strategic goal and at the entity level. It is a measure of gross costs of operations less earned revenue, and represents the cost to taxpayers for achieving each strategic goal and Agency Mission at the entity level.

Combined Statement of Budgetary Resources

reports information on the sources and status of budgetary resources for the reporting period. Information in this statement is reported on the budgetary basis of accounting, which supports compliance with budgetary controls and controlling legislation.



It takes a team of talented individuals working in unison to brainstorm, build and deliver what will become the world's most powerful space telescope. Marcelino Sansebastian is a Senior Instrument Technician at NASA's Goddard Space Flight Center (GSFC) in Greenbelt, Maryland who has been deeply involved with NASA's Webb since the project began. Known for his passion, skillset and unique nickname 'Gloo', Sansebastian has had his hand in helping design and invent a long list of mission-critical components that have flown to space over the last 30 years.

Aptly named a 'Spider' for its eight thermally isolating Kevlar fibers and coiled shock reducing legs, the device pictured here is designed to securely guide small cooling and exhaust tubes throughout the observatory. As a mission-critical component, the Spiders that have been installed on Webb were built by a technician who as a child, had dreamed of working for NASA. Photo Credit: NASA/Chris Gunn

FINANCIAL STATEMENTS, NOTES, AND SUPPLEMENTAL INFORMATION

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Astronaut Ricky Arnold, from aboard the ISS, shared this image of Hurricane Florence on September 10, 2018, taken as the orbiting laboratory flew over the massive storm. A few moments later, Hurricane Isaac and the outer bands of Helene were also visible. Image Credit: NASA

National Aeronautics and Space Administration
Consolidated Balance Sheets
As of September 30, 2018 and 2017

(In Millions of Dollars)

	2018	2017
Assets:		
Intragovernmental:		
Fund Balance with Treasury (Note 2)	$ 12,551	$ 11,537
Investments (Note 3)	17	17
Accounts Receivable (Note 4)	109	166
Total Intragovernmental	12,677	11,720
Accounts Receivable, Net (Note 4)	1	1
General Property, Plant and Equipment, Net (Note 5)	6,086	6,127
Other Assets (Note 7)	2	11
Total Assets	**$ 18,766**	**$ 17,859**
Stewardship PP&E (Note 6)		
Liabilities (Note 8):		
Intragovernmental:		
Accounts Payable	$ 61	$ 32
Other Liabilities (Note 10)	160	160
Total Intragovernmental	221	192
Accounts Payable	1,334	1,364
Federal Employee Benefits (Note 8)	38	38
Environmental and Disposal Liabilities (Note 9)	1,689	1,691
Other Accrued Liabilities (Note 10)	1,584	1,478
Other Liabilities (Note 10)	501	493
Total Liabilities	**5,367**	**5,256**
Commitments and Contingencies (Note 11)		
Net Position:		
Unexpended Appropriations	9,285	8,428
Cumulative Results of Operations	4,114	4,175
Total Net Position	**13,399**	**12,603**
Total Liabilities and Net Position	**$ 18,766**	**$ 17,859**

The accompanying notes are an integral part of these financial statements.

National Aeronautics and Space Administration
Consolidated Statements of Net Cost
For the Fiscal Years Ended September 30, 2018 and 2017

(In Millions of Dollars)

	2018	2017
Strategic Goal 1 – Expand human knowledge through new scientific discoveries:		
Gross Costs	$ 7,406	$ 6,697
Less: Earned Revenue	1,608	1,713
Net Cost	5,798	4,984
Strategic Goal 2 – Extend human presence deeper into space and to the moon for sustainable long-term exploration and utilization:		
Gross Costs	$ 6,488	$ 6,409
Less: Earned Revenue	378	376
Net Cost	6,110	6,033
Strategic Goal 3 – Address national challenges and catalyze economic growth:		
Gross Costs	$ 1,542	$ 1,613
Less: Earned Revenue	99	95
Net Cost	1,443	1,518
Strategic Goal 4 - Optimize capabilities and operations:		
Gross Costs	$ 6,893	$ 7,005
Less: Earned Revenue	127	129
Net Cost	6,766	6,876
Net Cost of Operations		
Total Gross Costs	$ 22,329	$ 21,724
Less: Total Earned Revenue	2,212	2,313
Net Cost	**$ 20,117**	**$ 19,411**

The accompanying notes are an integral part of these financial statements.

National Aeronautics and Space Administration
Consolidated Statements of Changes in Net Position
For the Fiscal Years Ended September 30, 2018 and 2017

(In Millions of Dollars)

	2018	2017
Unexpended Appropriations:		
Beginning Balance	$ 8,428	$ 7,519
Budgetary Financing Sources:		
Appropriations received	20,818	19,837
Other Adjustments	(48)	(10)
Appropriations used	(19,913)	(18,918)
Total Budgetary Financing Sources	857	909
Total Unexpended Appropriations	**$ 9,285**	**$ 8,428**
Cumulative Results of Operations:		
Beginning Balance	$ 4,175	$ 4,466
Budgetary Financing Sources:		
Appropriations used	19,913	18,918
Nonexchange revenue	6	6
Other Financing Sources:		
Donations and forfeitures of property	1	67
Transfers in/out without reimbursement	(9)	1
Imputed financing	150	132
Other	(5)	(4)
Total financing sources	20,056	19,120
Net cost of operations	(20,117)	(19,411)
Net change	(61)	(291)
Cumulative Results of Operations	**$ 4,114**	**$ 4,175**
Net Position	**$ 13,399**	**$ 12,603**

The accompanying notes are an integral part of these financial statements.

National Aeronautics and Space Administration
Combined Statements of Budgetary Resources
For the Fiscal Years Ended September 30, 2018 and 2017

(In Millions of Dollars)

	2018	2017
Budgetary Resources:		
Unobligated balance from prior year budget authority, net	$ 1,499	$ 1,298
Appropriations	20,819	19,838
Spending authority from offsetting collections	3,111	2,923
Total budgetary resources	**$ 25,429**	**$ 24,059**
Status of budgetary resources:		
New obligations and upward adjustments (total) (Note 12)	$ 23,375	$ 22,678
Unobligated balance, end of year:		
Apportioned, unexpired accounts	1,906	1,234
Unapportioned, unexpired accounts	38	37
Unexpired unobligated balance, end of year	1,944	1,271
Expired unobligated balance, end of year	110	110
Unobligated balance, end of year (total)	2,054	1,381
Total budgetary resources	**$ 25,429**	**$ 24,059**
Outlays, net:		
Outlays, net (total)	$ 19,759	$ 18,702
Distributed offsetting receipts (-)	(5)	(4)
Agency outlays, net	**$ 19,754**	**$ 18,698**

The accompanying notes are an integral part of these financial statements.

Note 1: Summary of Significant Accounting Policies

Reporting Entity

The National Aeronautics and Space Administration (NASA) is an independent agency established by Congress on October 1, 1958 by the National Aeronautics and Space Act of 1958. NASA was incorporated from its predecessor agency, the National Advisory Committee for Aeronautics, which provided technical advice to the United States (U.S.) aviation industry and performed aeronautics research. Today, NASA serves as the principal agency of the U.S. Government for initiatives in civil space and aviation.

NASA is organized into four Mission Directorates supported by one Mission Support Directorate (see Organizational Structure on page 8):

- Aeronautics Research: conducts research which enhances aircraft performance, environmental compatibility, capacity, flexibility, and safety of the future air transportation system;
- Human Exploration and Operations: develops new capabilities, supporting technologies and foundational research for affordable, sustainable human and robotic exploration;
- Science: explores the Earth, Moon, Mars, and beyond; charts the best route of discovery, and obtains the benefits of Earth and space exploration for society; and
- Space Technology: develops new technologies needed to support current and future NASA missions, other agencies, and the aerospace industry.

The Agency's administrative structure includes the Strategic Management Council, Executive Council, Mission Support Council, Program Management Council, and other Committees to integrate strategic, tactical, and operational decisions in support of strategic focus and direction.

Operationally, NASA is organized into nine Centers and other facilities across the country, the Headquarters Office, and the NASA Shared Services Center (NSSC).

The Agency's consolidated financial statements present the accounts of all funds that have been established and maintained to account for the resources under the control of NASA management.

In FY 2018, NASA implemented Statement of Federal Financial Accounting Standards (SFFAS) No. 47, *Reporting Entity.*

Basis of Accounting and Presentation

These consolidated financial statements are prepared in accordance with the Federal Accounting Standards Advisory Board (FASAB) standards in the format prescribed by the OMB Circular No. A-136, *Financial Reporting Requirements, Revised* (July 2018). FASAB's authority to set Federal Government accounting standards is recognized by the American Institute of Certified Public Accountants (AICPA). The financial statements present the financial position, net cost of operations, changes in net position, and budgetary resources of NASA, as required by the Chief Financial Officers Act of 1990, Public Law (P.L.) 101-576, and the Government Management Reform Act P.L. 103-356.

The accounting structure of Federal agencies is designed to reflect proprietary and budgetary accounting. Proprietary accounting uses the accrual method of accounting. Under the accrual method of accounting, revenues are recognized when earned and expenses are recognized when incurred, without regard to the timing of receipt or payment of cash. Budgetary accounting does not use the accrual method of accounting; it accounts for the sources and status of funds to facilitate compliance with legal controls over the use of Federal funds.

Material intra-agency transactions and balances have been eliminated from the principal financial statements for presentation on a consolidated basis, except for the Statement of Budgetary Resources, which is presented on a combined basis in accordance with OMB Circular No. A-136.

Budgets and Budgetary Accounting

NASA complies with Federal budgetary accounting guidelines of OMB Circular No. A-11, *Preparation, Submission and Execution of the Budget, Revised* (June 2018). Congress funds NASA's operations

Note 1: Summary of Significant Accounting Policies (continued)

through nine main appropriations: Science; Aeronautics; Exploration; Space Operations; Education; Safety, Security and Mission Services; Space Technology; Office of Inspector General; and Construction and Environmental Compliance and Restoration. NASA also receives reimbursements from reimbursable service agreements that cover the cost of goods and services NASA provides to other Federal entities or non-Federal entities. The reimbursable agreement price is based on cost principles to reasonably reflect the actual cost for the goods and services provided to the customer.

Research and Development, Other Initiatives and Similar Costs

NASA makes substantial Research and Development (R&D) investments for the benefit of the U.S. The R&D programs include activities to extend our knowledge of Earth, its space environment, and the universe; and to invest in new aeronautics and advanced space transportation technologies supporting the development and application of technologies. Following guidance outlined in the FASAB Technical Release No. 7, *Clarification of Standards Relating to the National Aeronautics and Space Administration's Space Exploration Equipment*, NASA applies the Financial Accounting Standards Board's (FASB) Accounting Standards Codification (ASC) 730-10-25, *Research and Development - Recognition*, and FASB ASC 730-10-50 *Research and Development - Disclosure*, to its R&D projects. Consistent with the above guidance, costs to acquire PP&E that is expected to be used only for a specific R&D project are expensed in the period they are incurred.

Application of Critical Accounting Estimates

The preparation of financial statements requires management to make assumptions and reasonable estimates affecting the reported amounts of assets and liabilities and disclosures of contingent liabilities as of the date of the financial statements and the reported amounts of revenues and expenses for the reporting period. Accordingly, actual results may differ from those estimates.

Fund Balance with Treasury

The U.S. Department of the Treasury (Treasury) collects and disburses cash on behalf of Federal agencies during the fiscal year. The collections include funds appropriated by Congress to fund the Agency's operations and revenues earned for services provided to other Federal agencies or the public. The disbursements are for goods and services received in support of NASA's operations and other liabilities. Fund Balance with Treasury (FBWT) is the balance of cash NASA has in its account with Treasury.

Investments in U.S. Government Securities

NASA investments include the following intragovernmental non-marketable securities:

(1) The Endeavor Teacher Fellowship Trust Fund (Endeavor Trust Fund) was established from public donations in tribute to the crew of the Space Shuttle Challenger. The Endeavor Trust Fund biannual interest earned is reinvested in short-term bills. P.L. 102-195 requires the interest earned from the Endeavor Trust Fund investments be used to create the Endeavor Teacher Fellowship Program.

(2) The Science, Space and Technology Education Trust Fund (Challenger Trust Fund) was established to advance science and technology education. The Challenger Trust Fund balance is invested in short-term bills and long-term bonds. P.L. 100-404 requires that a quarterly payment of $250,000 be sent to the Challenger Center from interest earned on the Challenger Trust Fund investments. In order to meet the requirement of providing funds to the Challenger Center, NASA invests the biannual interest earned in short-term bills with maturity that coincides with quarterly payments of $250,000 to beneficiaries. Interest received in excess of the amount needed for quarterly payment to beneficiaries is invested in long-term bonds.

Accounts Receivable

Most of NASA's Accounts Receivable are for intragovernmental reimbursements for cost of goods and services provided to other Federal agencies; the rest are for debts to NASA by employees and non-Federal vendors. Allowances for delinquent non-

Note 1: Summary of Significant Accounting Policies

(continued)

Federal accounts receivable are based on factors such as: aging of accounts receivable, debtors' ability to pay, payment history, and other relevant factors. Delinquent non-Federal accounts receivable over 120 days are referred to Treasury for collection, wage garnishment or cross-servicing in accordance with the Debt Collection Improvement Act (DCIA), as amended.

Operating Materials and Supplies

The Agency follows the purchases method of accounting for operating materials and supplies under which it expenses operating materials and supplies when purchased, not when used.

General Property, Plant and Equipment

NASA reports depreciation and amortization expense using the straight-line method over an asset's estimated useful life, beginning with the month the asset is placed in service. General Property, Plant and Equipment (G-PP&E) are capitalized assets with acquisition costs of $500,000 or more, a useful life of 2 years or more, and R&D assets that are determined at the time of acquisition to have alternative future use. Assets that do not meet these capitalization criteria are expensed. Capitalized costs include costs incurred by NASA to bring the property to a form and location suitable for its intended use. Certain NASA assets are held by government contractors. Under provisions of the Federal Acquisition Regulation (FAR), the contractors are responsible for the control and accountability of the assets in their possession. These government-owned, contractor-held assets are included within the balances reported in NASA's financial statements.

NASA has barter agreements with international entities; the assets and services received under these barter agreements are unique, with limited easement to only a few countries, as these assets are on the International Space Station (ISS). The intergovernmental agreements state that the parties will seek to minimize the exchange of funds in the cooperative program, including the use of barters to provide goods and services. NASA has received some assets from these parties in exchange for future services. The fair value is indeterminable; therefore, no value was ascribed to these transactions in accordance with FASB ASC 845-10-25, *Non-Monetary Transactions – Recognition*, and ASC 845-10-50, *Non-Monetary Transactions – Disclosure*. The amounts reflected in NASA's financial reports for the ISS exclude components of the ISS owned or provided by other participants in the ISS.

Statement of Federal Financial Accounting Standards (SFFAS) No. 10, *Accounting for Internal Use Software*, requires the capitalization of internally developed, contractor developed, and commercial off the shelf software. Capitalized costs for internally developed software include the full costs (direct and indirect) incurred during the software development stage only. For purchased software, capitalized costs include amounts paid to vendors for the software and other material costs incurred by NASA to implement and make the software ready for use through acceptance testing. NASA capitalizes costs for internal use software when the total projected cost is $1 million or more and the expected useful life of the software is 2 years or more.

Liabilities Covered by Budgetary Resources

As a component of a sovereign entity, NASA cannot pay for liabilities unless authorized by law and covered by budgetary resources. Liabilities Covered by Budgetary Resources are those for which appropriated funds are available as of the balance sheet date. Budgetary resources include: new budget authority, unobligated balances of budgetary resources at the beginning of the year or net transfer of prior year balances during the year, spending authority from offsetting collections (credited to an appropriation or fund account), and recoveries of unexpired budget authority through downward adjustments of prior year obligations.

Liabilities and Contingencies Not Covered by Budgetary Resources

Liabilities and Contingencies Not Covered by Budgetary Resources include future environmental cleanup liability, legal claims, pensions and other retirement benefits, workers' compensation, annual leave, and payables related to cancelled appropriations.

Note 1: Summary of Significant Accounting Policies

(continued)

Federal Employee Benefits

A liability is recorded for workers' compensation claims related to the Federal Employees' Compensation Act (FECA), administered by the U.S. Department of Labor. The FECA provides income and medical cost protection to covered Federal civilian employees injured on the job, employees who have incurred a work-related occupational disease, and beneficiaries of employees whose death is attributable to a job-related injury or occupational disease. The FECA program initially pays valid claims and subsequently seeks reimbursement from the Federal agencies employing the claimants. The FECA liability includes the actuarial liability for estimated future costs of death benefits, workers' compensation, and medical and miscellaneous costs for approved compensation cases.

Personnel Compensation and Benefits

Annual, Sick and Other Leave

Annual leave is accrued as it is earned; the accrual is reduced as leave is taken. Each year, the balance in the accrued annual leave account is adjusted to reflect current pay rates. To the extent current or prior year appropriations are not available to fund annual leave earned but not taken, funding will be obtained from future financing sources. Sick leave and other types of non-vested leave are expensed as taken.

Retirement Benefits

NASA employees participate in the Civil Service Retirement System (CSRS), a defined benefit plan, or the Federal Employees Retirement System (FERS), a defined benefit and contribution plan. For CSRS employees, NASA makes contributions of 7.0 percent of gross pay. For FERS employees, NASA makes contributions to the defined benefit plan of 13.7 percent of gross pay. For employees hired January 1, 2013, and after, NASA contributes 11.9 percent of gross pay. The Agency also contributes 1.0 percent to a thrift savings plan (contribution plan) for each employee and matches employee contributions to this plan up to an additional 4.0 percent of gross pay.

Insurance Benefits

SFFAS No. 5, *Accounting for Liabilities of the Federal Government*, requires Government agencies to report the full cost of Federal Employee Health Benefits (FEHB) and the Federal Employees Group Life Insurance (FEGLI) Programs. NASA uses the applicable cost factors and data provided by the OPM to value these liabilities.

Subsequent Events

Subsequent events have been evaluated through the auditors' report date, which is the date the financial statements were available to be issued, and management determined that there are no other items to disclose.

Reclassification of FY 2017 Information

Certain reclassifications have been made to FY 2017 financial statements, notes, and supplemental information to better align with the Agency's policies and procedures effective in FY 2018, in accordance with the OMB Circular A-136.

Note 2: Fund Balance with Treasury

The status of Fund Balance with Treasury (FBWT) represents the total fund balance recorded in the general ledger for unobligated and obligated balances. Unobligated balances — available is the amount remaining in appropriation funds available for obligation. Unobligated balances — unavailable is primarily compromised of amounts remaining in appropriated funds used only for adjustments to previously recorded obligations. Obligated balances not yet disbursed is the cumulative amount of obligations incurred for which outlays have not been made. Non-budgetary FBWT is comprised of amounts in other types of funds.

(In Millions of Dollars)	2018	2017
Status of Fund Balances with Treasury:		
Unobligated Balances		
Available	$ 1,906	$ 1,234
Unavailable	148	147
Obligated Balance not yet Disbursed	10,477	10,139
Non-Budgetary FBWT	20	17
Total	**$ 12,551**	**$ 11,537**

Note 3: Investments

Investments consist of non-marketable par value intragovernmental securities issued by Treasury's Bureau of the Fiscal Service. Trust fund balances are invested in Treasury securities, which are purchased at either a premium or discount, and redeemed at par value exclusively through Treasury's Federal Investment Branch. The effective-interest method is used to amortize premiums on bonds, and the straight-line method is used to amortize discounts on bills.

Interest receivable on investments was less than one-half million dollars, in FY 2018 and FY 2017. In addition, NASA did not have any adjustments resulting from the sale of securities prior to maturity or any change in value that was more than temporary.

2018							
(In Millions of Dollars)	Cost	Amortization Method	Amortized (Premium) Discount	Interest Receivable	Investments, Net	Other Adjustments	Market Value Disclosure
Intragovernmental Securities:		Straight-Line Effective-interest					
Non-Marketable: Par value	$ 21	0.724 - 6.602%	$ (4)	$ —	$ 17	$ —	$ 17
Total	**$ 21**		**$ (4)**	**$ —**	**$ 17**	**$ —**	**$ 17**

2017							
(In Millions of Dollars)	Cost	Amortization Method	Amortized (Premium) Discount	Interest Receivable	Investments, Net	Other Adjustments	Market Value Disclosure
Intragovernmental Securities:		Straight-Line Effective-interest					
Non-Marketable: Par value	$ 21	0.724 - 6.602%	$ (4)	$ —	$ 17	$ —	$ 17
Total	**$ 21**		**$ (4)**	**$ —**	**$ 17**	**$ —**	**$ 17**

Note 4: Accounts Receivable, Net

The Accounts Receivable balance represents net valid claims by NASA to cash or other assets of other entities. Intragovernmental Accounts Receivable represents reimbursements due from other Federal entities for goods and services provided by NASA on a reimbursable basis. Accounts Receivable Due from the Public is the total of miscellaneous debts owed to NASA from employees and/or smaller reimbursements from other non-Federal entities. A periodic evaluation of public accounts receivable is performed to estimate any uncollectible amounts based on current status, financial and other relevant characteristics of debtors, and the overall relationship with the debtor. An allowance for uncollectible accounts is recorded for Accounts Receivable Due from the Public in order to reduce Accounts Receivable to its net realizable value in accordance with SFFAS No. 1, *Accounting for Selected Assets and Liabilities*. The total allowance for uncollectible accounts during FY 2018 and FY 2017 is less than one–half million and one million dollars, respectively.

2018

(In Millions of Dollars)	Accounts Receivable	Allowance for Uncollectible Accounts	Net Amount Due
Intragovernmental	$ 109	$ —	$ 109
Public	1	—	1
Total	**$ 110**	**$ —**	**$ 110**

2017

(In Millions of Dollars)	Accounts Receivable	Allowance for Uncollectible Accounts	Net Amount Due
Intragovernmental	$ 166	$ —	$ 166
Public	2	(1)	1
Total	**$ 168**	**$ (1)**	**$ 167**

Note 5: General Property, Plant and Equipment, Net

There are no known restrictions to the use or convertibility of NASA G-PP&E. The composition of NASA G-PP&E as of September 30, 2018 and 2017 is presented in the table below.

NASA capitalizes the International Space Station (ISS) as G-PP&E, which includes the on-orbit station, as well as on-ground and other support equipment that is required for ISS operations. As of September 30, 2018 and 2017, the on-orbit station is fully depreciated. The book value reflected for ISS represents the on-ground and other support equipment, which are capitalized and depreciated over the useful life of the individual equipment.

2018					
(In Millions of Dollars)	Depreciation Method	Estimated Useful Life	Cost	Accumulated Depreciation	Book Value
General PP&E					
International Space Station and Equipment	Straight-line	5–20 years	$ 12,779	$ (12,497)	$ 282
Structures, Facilities and Leasehold Improvements	Straight-line	15–40 years	11,200	(7,934)	3,266
Equipment	Straight-line	5–20 years	3,640	(2,304)	1,336
Construction In Progress - Personal Property	N/A	N/A	439	—	439
Construction In Progress - Real Property	N/A	N/A	630	—	630
Internal Use Software	Straight-line	5 years	251	(245)	6
Land	N/A	N/A	124	—	124
Internal Use Software In Development	N/A	N/A	3	—	3
Total			**$ 29,066**	**$ (22,980)**	**$ 6,086**

2017					
(In Millions of Dollars)	Depreciation Method	Estimated Useful Life	Cost	Accumulated Depreciation	Book Value
General PP&E					
International Space Station and Equipment	Straight-line	5–20 years	$ 12,846	$ (12,572)	$ 274
Structures, Facilities and Leasehold Improvements	Straight-line	15–40 years	10,636	(7,661)	2,975
Equipment	Straight-line	5–20 years	3,140	(2,157)	983
Construction In Progress - Personal Property	N/A	N/A	900	—	900
Construction In Progress - Real Property	N/A	N/A	859	—	859
Internal Use Software	Straight-line	5 years	258	(248)	10
Land	N/A	N/A	124	—	124
Internal Use Software In Development	N/A	N/A	2	—	2
Total			**$ 28,765**	**$ (22,638)**	**$ 6,127**

Note 6: Stewardship PP&E

Federal agencies are required to classify and report heritage assets, multi-use heritage assets, and stewardship land in accordance with SFFAS No. 29, *Heritage Assets and Stewardship Land*.

Stewardship PP&E have physical characteristics similar to those of G-PP&E but differ from G-PP&E because their value is more intrinsic and not easily determinable in dollars. The only type of stewardship PP&E owned by NASA are heritage assets.

Continued on next page →

Note 6: Stewardship PP&E (continued)

Heritage assets are PP&E that possess one or more of the following characteristics:

- Historical or natural significance
- Cultural, educational or aesthetic value
- Significant architectural characteristics

Dollar value and useful life of heritage assets are not easily determinable. There is no minimum dollar threshold for designating PP&E as a heritage asset, and depreciation expense is not taken on these assets. For these reasons, heritage assets (other than multi-use heritage assets) are reported in physical units, rather than with assigned dollar values. In accordance with SFFAS No. 29, the cost of acquisition, improvement, reconstruction, or renovation of heritage assets is expensed in the period incurred.

Assets that are used in day-to-day Government operations and have a heritage function are considered multi-use heritage assets. Such assets are accounted for as G-PP&E and are capitalized and depreciated in the same manner as other G-PP&E. Multi-use heritage assets at the end of the period totaled 80 buildings and structures as of September 30, 2018 and 70 buildings and structures as of September 30, 2017. The value associated with these multi-use heritage assets is reflected in the G-PP&E values reported in Note 5.

When a G-PP&E has no use in operations, but is designated as a heritage asset, its cost and accumulated depreciation are removed from the books. They remain on the record as heritage assets, except where there is legal authority for transfer or sale at which time they are removed from the heritage asset record. Heritage assets are withdrawn when they are disposed or reclassified as multi-use heritage assets. Heritage assets are generally in fair condition suitable for display.

NASA currently has four major classes of heritage assets: Buildings and Structures; Air and Space Displays and Artifacts; Art; and Miscellaneous Items. The first two categories of heritage assets support NASA's mission by providing the public with tangible examples of assets, which were built and deployed to support NASA's mission. These real life assets enhance the public's understanding of NASA's numerous programs. Typically, the Buildings and Structures have been designated as National Historic Landmarks.

The third category is artwork inspired by the U.S. Aerospace program, as well as historical books and documents. This category is comprised of items created by artists who have contributed their time and talent to record their impressions of the U.S. Aerospace Program in paintings, drawings, and other media. These works of art not only provide a historic record of NASA projects, but they support NASA's mission by giving the public a new and fuller understanding of advancements in aerospace. In addition to artistic works, the category further includes historical books, documents, and other library materials that document NASA's history.

The fourth category of heritage assets is Miscellaneous Items. This category includes assorted mementos of historic NASA events and uncompleted assets. Examples of miscellaneous items include items from previous missions that have historical significance to NASA and historic mission control artifacts that possess educational value, therefore they have been classified as heritage.

Heritage Assets *(In Physical Units)*	**2017**	**Additions**	**Withdrawals**	**2018**
Buildings and Structures	10	—	—	10
Air and Space Displays and Artifacts	672	14	(24)	662
Art	815	2	—	817
Miscellaneous Items	233	2	(1)	234
Total Heritage Assets	**1,730**	**18**	**(25)**	**1,723**

Note 7: Other Assets

NASA's Other Assets consist of Advances and G-PP&E that NASA has determined are no longer needed and are awaiting disposal, retirement, or removal from services. The Advances primarily represent the payments made to an energy service company for the Energy Savings Performance Contract at Glenn Research Center. The G-PP&E Other Assets are recorded at estimated net realizable value.

(In Millions of Dollars)	2018	2017
Non-Intragovernmental Assets		
Other Advances	$ 2	$ 1
G-PP&E - Removed from Service and Pending Disposal	—	10
Total Other Assets	**$ 2**	**$ 11**

Note 8: Liabilities Not Covered by Budgetary Resources

Liabilities not covered by budgetary resources include certain environmental matters (see Note 9, *Environmental and Disposal Liabilities* for more information), annual leave, workers' compensation under FECA, accounts payable related to cancelled appropriations, legal claims, energy savings performance contracts, and pensions and other retirement benefits.

The present value of the FECA actuarial liability estimate at year-end was calculated by the Department of Labor using a discount rate of 2.72 percent in FY 2018 and 2.68 percent in FY 2017. This liability includes the estimated future costs for claims incurred but not reported or approved as of the end of each year. NASA has recorded accounts payable related to cancelled appropriations for which there are contractual commitments to pay. These payables will be funded from appropriations available for obligation at the time a bill is processed, in accordance with P.L. 101-510, National Defense Authorization Act.

Continued on next page →

Note 8: Liabilities Not Covered by Budgetary Resources (continued)

(In Millions of Dollars)	2018	2017
Intragovernmental Liabilities:		
Other Liabilities		
Workers' Compensation	$ 8	$ 8
Total Intragovernmental	8	8
Public Liabilities:		
Accounts Payable		
Accounts Payable for Cancelled Appropriations	58	58
Federal Employee Benefits		
Actuarial FECA Liability	38	38
Environmental and Disposal Liabilities	1,689	1,691
Less: Environmental and Disposal Liabilities - Funded	114	86
Other Liabilities		
Unfunded Annual Leave	215	212
Contingent Liabilities	5	43
Total Liabilities Not Covered by Budgetary Resources	**1,899**	**1,964**
Total Liabilities Covered by Budgetary Resources	**3,448**	**3,274**
Total Liabilities Not Requiring Budgetary Resources	**20**	**18**
Total Liabilities	**$ 5,367**	**$ 5,256**

Note 9: Environmental and Disposal Liabilities

In accordance with guidance issued by FASAB, if an agency is required by Federal, state, and local statutes and regulation to clean up hazardous waste resulting from Federal operations, the amount of cleanup cost, if estimable, must be reported and/or disclosed in the financial statements.

The statutes and regulations most applicable to NASA covering environmental response, clean-up, and monitoring include: the Comprehensive Environmental Response, Compensation and Liability Act; the Resource Conservation and Recovery Act; the Nuclear Waste Policy Act of 1982; and applicable state and local laws.

NASA assesses the likelihood of required cleanup as probable (more likely than not to occur), reasonably possible (more than remote but less than probable), or remote (slight chance of occurring). If the likelihood of required cleanup is probable and the cost can be reasonably estimated, a liability is recorded in the financial statements. If the likelihood of required cleanup is reasonably possible, the estimated cost of cleanup is disclosed in the notes to the financial statements. If the likelihood of required cleanup is remote, no liability or estimate is recorded or disclosed.

Environmental and Disposal Liabilities Represent Cleanup Costs Resulting From:

- Operations, including facilities obtained from other governmental entities, that have resulted in contamination from waste disposal methods, leaks and spills;
- Other past activity that created a public health or environmental risk, including identifiable costs associated with asbestos abatement; and
- Total cleanup costs associated with the removal, containment, and/or disposal of hazardous wastes or material and/or property at permanent or temporary closure or shutdown of associated PP&E.

Note 9: Environmental and Disposal Liabilities (continued)

(In Millions of Dollars)	2018	2017
Environmental Liabilities		
Restoration Projects	$ 1,425	$ 1,429
Asbestos	191	190
End of Life Disposal of Property, Plant & Equipment	73	72
Total Environmental and Disposal Liabilities	**$ 1,689**	**$ 1,691**

Restoration Projects

NASA recorded a total estimated liability for known restoration projects of $1.425 billion in FY 2018. This was a decrease of $4 million from $1.429 billion recorded in FY 2017. The decrease in this liability is primarily due to the availability of new or updated information on the extent of contamination and refinements to the estimation methodology. The liability for each restoration project is estimated for a duration of no more than 30 years, except where required by state statutes, regulations, or an agreement.

In addition to the probable cleanup costs for known hazardous conditions recognized in the financial statements, there are other remediation sites where the likelihood of required cleanup for known hazardous conditions is reasonably possible. Remediation costs at certain sites classified as reasonably possible were estimated to be $160 million for FY 2018 and $156 million for FY 2017. The increase in this estimate is primarily due to additional remediation projects where clean up was deemed reasonably possible.

With respect to environmental remediation that NASA considers probable or reasonably possible but not estimable, NASA concluded that either the likelihood of a NASA liability is less than probable but more than remote, but the regulatory drivers and/or technical data that exist are not reliable enough to calculate an estimate.

Asbestos

NASA maintains numerous structures and facilities across each of its Centers that are known to contain asbestos. In accordance with FASAB Technical Bulletin 2006-1, *Recognition and Measurement of Asbestos Related Cleanup Costs*, NASA and other Federal entities are required to recognize a liability for probable asbestos cleanup costs. FASAB Technical Release 10, *Implementation Guidance on Asbestos Cleanup Costs Associated with Facilities and Installed Equipment*, allows for an extrapolation of asbestos cleanup cost estimates for similar properties to develop an Agency-wide cleanup estimate.

In FY 2017, NASA updated its methodology for estimating the asbestos liability by using actual costs incurred to clean up asbestos in NASA structures and facilities that were recently demolished or fully renovated. Agency-wide asbestos cleanup cost factors were developed for those structures and facilities measured in square feet and for those not measured in square feet. These cost factors were extrapolated across applicable NASA structures and facilities. The FY 2018 asbestos cleanup cost liability of $191 million represents an increase of $1 million compared to the $190 million recorded in FY 2017.

End of Life Disposal of Property, Plant & Equipment

Consistent with SFFAS No. 5, *Accounting for Liabilities of the Federal Government* and with SFFAS No. 6, *Accounting for Property, Plant, and Equipment*, NASA estimates the anticipated environmental disposal cleanup costs for PP&E. NASA recognizes and records in its financial statements an environmental cleanup liability for end-of-life disposal of PP&E that is probable and measurable.

NASA recorded a total estimated liability for the end-of-life disposal of PP&E of $73 million in FY 2018. This was an increase of $1 million over the $72 million recorded in FY 2017. This estimate includes both facilities with permits that require cleanup and an estimate for all remaining PP&E. As described in the

following paragraphs, this estimate also considers end-of-life disposal costs for assets in space, including the ISS and satellites.

The current proposed decommissioning approach for the ISS is to execute a controlled targeted deorbit to a remote ocean location. This is consistent with the approach used to deorbit other space vehicles such as Russia's Progress, Europe's Automated Transfer Vehicle (ATV) and Japan's H-II Transfer Vehicle (HTV). The documented target reliability for this decommissioning approach is 99 percent. Prior to decommissioning the ISS, any hazardous materials on board the ISS would be removed or jettisoned. As a result, only residual quantities of hazardous, toxic, and radioactive materials would remain prior to the decommissioning.

Based on past experience with the re-entry of satellites, larger portions or fragments of the ISS would be expected to survive the thermal and aerodynamic stresses of re-entry. However, the historical disposal of satellites and vehicles into broad ocean areas with a controlled deorbit has left little evidence of their re-entry. Any remaining contamination in the ISS debris field would not be expected to have a substantive impact on marine life. Therefore, the probability of NASA incurring environmental cleanup costs related to the ISS is remote and no estimate for such costs has been developed or reported in these financial statements.

Note 10: Other Liabilities and Other Accrued Liabilities

Intragovernmental Other Liabilities primarily represent accrued cost estimates for goods and services performed by Federal trading partners, and Advances from Others relates to agreements for services between NASA and Federal trading partners for reimbursable services performed.

Other Liabilities with public entities primarily represents unfunded annual leave and funded sick leave that have been earned but not taken by NASA employees. Advances from Others primarily consists of payments received from non-Federal entities in advance of NASA's performance of services under reimbursable agreements.

Other Accrued Liabilities primarily consist of the accrual of contractor costs for goods and services performed. The period of performance for contractor contracts typically spans the duration of NASA programs, which could be for a number of years prior to final delivery of the product. In such cases, NASA records a cost accrual throughout the fiscal year as the work is performed. Other Accrued Liabilities also include the accrual of incurred but not reported (IBNR) grant program costs incurred in support of NASA's research and development and other related activities.

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Note 10: Other Liabilities and Other Accrued Liabilities (continued)

(In Millions of Dollars)	2018 Current	2018 Non-Current	2018 Total	2017 Current	2017 Non-Current	2017 Total
Intragovernmental Liabilities:						
Advances from Others	$ 52	$ —	$ 52	$ 54	$ —	$ 54
Workers' Compensation	7	1	8	3	5	8
Employer Contributions and Payroll Taxes	17	—	17	17	—	17
Total Other Liabilities	76	1	77	74	5	79
Other Accrued Liabilities	83	—	83	81	—	81
Total Intragovernmental	**159**	**1**	**160**	**155**	**5**	**160**
Public Liabilities:						
Unfunded Annual Leave	—	215	215	—	212	212
Accrued Funded Payroll	85	—	85	84	—	84
Advances from Others	105	—	105	113	—	113
Employer Contributions and Payroll Taxes	9	—	9	8	—	8
Liability for Deposit and Clearing Funds	20	—	20	18	—	18
Contingent Liabilities	—	5	5	—	43	43
Capital Lease Liabilities	2	—	2	2	—	2
Other Liabilities	60	—	60	13	—	13
Total Other Liabilities	281	220	501	238	255	493
Other Accrued Liabilities	1,584	—	1,584	1,478	—	1,478
Total Public	**1,865**	**220**	**2,085**	**1,716**	**255**	**1,971**
Total Other Liabilities and Other Accrued Liabilities	**$ 2,024**	**$ 221**	**$ 2,245**	**$ 1,871**	**$ 260**	**$ 2,131**

Note 11: Commitments and Contingencies

NASA is a party in various administrative proceedings, court actions (including tort suits), and claims. For cases in which management and legal counsel believe it is probable that the outcomes will result in a loss to NASA, contingent liabilities are recorded.

There were cases reviewed by legal counsel where the probable future measurable loss is remote, and as such no contingent liability has been recorded in connection with these cases.

There are certain cases where the likelihood of loss is reasonably possible, with the loss estimated up to $1 million for September 30, 2018.

(In Millions of Dollars)	2018	2017
Contingent Liabilities	$ 5	$ 43
Total Contingent Liabilities	**$ 5**	**$ 43**

Note 12: Apportionment Categories of Obligations Incurred: Direct vs. Reimbursable Obligations

Category A obligations consist of amounts requested to be apportioned annually and distributed for each calendar quarter in the fiscal year. Category B obligations consist of amounts requested to be apportioned on a basis other than calendar quarters, such as time periods other than quarters, activities, projects, objects, or a combination thereof.

(In Millions of Dollars)	2018	2017
Direct New Obligations and Upward Adjustments:		
Category A	$ 1	$ 1
Category B	20,451	19,876
Reimbursable New Obligations and Upward Adjustments:		
Category B	2,923	2,801
Total New Obligations and Upward Adjustments:	**$ 23,375**	**$ 22,678**

Note 13: Explanation of Differences Between the SBR and the Budget of the U.S. Government

The FY 2020 Budget of the United States Government (President's Budget), which presents the actual amounts for the year ended September 30, 2018, has not been published as of the issue date of these financial statements. Upon approval of the Administration, NASA will publish its FY 2020 President's Budget Request on the NASA Website at https://www.nasa.gov/news/budget.

NASA reconciled the amounts of the FY 2017 column on the SBR to the actual amounts for FY 2017 in the FY 2019 President's Budget for budgetary resources, obligations incurred, distributed offsetting receipts, and net outlays as presented below.

(In Millions of Dollars)	Budgetary Resources	Obligations	Distributed Offsetting Receipts	Net Outlays
Combined Statement of Budgetary Resources	$ 24,059	$ 22,678	$ (4)	$ 18,702
Included on SBR, not in President's Budget				
Expired Accounts	(139)	(29)	—	—
Distributed Offsetting Receipts	—	—	4	—
Budget of the United States Government	**$ 23,920**	**$ 22,649**	**$ —**	**$ 18,702**

The difference between the SBR and the President's Budget represents expired accounts and distributed offsetting receipts reported on the SBR but not in the President's Budget.

Note 14: Undelivered Orders at the End of the Period

Undelivered Orders represent the amount of goods and/or services ordered to perform NASA's mission objectives, which have not been received. Undelivered Orders at the end of the period totaled $9.4 billion and $8.8 billion as of September 30, 2018 and September 30, 2017, respectively.

(In Millions of Dollars)	2018	2017
Federal		
Unpaid	$ 321	$ 389
Paid	114	104
Total	435	493
Nonfederal		
Unpaid	8,918	8,349
Paid	5	4
Total	8,923	8,353
Total Undelivered Orders	$ 9,358	$ 8,846

Note 15: Reconciliation of Net Cost of Operations to Budget

SFFAS No. 7, *Accounting for Revenue and Other Financing Sources and Concepts for Reconciling Budgetary and Financial Accounting*, requires a reconciliation of proprietary and budgetary accounting information. Accrual based measures used in the Statement of Net Cost differ from the obligation based measures used in the Statement of Budgetary Resources. This reconciliation shows the relationship between the net obligations derived from the Statement of Budgetary Resources and net costs of operations derived from the Statement of Net Cost by identifying and explaining key items that affect one statement but not the other.

(In Millions of Dollars)	2018	2017
Resources Used to Finance Activities		
Budgetary Resources Obligated		
New Obligations and Upward Adjustments	$ 23,375	$ 22,678
Less: Spending Authority from Offsetting Collections and Recoveries	3,411	3,138
Obligations Net of Offsetting Collections and Recoveries	19,964	19,540
Less: Offsetting Receipts	—	—
Net Obligations	19,964	19,540
Other Resources		
Donations & Forfeitures of Property	1	67
Transfers In/Out Without Reimbursements	(9)	1
Imputed Financing from Costs Absorbed by Others	150	132
Net Other Resources Used to Finance Activities	142	200
Total Resources Used to Finance Activities	**20,106**	**19,740**
Resources Used to Finance Items Not Part of the Net Cost of Operations		
Change in Budgetary Resources Obligated for Goods, Services, and Benefits Ordered But Not Yet Provided	(51)	(567)
Resources that Fund Expenses Recognized in Prior Periods	(39)	—
Resources that Finance the Acquisition of Assets	(567)	(696)
Other Resources or Adjustments to Net Obligated Resources that Do Not Affect Net Cost of Operations	8	(68)
Total Resources Used to Finance Items Not Part of the Net Cost of Operations	**(649)**	**(1,331)**
Total Resources Used to Finance the Net Cost of Operations	**$ 19,457**	**$ 18,409**
Components of Net Cost that Will Not Require or Generate Resources in the Current Period		
Components Requiring or Generating Resources in Future Periods		
Increases in Annual Leave Liability	$ 3	$ 1
Increases in Environmental and Disposal Liability	—	92
Other	48	18
Total Components of Net Cost that Will Require or Generate Resources in Future Periods	51	111
Components Not Requiring or Generating Resources		
Depreciation	500	520
Revaluation of Assets or Liabilities	6	6
Other	103	365
Total Components of Net Cost of Operations that Will Not Require or Generate Resources	609	891
Total Components of Net Cost of Operations that Will Not Require or Generate Resources in the Current Period	**660**	**1,002**
Net Cost of Operations	**$ 20,117**	**$ 19,411**

REQUIRED SUPPLEMENTARY STEWARDSHIP INFORMATION

NASA's strategic goals and outcomes are the basis of the Agency's performance framework and are executed to support its strategic plan. To provide a complete analysis of NASA's costs, both Research and Development (R&D) and non-R&D costs are presented. Descriptions for the strategic goals and outcomes associated with these costs are below.

Research and Development Costs by Strategic Goal

(In Millions of Dollars)	2018	2017	2016	2015	2014
Research and Development Costs					
Basic					
Strategic Goal 1	$ 5,184	$ 2,914	$ 2,897	$ 2,784	$ 2,656
Strategic Goal 2	291	293	416	309	330
Strategic Goal 3	—	56	—	—	—
Strategic Goal 4	—	—	—	(1)	4
Total Basic Expenses	**$ 5,475**	**$ 3,263**	**$ 3,313**	**$ 3,092**	**$ 2,990**
Applied					
Strategic Goal 1	$ 331	$ 274	$ 222	$ 207	$ 213
Strategic Goal 2	1,303	1,236	1,865	1,288	1,384
Strategic Goal 3	839	796	774	824	732
Strategic Goal 4	30	29	55	32	83
Total Applied Expenses	**$ 2,503**	**$ 2,335**	**$ 2,916**	**$ 2,351**	**$ 2,412**
Development					
Strategic Goal 1	$ —	$ 1,918	$ 1,715	$ 1,848	$ 1,762
Strategic Goal 2	3,704	3,574	3,357	3,232	2,983
Strategic Goal 3	248	169	148	187	248
Strategic Goal 4	499	948	1,560	973	429
Total Development Expenses	**$ 4,451**	**$ 6,609**	**$ 6,780**	**$ 6,240**	**$ 5,422**
Total Research and Development	**$ 12,429**	**$ 12,207**	**$ 13,009**	**$ 11,683**	**$ 10,824**
Non-Research and Development Cost					
Strategic Goal 1	$ 1,891	$ 1,591	$ 1,495	$ 1,568	$ 1,144
Strategic Goal 2	1,190	1,306	1,380	3,342	3,357
Strategic Goal 3	455	592	573	226	193
Strategic Goal 4	6,364	6,028	5,354	5,042	4,811
Total Non-Research and Development Expenses	**$ 9,900**	**$ 9,517**	**$ 8,802**	**$ 10,178**	**$ 9,505**
Total Expenses	**$ 22,329**	**$ 21,724**	**$ 21,811**	**$ 21,861**	**$ 20,329**

NASA makes substantial R&D investments for the benefit of the Nation. These amounts are expensed as incurred in determining the gross costs of operations.

REQUIRED SUPPLEMENTARY STEWARDSHIP INFORMATION (continued)

NASA's strategic goals, codified in its 2018 Strategic Plan, establish the foundation for the Agency's performance framework. For each of its timeless strategic goals, the Agency has identified nearer-term outcomes that it strives to achieve in support of its strategic plan. Many of these outcomes require substantial R&D investments that NASA makes for the benefit of the Nation.

NASA's R&D programs include activities to extend our knowledge of Earth, its space environment, and the universe, and to invest in new aeronautics and advanced space transportation technologies that support the development and application of technologies critical to the economic, scientific, and technical competitiveness of the United States.

Investment in R&D refers to those expenses incurred to support the search for new or refined knowledge and ideas, as well as the application or use of such knowledge and ideas for the development of new or improved products and processes. In each instance, the primary motivation is the continuous improvement of the nation's economic and productive capacity, yielding untold benefits for both today and future generations.

Strategic Goals and Outcomes

Strategic Goal 1: Expand Human Knowledge through New Scientific Discoveries

- Conduct scientific studies of the Earth and Sun from space, return data and samples from other bodies in the solar system, peer out into the vast reaches of the universe, and play a catalyzing role in lunar robotic exploration by supporting innovative approaches to advancing science.

- Conduct a robust program of space-based research to advance technologies that enable space exploration, and to pioneer uses of the space environment to benefit life on Earth.

Strategic Goal 2: Extend Human Presence Deeper Into Space and To the Moon for Sustainable Long-Term Exploration and Utilization

- Enable space-based low Earth orbit economy by transitioning the ISS operations and maintenance to commercial and international partners, while continuing to leverage ISS for research, technology development, and to extend human presence in space.

- Extend human presence into cis-lunar space and the lunar surface, with capabilities that allow for sustained operations in deep space and the lunar surface.

Strategic Goal 3: Address National Challenges and Catalyze Economic Growth

- Advance revolutionary technologies for NASA and the Nation, involving commercial space products, specifically for utilization of near-Earth space; efficient transportation through space; access to planetary surfaces; enabling human space exploration; next generation science missions; and growth and utilization of the U.S. industrial and academic base.

- Maintain and advance U.S. global leadership in aviation through application of new concepts and technologies pioneered by NASA and developed in partnership with U.S. industry that lead to transformative improvements in mobility, efficiency, and safety.

- Inspire, engage, educate, and employ the next generation of explorers through NASA-unique Science, Technology, Engineering, and Mathematics (STEM) learning opportunities.

REQUIRED SUPPLEMENTARY STEWARDSHIP INFORMATION (continued)

Strategic Goals and Outcomes (continued)

Strategic Goal 4: Optimize Capabilities and Operations

- Support cooperative, reimbursable, and funded initiatives through domestic and international partnerships.
- Support the communication, launch service, rocket propulsion testing, and strategic capabilities needs of NASA's programs.
- Assure effective management of NASA programs and operations to complete the mission safely and successfully.
- Cultivate a diverse and innovative workforce with the right balance of skills and experience to provide an inclusive work environment in which employees that possess varying perspectives, education levels, life experiences, and backgrounds can work together and remain fully engaged in our mission.
- Increase the resiliency of NASA's enterprise systems by assessing risks and implementing comprehensive, economical, and actionable solutions.
- Enable NASA's mission by providing the facilities, tools, and services required to efficiently manage, operate, and sustain the infrastructure necessary to meet mission objectives.

Investments in Human Capital

Human capital investments are expenses, included in NASA's Net Cost of Operations, for education and training programs that are intended to increase or maintain national economic productive capacity and produce outputs and outcomes that provide evidence of maintaining or increasing national productive capacity. These investments exclude education and training expenses for Federal civilian personnel. The following table summarizes NASA's costs that represent investments in human capital by program for FY 2014 through FY 2018.

(In Millions of Dollars)	2018	2017	2016	2015	2014
National Space Grant and College Fellowship Program	$ 44	$ 47	$ 43	$ 42	$ 34
Established Program to Stimulate Competitive Research	18	20	19	22	22
Minority University Research & Education Program	32	32	25	22	24
Total Investment in Human Capital	**$ 94**	**$ 99**	**$ 87**	**$ 86**	**$ 80**

National Space Grant and College Fellowship Program (Space Grant)

Space Grant was established to increase understanding, research, development, and utilization of aerospace science and technology through the Nation's universities. The competitive grant opportunity enables the active involvement of 52 consortia in 50 States, the District of Columbia, and the Commonwealth of Puerto Rico. Space Grant supports and enhances science and engineering education, and research efforts for educators and learners by leveraging the resource capabilities and technologies of over 900 affiliates from universities, colleges, industries, museums, science centers, and state and local agencies, and provides students access to research and hands-on STEM experiences.

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REQUIRED SUPPLEMENTARY STEWARDSHIP INFORMATION (continued)

Investments in Human Capital (continued)

Established Program to Stimulate Competitive Research (EPSCoR)

EPSCoR establishes partnerships with government, higher education and industry that are designed to affect lasting improvements in a state's or region's research infrastructure, R&D capacity and hence, it's national R&D competitiveness. The program strives to improve a jurisdiction's research infrastructure to a level such that its research and development programs contribute to its economic development. EPSCoR supports competitively funded awards and provides research and technology development opportunities for faculty and research teams.

Minority University Research & Education Program (MUREP)

MUREP provides financial assistance via competitive awards to Minority Serving Institutions (MSIs). NASA's MUREP investments enhance the research, academic, and technology capabilities of MSIs through multi-year awards. Awards assist faculty and students in research and provide authentic STEM engagement related to NASA missions. These competitive awards provide NASA specific knowledge and skills to historically underrepresented and underserved learners in STEM. MUREP investments also assist NASA in meeting the goal of a diverse workforce through student participation in internships, scholarships, and fellowships at NASA Centers and JPL.

REQUIRED SUPPLEMENTARY INFORMATION

Combining Statement of Budgetary Resources
For the Fiscal Year Ended September 30, 2018

(In Millions of Dollars)	Space Operations	Science	Exploration	Aeronautics	Safety, Security and Mission Services	Education Mission
Budgetary Resources:						
Unobligated Balance from Prior Year Budget Authority, Net	$ 212	$ 357	$ 120	$ 21	$ 389	$ 17
Appropriations	4,749	6,212	4,790	690	2,827	100
Spending Authority from Offsetting Collections	—	—	—	—	2,655	—
Total Budgetary Resources	**$ 4,961**	**$ 6,569**	**$ 4,910**	**$ 711**	**$ 5,871**	**$ 117**
Status of Budgetary Resources:						
New Obligations and Upward Adjustments (Total)	$ 4,785	$ 6,154	$ 4,484	$ 685	$ 5,318	$ 105
Unobligated Balance, End of Year:						
Apportioned, Unexpired Accounts	117	385	411	24	534	7
Unapportioned, Unexpired Accounts	—	15	6	—	16	—
Unexpired Unobligated Balance, End of Year	117	400	417	24	550	7
Expired Unobligated Balance, End of Year	59	15	9	2	3	5
Unobligated Balance, End of Year (Total)	176	415	426	26	553	12
Total Status of Budgetary Resources	**$ 4,961**	**$ 6,569**	**$ 4,910**	**$ 711**	**$ 5,871**	**$ 117**
			—			
Outlays, Net (Total)	4,728	5,847	4,481	650	2,760	109
Distributed Offsetting Receipts (-)	—	—	—	—	—	—
Agency Outlays, Net	**$ 4,728**	**$ 5,847**	**$ 4,481**	**$ 650**	**$ 2,760**	**$ 109**

(continued)

(In Millions of Dollars)	Office of Inspector General	Space Technology	Construction and Environmental Compliance and Restoration	Other	Total
Budgetary Resources:					
Unobligated Balance from Prior Year Budget Authority, Net	$ 2	$ 58	$ 295	$ 28	$ 1,499
Appropriations	39	760	650	2	20,819
Spending Authority from Offsetting Collections	1	—	7	448	3,111
Total Budgetary Resources	**$ 42**	**$ 818**	**$ 952**	**$ 478**	**$ 25,429**
Status of Budgetary Resources:					
New Obligations and Upward Adjustments (Total)	$ 40	$ 772	$ 581	$ 451	$ 23,375
Unobligated Balance, End of Year:					
Apportioned, Unexpired Accounts	1	40	370	17	1,906
Unapportioned, Unexpired Accounts	—	—	—	1	38
Unexpired Unobligated Balance, End of Year	1	40	370	18	1,944
Expired Unobligated Balance, End of Year	1	6	1	9	110
Unobligated Balance, End of Year (Total)	2	46	371	27	2,054
Total Status of Budgetary Resources	**$ 42**	**$ 818**	**$ 952**	**$ 478**	**$ 25,429**
Outlays, Net (Total)	38	732	424	(10)	19,759
Distributed Offsetting Receipts (-)	—	—	—	(5)	(5)
Agency Outlays, Net	**$ 38**	**$ 732**	**$ 424**	**$ (15)**	**$ 19,754**

REQUIRED SUPPLEMENTARY INFORMATION

Combining Statement of Budgetary Resources
For the Fiscal Year Ended September 30, 2017

(In Millions of Dollars)	Space Operations	Science	Exploration	Aeronautics	Safety, Security and Mission Services	Education Mission
Budgetary Resources:						
Unobligated Balance from Prior Year Budget Authority, Net	$ 209	$ 357	$ 84	$ 19	$ 352	$ 18
Appropriations	4,942	5,763	4,324	656	2,768	100
Spending Authority from Offsetting Collections	—	—	—	—	2,479	—
Total Budgetary Resources	**$ 5,151**	**$ 6,120**	**$ 4,408**	**$ 675**	**$ 5,599**	**$ 118**
Status of Budgetary Resources:						
New Obligations and Upward Adjustments (Total)	$ 5,002	$ 5,807	$ 4,319	$ 660	$ 5,143	$ 106
Unobligated Balance, End of Year:						
Apportioned, Unexpired Accounts	90	298	53	13	451	8
Unapportioned, Unexpired Accounts	—	—	28	—	—	—
Unexpired Unobligated Balance, End of Year	90	298	81	13	451	8
Expired Unobligated Balance, End of Year	59	15	8	2	5	4
Unobligated Balance, End of Year (Total)	149	313	89	15	456	12
Total Status of Budgetary Resources	**$ 5,151**	**$ 6,120**	**$ 4,408**	**$ 675**	**$ 5,599**	**$ 118**
			—			
Outlays, Net (Total)	4,237	5,522	4,151	629	2,833	124
Distributed Offsetting Receipts (-)	—	—	—	—	—	—
Agency Outlays, Net	**$ 4,237**	**$ 5,522**	**$ 4,151**	**$ 629**	**$ 2,833**	**$ 124**

(continued)

(In Millions of Dollars)	Office of Inspector General	Space Technology	Construction and Environmental Compliance and Restoration	Other	Total
Budgetary Resources:					
Unobligated Balance from Prior Year Budget Authority, Net	$ 3	$ 81	$ 148	$ 27	$ 1,298
Appropriations	38	686	559	2	19,838
Spending Authority from Offsetting Collections	1	—	6	437	2,923
Total Budgetary Resources	**$ 42**	**$ 767**	**$ 713**	**$ 466**	**$ 24,059**
Status of Budgetary Resources:					
New Obligations and Upward Adjustments (Total)	$ 40	$ 720	$ 443	$ 438	$ 22,678
Unobligated Balance, End of Year:					
Apportioned, Unexpired Accounts	—	42	262	17	1,234
Unapportioned, Unexpired Accounts	—	—	8	1	37
Unexpired Unobligated Balance, End of Year	—	42	270	18	1,271
Expired Unobligated Balance, End of Year	2	5	—	10	110
Unobligated Balance, End of Year (Total)	2	47	270	28	1,381
Total Status of Budgetary Resources	**$ 42**	**$ 767**	**$ 713**	**$ 466**	**$ 24,059**
Outlays, Net (Total)	38	698	484	(14)	18,702
Distributed Offsetting Receipts (-)	—	—	—	(4)	(4)
Agency Outlays, Net	**$ 38**	**$ 698**	**$ 484**	**$ (18)**	**$ 18,698**

REQUIRED SUPPLEMENTARY INFORMATION (continued)

Deferred Maintenance and Repairs for FY 2018

Federal agencies are required to report information related to the estimated cost to remedy deferred maintenance of property, plant and equipment as required supplementary information in accordance with SFFAS No. 42, *Deferred Maintenance and Repairs*.

Maintenance and repairs (M&R) are activities directed toward keeping fixed assets in an acceptable condition. Activities include preventive maintenance; replacement of parts, systems, or components; and other activities needed to preserve or maintain the asset. M&R, as distinguished from capital improvements, excludes activities directed toward expanding the capacity of an asset or otherwise upgrading it to serve needs different from, or significantly greater than, its current use. Deferred maintenance and repairs (DM&R) are M&R activities that were not performed when they should have been or were scheduled to be and which, therefore, are put off or delayed for a future period. DM&R reporting enables the Government to be accountable to citizens for the proper administration and stewardship of its assets. Specifically, DM&R reporting assists users by providing an entity's realistic estimate of DM&R amounts and the effectiveness of asset maintenance practices the entities employ in fulfilling their missions.

Facilities, Buildings, and Other Structures

It is NASA's policy to ensure that NASA-owned and operated assets are properly aligned with the NASA mission and are safe, environmentally sound, affordable, the right type and size, and in acceptable operating condition. NASA's facilities are maintained in the most cost effective fashion to minimize risk to processes and products, protect the safety and health of personnel and the environment, protect and preserve capabilities and capital investments, provide quality work places for NASA employees, and enable the Agency's mission. Estimates reported herein include DM&R for all facilities on-site or off-site that are owned, leased, occupied, or used by NASA (NASA Programs or Contractors) including heritage assets without regard to capitalization thresholds or depreciation status. NASA does not assess DM&R on general land parcels.

Equipment

Pursuant to the cost/benefit considerations provided in SFFAS No. 6 and SFFAS No. 42, NASA has determined that it is not cost beneficial to report DM&R on personal property (capital equipment).

Defining and Implementing M&R Policies

NASA uses a Deferred Maintenance parametric estimating method (DM method) in order to conduct a consistent condition assessment of its facilities, buildings and other structures (including heritage assets). This method measures NASA's current real property asset condition and documents the extent of real property deterioration. The DM method produces both a cost estimate of DM&R, and a Facility Condition Index (FCI). Both measures are indicators of the overall condition of NASA's facilities. The facilities condition assessment methodology involves an independent, rapid visual assessment of nine different systems within each facility to include: structure, roof, exterior, interior finishes, heating, ventilating and air conditioning (HVAC) systems, electrical, plumbing, conveyance, and program support equipment. The DM method is designed for application to a large population of facilities; results are not necessarily applicable for individual facilities or small populations of facilities.

Ranking and Prioritizing M&R Activities

NASA typically prioritizes the M&R activities for health, safety, life safety, fire detection and protection, and environmental requirements. NASA also prioritizes the M&R projects with an emphasis on mission critical facilities, followed by mission support, then Center support. The evaluation of the facility conditions by building type indicates that NASA continues to focus M&R activities on direct mission-related facilities and infrastructure.

REQUIRED SUPPLEMENTARY INFORMATION (continued)

Deferred Maintenance and Repairs for FY 2018 (continued)

Factors Considered in Determining Acceptable Condition Standards

NASA applies industry accepted codes and standards or equipment manufacturer's recommendations to all facilities related work. The standard of condition depends on the intended use, the mission criticality, utilization or health and safety aspects of that use.

Changes from Prior Year

As of September 30, 2018, $2.56 billion of DM&R was estimated to be required to return real property assets to an acceptable operating condition. This is an overall increase of $131 million from September 30, 2017. The increase in the DM&R estimate can be attributed to various reasons including changes to deterioration of facilities due to natural disasters, damage from testing to Program Support Equipment (PSE) in high-value assets, and large increases in Current Replacement Value (CRV) of high value infrastructure assets as upgrades progress.

NASA performs deferred maintenance (DM) assessment on Real Property Assets in a two-year cycle. In FY 2017, the DM assessment was performed on half of NASA's Real Property Assets and in FY 2018, the remaining assets were assessed. These alternating assessments result in a physical assessment of all Real Property Assets in a two-year cycle.

(In Millions of Dollars)	2018	2017
Asset Category		
Real Property	$ 2,544	$ 2,416
Heritage Assets - Real Property	15	12
Total Deferred Maintenance and Repairs	**$ 2,559**	**$ 2,428**

NASA OFFICE OF INSPECTOR GENERAL

SUITE 8U37, 300 E ST SW
WASHINGTON, D.C. 20546-0001

November 15, 2018

TO: James F. Bridenstine
Administrator

Jeff DeWit
Chief Financial Officer

SUBJECT: *Audit of NASA's Fiscal Year 2018 Financial Statements* (Report No. IG-19-004; Assignment No. A-18-006-00)

Dear Administrator Bridenstine and Mr. DeWit,

The Office of Inspector General contracted with the independent public accounting firm CliftonLarsonAllen LLP (CLA) to audit NASA's fiscal year (FY) 2018 financial statements. CLA performed the audit in accordance with the Government Accountability Office's (GAO) *Government Auditing Standards* and the Office of Management and Budget's Bulletin No. 19-01, "Audit Requirements for Federal Financial Statements."

This audit resulted in an unmodified opinion on NASA's FY 2018 financial statements (see attached Enclosure). An unmodified opinion means the financial statements present fairly, in all material respects, the financial position and results of NASA's operations in conformity with U.S. generally accepted accounting principles.

CLA also reported on NASA's internal control and compliance with laws and regulations. For FY 2018, CLA identified one significant deficiency related to information technology management. Further, CLA closed the previously reported significant deficiency related to recording certain liabilities related to the Jet Propulsion Laboratory. CLA did not identify any instances of noncompliance this year.

In connection with the contract, we reviewed CLA's report and related documentation and inquired of its representatives. Our review, as differentiated from an audit of the financial statements in accordance with GAO's *Government Auditing Standards*, was not intended to enable us to express, and we do not express, an opinion on NASA's financial statements, conclusions about the effectiveness of internal control over financial reporting, or conclusions on compliance with certain laws and regulations, including but not limited to the Federal Financial Management Improvement Act of 1996. Rather, CLA is responsible for the enclosed auditor's report dated November 15, 2018, and the conclusions expressed therein. However, our review disclosed no instances where CLA did not comply, in all material respects, with GAO's *Government Auditing Standards*.

We appreciate the courtesies extended to our team during the audit. Please contact Jim Morrison, Assistant Inspector General for Audits, at 202-358-0378 or james.l.morrison@nasa.gov if you have any questions about the enclosed report.

Sincerely,

Paul K. Martin
Inspector General

Enclosure – 1

CliftonLarsonAllen LLP
CLAconnect.com

INDEPENDENT AUDITORS' REPORT

Administrator
National Aeronautics and Space Administration

Inspector General
National Aeronautics and Space Administration

Report on the Financial Statements

We have audited the accompanying consolidated financial statements of the National Aeronautics and Space Administration (NASA), which comprise the consolidated balance sheets as of September 30, 2018 and 2017, and the related consolidated statements of net cost and changes in net position, and the combined statements of budgetary resources for the years then ended, and the related notes to the consolidated financial statements (collectively referred to as financial statements).

Management's Responsibility for the Financial Statements

NASA management is responsible for the preparation and fair presentation of these financial statements in accordance with accounting principles generally accepted in the United States of America (U.S.); this includes the design, implementation, and maintenance of internal control relevant to the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error.

Auditors' Responsibility

Our responsibility is to express an opinion on these financial statements based on our audits. We conducted our audits in accordance with auditing standards generally accepted in the U.S.; the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States; and Office of Management and Budget (OMB) Bulletin No. 19-01, *Audit Requirements for Federal Financial Statements* (OMB Bulletin 19-01). Those standards and OMB Bulletin 19-01 require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditors' judgment, including the assessment of the risk of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control.

INDEPENDENT AUDITORS' REPORT (Continued)

Accordingly, we express no such opinion. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of significant accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinions.

Opinion on the Financial Statements

In our opinion, the consolidated financial statements referred to above present fairly, in all material respects, the financial position of the National Aeronautics and Space Administration as of September 30, 2018 and 2017 and its net cost, changes in net position, and budgetary resources for the years then ended, in accordance with accounting principles generally accepted in the U.S.

Other Matters

Required Supplementary Information

Accounting principles generally accepted in the U.S. require that the information in NASA's Management Discussion and Analysis (MD&A), Required Supplementary Information (RSI), and Required Supplementary Stewardship Information (RSSI) sections be presented to supplement the financial statements. Such information, although not a part of the financial statements, is required by the Federal Accounting Standards Advisory Board, who considers it to be an essential part of financial reporting for placing the financial statements in an appropriate operational, economic, or historical context. We have applied certain limited procedures to the required supplementary information in accordance with auditing standards generally accepted in the U.S., which consisted of inquiries of management about the methods of preparing the information and comparing the information for consistency with management's responses to our inquiries, the financial statements, and other knowledge we obtained during our audits of the financial statements. We do not express an opinion or provide any assurance on this information because the limited procedures do not provide us with sufficient evidence to express an opinion or provide any assurance.

Other Information

Our audits were conducted for the purpose of forming an opinion on the financial statements as a whole. All other sections referred to in the Agency Financial Report (AFR) table of contents, exclusive of the MD&A; Financial Statements, Notes, and Supplemental Information; and Independent Auditors' Report, are presented for purposes of additional analysis and are not a required part of the financial statements. In addition, management has included references to information on websites or other data outside of the AFR. This information has not been subjected to the auditing procedures applied in the audits of the financial statements, and accordingly, we do not express an opinion or provide any assurance on it.

INDEPENDENT AUDITORS' REPORT (Continued)

Report on Internal Control over Financial Reporting and on Compliance and Other Matters Based on an Audit of Financial Statements Performed in Accordance with *Government Auditing Standards*

Internal Control over Financial Reporting

In planning and performing our audit of the consolidated financial statements as of and for the year ended September 30, 2018, we considered NASA's internal control over financial reporting (internal control) to determine the audit procedures that are appropriate in the circumstances for the purpose of expressing our opinion on the financial statements, but not for the purpose of expressing an opinion on the effectiveness of NASA's internal control. Accordingly, we do not express an opinion on the effectiveness of NASA's internal control.

A *deficiency* in internal control exists when the design or operation of a control does not allow management or employees, in the normal course of performing their assigned functions, to prevent, or detect and correct, misstatements on a timely basis. A *material weakness* is a deficiency, or a combination of deficiencies, in internal control, such that there is a reasonable possibility that a material misstatement of NASA's financial statements will not be prevented, or detected and corrected on a timely basis. A *significant deficiency* is a deficiency, or a combination of deficiencies, in internal control that is less severe than a material weakness, yet important enough to merit attention by those charged with governance.

Our consideration of internal control was for the limited purpose described in the first paragraph of this section and was not designed to identify all deficiencies in internal control that might be material weaknesses or significant deficiencies and therefore, material weaknesses or significant deficiencies may exist that have not been identified. Given these limitations, during our audit we did not identify any deficiencies in internal control that we consider to be material weaknesses. However, we did identify a certain deficiency in internal control that we consider to be a significant deficiency. This deficiency is listed below and described in **Exhibit A**:

- Information Technology Management

Compliance with Laws, Regulations, Contracts, and Grant Agreements

As part of obtaining reasonable assurance about whether NASA's financial statements are free from material misstatement, we performed tests of its compliance with certain provisions of laws, regulations, contracts, and grant agreements, noncompliance with which could have a direct effect on the determination of material financial statement amounts and disclosures. However, providing an opinion on compliance with those provisions was not an objective of our audit, and accordingly, we do not express such an opinion. The results of our tests for the year ended September 30, 2018 disclosed no instances of noncompliance or other matters that are required to be reported in accordance with *Government Auditing Standards* or OMB Bulletin 19-01.

We also performed tests of compliance with certain provisions of the Federal Financial Management Improvement Act of 1996 (FFMIA). However, providing an opinion on compliance with FFMIA was not an objective of our audit, and accordingly, we do not express such an opinion. The results of our tests of these provisions disclosed no instances in which NASA's financial management systems did not comply substantially with (1) Federal financial management systems requirements, (2) applicable Federal accounting standards, or (3) the United States Standard General Ledger (USSGL) at the transaction level.

INDEPENDENT AUDITORS' REPORT (Continued)

Management's Responsibility for Internal Control and Compliance

Management is responsible for (1) evaluating the effectiveness of internal control over financial reporting based on criteria established under the Federal Managers' Financial Integrity Act of 1982 (FMFIA), (2) providing a statement of assurance on the overall effectiveness on internal control over financial reporting, (3) ensuring NASA's financial management systems comply substantially with FFMIA requirements, and (4) complying with other applicable laws, regulations, contracts, and grant agreements.

Auditors' Responsibilities

We are responsible for: (1) obtaining a sufficient understanding of internal control over financial reporting to plan the audit, (2) testing whether NASA's financial management systems comply substantially with the FFMIA requirements referred to above, and (3) testing compliance with certain provisions of laws, regulations, contracts, and grant agreements.

We did not evaluate all internal controls relevant to operating objectives as broadly established by the FMFIA, such as those controls relevant to preparing statistical reports and ensuring efficient operations. We limited our internal control testing to controls over financial reporting. Because of inherent limitations in internal control, misstatements due to error or fraud, losses, or noncompliance may nevertheless occur and not be detected. We also caution that projecting our audit results to future periods is subject to risk that controls may become inadequate because of changes in conditions or that the degree of compliance with controls may deteriorate. In addition, we caution that our internal control testing may not be sufficient for other purposes.

We did not test compliance with all laws, regulations, contracts, and grant agreements applicable to NASA. We limited our tests to certain provisions of laws, regulations, contracts, and grant agreements noncompliance with which could have a direct effect on the determination of material financial statement amounts and disclosures. However, providing an opinion on compliance with those provisions was not an objective of our audit, and accordingly, we do not express such an opinion. We caution that noncompliance may occur and not be detected by these tests and that such testing may not be sufficient for other purposes. Also, our work on FFMIA would not necessarily disclose all instances of noncompliance with FFMIA requirements.

Management's Response to Findings

Management's response to the finding identified in our report is presented in **Exhibit B**. We did not audit NASA's response and, accordingly, we express no opinion on it.

Status of Prior Year's Control Deficiencies and Noncompliance Issue

We have reviewed the status of NASA's corrective actions with respect to the findings included in the prior year's Independent Auditors' Report, dated November 15, 2017. The status of prior year findings is presented in **Exhibit C**.

Purpose of the Report on Internal Control over Financial Reporting and on Compliance

The purpose of the Report on Internal Control over Financial Reporting and on Compliance is solely to describe the scope of our testing of internal control and compliance and the results of that testing, and not to provide an opinion on the effectiveness of NASA's internal control or on compliance. These reports are an integral part of an audit performed in accordance with

INDEPENDENT AUDITORS' REPORT (Continued)

Government Auditing Standards in considering NASA's internal control and compliance. Accordingly, these reports are not suitable for any other purpose.

CliftonLarsonAllen LLP

Greenbelt, Maryland
November 15, 2018

INDEPENDENT AUDITORS' REPORT (Continued)
EXHIBIT A
Significant Deficiency
September 30, 2018

Information Technology Management

Background

The United States Government Accountability Office (GAO) has stated that protecting government computer systems has never been more important because of the complexity and interconnectivity of systems (including those exposed to the Internet and wireless connections), the ease of obtaining and using hacking tools, the steady advances in the sophistication and effectiveness of attack technologies, and the emergence of new and more destructive attacks. Further, the boundary lines between internal and external networks are diminishing as a result of increased interconnectivity. GAO cited challenges, such as maintaining software at current versions with the latest security patches to protect against known vulnerabilities, as contributing factors to weaknesses within Federal agency security programs.

To address these issues throughout the government, the Office of Management and Budget (OMB) revised OMB Circular No. A-130, *Managing Federal Information as a Strategic Resource* (OMB Circular A-130). This circular defines agencies' responsibilities for protecting Federal information resources. NASA relies extensively on Information Technology (IT) system controls to govern the initiation and authorization of financial transactions at user workstations, and the transmission of those transactions across the network to servers that record, process, summarize, and report financial transactions in support of the financial statements. Internal controls over these financial and supporting operations are essential to ensure the confidentiality, integrity, and availability (C-I-A) of critical data while reducing the risk of error, fraud, and other illegal acts.

Information Technology Conditions

IT controls include general controls (at the network, system, and application layers), as well as application business process controls. General controls are the policies and procedures that apply to all or a large segment of an entity's information systems and help ensure their proper operation. The effectiveness of general controls is a significant factor in establishing the effectiveness of business process application controls. Application level general controls consist of general controls operating at the business process application level, including those related to security management, access controls, configuration management, segregation of duties, and contingency planning. Weaknesses in application level general controls can result in unauthorized access, use, disclosure, disruption, modification, or destruction of applications and application data. Without effective general application controls, business process application controls may be rendered ineffective by circumvention or modification.

One of the key general control areas includes configuration management controls. Configuration management controls are intended to provide reasonable assurance that systems, networks, and applications are configured and operating securely. Vulnerability management, an important component of configuration management, specifically addresses mitigating the risks associated with known vulnerabilities.

Since 2015, we noted that NASA did not have an effective vulnerability management process relating to monitoring, detecting, and remediating known vulnerabilities. Specifically, we noted deficiencies in the following areas: A) Patch Management, B) Configuration Weaknesses, and C) Unsupported Software. In addition, since 2016, we noted that NASA had additional control deficiencies at the financial system application layer related to segregation of duties (SoD), user administration and least privilege, and audit logging and monitoring.

INDEPENDENT AUDITORS' REPORT (Continued)
EXHIBIT A
Significant Deficiency
September 30, 2018

To address the prior year issues, management developed short-term and long-term corrective action plans to remediate the weaknesses. The plans included creating new and enhancing existing processes, as well as acquiring audit logging tools. For example, NASA management acquired and is in the process of fully implementing a new logging tool to capture application logs, correlate audit events, and send alerts on suspicious activity to applicable parties. In addition, management has implemented a project team to review and expand the scope and extent of NASA's financial system's SoD monitoring controls. It is recognized that it will take time to effectively implement and execute the corrective action plans across the enterprise. As such, we found security weaknesses similar in type and risk level to our prior year findings.

While NASA was able to successfully remediate several prior year findings related to specific vulnerabilities exploited, NASA did not substantially address deficiencies in its vulnerability management program identified in the prior year. The vulnerability management program continued to insufficiently address the monitoring, detection, and timely remediation of vulnerabilities associated with the financial application and general support systems. Specifically, a substantial number of critical and high severity vulnerabilities remained outstanding for an extensive period of time, contrary to NASA policies and procedures. These weaknesses expose NASA to significant risk of exploitation. Below are the categories of control deficiencies related to NASA's vulnerability management program:

1. **Patch Management** – Systems, applications, and networks supporting financial applications were not patched in accordance with NASA guidelines to mitigate information security vulnerabilities. Patching is usually the most effective way to mitigate security flaws in software. Failure to apply patches timely increases the risk that known vulnerabilities will be exploited.

2. **Configuration Weaknesses** – Operating systems and applications were inadequately configured, which placed key financial systems at unnecessary risk of unauthorized access and manipulation. Default settings are publicly available on the Internet and are well known by attackers. These settings can be exploited to gain unauthorized access that can compromise the C-I-A of sensitive information. Failure to change weak security configurations could result in successful attacks on NASA's financial and supporting systems.

3. **Unsupported Software** – Systems and programs, which were no longer fully supported by the associated software vendors, remained unsupported for an extended period of time and continued to expose NASA to vulnerabilities that cannot be sufficiently mitigated.

NASA relied on its defense in depth (DiD) approach, the intent of which was to implement controls at each layer of the IT environment, in order to comprehensively address security risks from vulnerabilities. While we found that NASA had implemented certain defensive technologies and processes to protect the C-I-A of NASA's data, we noted deficiencies in NASA's DiD approach. Specifically, NASA did not substantially address prior year deficiencies related to its financial systems' general application controls, outlined below:

1. **Segregation of Duties (SoD)** – NASA's financial system's SoD management tool was not appropriately configured to comprehensively prevent or detect SoD conflicts.

INDEPENDENT AUDITORS' REPORT (Continued)
EXHIBIT A
Significant Deficiency
September 30, 2018

2. **User Administration and Least Privilege** – We noted terminated financial system users' access rights were not consistently disabled in a timely manner, and financial supporting systems users' access rights were not consistently recertified. Finally, we noted instances where not all available application layers of security were being utilized to form a comprehensive layered "defense in depth" approach.

3. **Audit Logging and Monitoring** – NASA did not have an effective process to review financial systems audit logs to address suspicious and potentially harmful activity.

NASA did not follow internal and Federal standards in implementing configuration management and access controls as noted by the following standards:

- NASA Information Technology Security Handbook, *Security Categorization, Risk Assessment, Vulnerability Scanning, Expedited Patching, & Organizationally Defined Values,* (ITS-HBK 2810.04-01A) outlines the mitigation requirements for non-mission systems as follows: expedited patches within seven business days; non-expedited patches within 30 days; high and medium vulnerabilities from monthly scans within 30 days of scan date; high and medium vulnerabilities from quarterly scans within 90 days from scan date; and low vulnerabilities from monthly and quarterly scans within 180 days from scan date.

- OMB Circular A-130, *Managing Information as a Strategic Resource*, Appendix I, establishes minimum requirements for Federal information programs and assigns Federal agency responsibilities for the security of information and information systems. The Circular specifically prohibits agencies from the use of unsupported information systems and system components, and requires agencies to ensure that systems and components that cannot be appropriately protected or secured are given a high priority for upgrade or replacement. In addition, the Circular requires agencies to implement and maintain current updates and patches for all software and firmware components of information systems.

- The National Institute of Standards and Technology (NIST) Special Publication (SP) 800-53, Revision 4, *Security and Privacy Controls for Federal Information Systems and Organizations*, security controls related to patch management, configuration management and access controls note the following:

  - SI-2, Flaw Remediation, states that an organization must identify information systems affected by announced software flaws, including potential vulnerabilities resulting from those flaws, and report this information to designated organizational personnel with information security responsibilities. Security-relevant software updates include, for example, patches, service packs, hot fixes, and anti-virus signatures.
  - SI-3, Malicious Code Protection, states that an organization employs malicious code protection mechanisms at information system entry and exit points to detect and eradicate malicious code.
  - SC-7, Boundary Protection, states that the information system monitors and controls communication at the external boundary of the system and at key internal boundaries within the system.

INDEPENDENT AUDITORS' REPORT (Continued)
EXHIBIT A
Significant Deficiency
September 30, 2018

- AU-6, Audit Review, Analysis and Reporting, states that an organization must review and analyze information system audit records for indications of inappropriate or unusual activity.
- AC-2, Account Management, states that an organization creates, modifies, disables, and removes information system accounts in accordance with organizational defined procedures.
- AC-5, Separation of Duties, states that an organization must separate organizationally defined duties of individuals, document separation of duties of individuals, and define information system access authorizations to support separation of duties.
- AC-6, Least Privilege, states that an organization must employ the principle of least privilege, allowing only authorized access for users (or processes acting on behalf of users) which are necessary to accomplish assigned tasks in accordance with organizational missions and business functions.
- AT-3, Security Awareness Training – supplemental guidance, states that organizations determine the appropriate content of security awareness training and security awareness techniques based on the specific organizational requirements. The content includes a basic understanding of the need for information security and user actions to maintain security and to respond to suspected security incidents.
- CM-7, Least functionality, states that an organization configures the information system to provide only essential functions; and prohibits or restricts the use of functions, ports, protocols, and services based on organizational defined prohibited or restricted functions, ports, protocols and/or services.

- NIST SP 800-40, Revision 3, *Guide to Enterprise Patch Management Technologies*, states that patches are usually the most effective way to mitigate software flaw vulnerabilities, and are often the only fully effective solution. Sometimes there are alternatives to patches, such as temporary workarounds involving software or security control reconfiguration, but these workarounds often negatively impact functionality.

Absent an effectively implemented and enforced configuration management program that addresses significant security weaknesses, there is an increased risk that financial information may be inadvertently or deliberately disclosed, manipulated, or misappropriated. Additionally, inappropriate or unnecessary changes may be made to key financial information systems, which could result in compromising the accuracy and integrity of financial information. Further, without effective application access controls, there is an increased risk of unauthorized or inappropriate access to financial and sensitive data.

We have provided NASA management with separate notices of findings and recommendations (NFRs) and a limited distribution report that further details IT control deficiencies and vulnerabilities in NASA's systems respectively. Due to the sensitivity of the subject matter, we have not discussed those matters in detail in this report.

Recommendations:
We recommend that NASA enhance its efforts to analyze and prioritize remediation to address security and control deficiencies with a focus on key tasks that include, but are not limited to:

1. Improve the patch and vulnerability management program.
2. Eliminate configuration weaknesses.

INDEPENDENT AUDITORS' REPORT (Continued)
EXHIBIT A
Significant Deficiency
September 30, 2018

3. Improve technical controls, including controls that monitor and control communications at the boundary of information systems.
4. Enhance the effectiveness of the security awareness training program.
5. Improve the scope and extent of segregation of duties monitoring controls.
6. Improve user administration controls, specifically around terminations and user access recertification.
7. Utilize available layers of application security controls to enhance the existing "defense in depth" approach.
8. Improve the scope and extent of audit logging and review controls.

EXHIBIT B

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

November 15, 2018

Office of the Chief Financial Officer

TO: Inspector General

FROM: Chief Financial Officer

SUBJECT: Management Response to Report of Independent Auditors

I am pleased to accept your audit report on the Consolidated Financial Statements of the National Aeronautics and Space Administration (NASA) for FY 2017 and FY 2018. The Agency's efforts and achievements toward improved financial management are clearly reflected in the audit opinion. For the eighth year in a row, NASA has received an unmodified "clean" opinion on its financial statements with no reported material weaknesses. Further, NASA continues to be in substantial compliance with the Federal Financial Management Improvement Act.

NASA's independent auditors (CliftonLarsonAllen (CLA)) reported one significant deficiency related to Information Technology (IT) Configuration Management. NASA's response to this deficiency is provided below.

Information Technology Configuration
The annual financial statement audit has provided NASA with additional insight to areas where enhancement in protecting the confidentiality, integrity, and availability of financial data is warranted. NASA takes all findings seriously, as evidenced by the immediate addressing of a substantial portion of the FY 2017 findings. NASA continues to make steady improvement in all aspects of the Agency cybersecurity protection program. The annual financial statement audit findings are factored into the Agency's multi-year strategy to improve the security of NASA IT systems. While the vulnerability management program tracks and addresses all vulnerabilities, immediate emphasis remains on any Critical and High vulnerabilities identified through critical work such as the annual financial audit.

NASA notes that, without the internal access provided to CLA by NASA to conduct in-depth vulnerability and penetration testing, CLA would have been otherwise unable to access the required levels of systems information and interface. NASA considers this a significant improvement in the Agency's cybersecurity posture.

NASA continues improving the Agency vulnerability management program by holding system owners accountable, increasing management visibility, and refining vulnerability detection efforts. An example of this focus is the roll-out of a 120-day vulnerability mitigation campaign, accompanied by monthly and quarterly vulnerability detection campaigns which target configuration related weaknesses such as looking for systems deployed with default username and password. It should be noted that NASA management proactively established a more stringent and consistent process for documenting, reviewing and approving risk based decisions and closing corrective action plans, to include the proof of remediation.

In addition to these efforts, NASA continues the deployment of improved system management and patching tools and a zoning architecture that ensures that only authorized systems are allowed on the network. These enhanced tools, as well as, leveraging the capabilities of the tool suite from the deployment of the Department of Homeland Security (DHS) Continuous Diagnostics and Mitigation (CDM) across the NASA information systems, have improved NASA's ability to detect and mitigate vulnerabilities. This architecture is key to enabling the agency to test systems for compliance and if they are not then the systems can be moved into a quarantine zone for remediation.

CLA's review also identified potential opportunities to strengthen NASA's Defense in Depth (DiD) controls, some of which have been addressed and the remainder are being evaluated for improvement. NASA will continue to work with the contracted financial systems auditors to address and resolve these issues in the coming fiscal year.

I appreciate the efforts and leadership of NASA's OIG and of the auditors throughout the audit of NASA's financial statements and related internal controls over financial reporting. Please convey my sincere appreciation and thanks to your team for the professionalism and cooperation exhibited during this audit.

for Jeff DeWit
Chief Financial Officer

Concur:

Renee P. Wynn
Chief Information Officer

INDEPENDENT AUDITORS' REPORT (Continued)
EXHIBIT C
Status of Prior Year's Significant Deficiencies
September 30, 2018

Our assessment of the current status of the prior year control deficiencies is presented below:

Fiscal Year 2017 Finding	Fiscal Year 2018 Status
Significant Deficiency 1 – Information Technology Management	Repeat – See Exhibit A.
Significant Deficiency 2 – Recording Certain Liabilities Related to the Jet Propulsion Laboratory	Closed – The severity of the deficiency was lessened in FY 2018.

SECTION 3

OTHER INFORMATION

The two-stage Falcon 9 launch vehicle lifts off Space Launch Complex 40 at Cape Canaveral Air Force Station carrying the Dragon resupply spacecraft to the ISS. Liftoff was on December 15, 2017 at 10:36 a.m. Eastern Standard Time (EST). On its 13th commercial resupply services mission to the ISS, Dragon (CRS-13) brought up supplies, equipment and new science experiments for technology research. The SpaceX Dragon spacecraft will delivered about 4,800 pounds of cargo and material to support science investigations aboard the space station. Photo Credit: NASA/Tony Gray and Sandra Joseph

NASA OFFICE OF INSPECTOR GENERAL

SUITE 8U37, 300 E ST SW
WASHINGTON, D.C. 20546-0001

November 15, 2018

TO: James F. Bridenstine
Administrator

SUBJECT: *2018 Report on NASA's Top Management and Performance Challenges*

Dear Administrator Bridenstine,

As required by the Reports Consolidation Act of 2000, this annual report provides our views of the top management and performance challenges facing NASA for inclusion in the 2018 Agency Financial Report. We previously provided a draft copy of this document to NASA officials and considered all comments received when finalizing our report.

Similar to past years, in deciding whether to identify an issue as a top challenge we considered its significance in relation to NASA's mission; whether the underlying causes are systemic in nature; its susceptibility to fraud, waste, and abuse; and the Agency's progress in addressing the challenge. Not surprisingly, given the importance and scope of the issues, this year's list includes many of the same challenges discussed in previous reports.

Looking to 2019, we organized the top management and performance challenges facing NASA under the following topics:

- Space Flight Operations in Low Earth Orbit
- Deep Space Exploration
- NASA's Science Portfolio
- Information Technology Governance and Security
- Infrastructure and Facilities
- Contracting and Grants

During the coming year, the Office of Inspector General plans to conduct audits and investigations that focus on NASA's continuing efforts to meet these and other challenges.

Sincerely,

Paul K. Martin
Inspector General

Enclosure

NASA'S TOP MANAGEMENT AND PERFORMANCE CHALLENGES—NOVEMBER 2018

This annual report provides the Office of Inspector General's (OIG) independent assessment of the top management and performance challenges facing NASA, which we organize under the following topics:

- Space Flight Operations in Low Earth Orbit
- Deep Space Exploration
- NASA's Science Portfolio
- Information Technology Governance and Security
- Infrastructure and Facilities
- Contracting and Grants

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 the part of NASA. 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.

The challenges described in this report correspond to those we identified in last year's report apart from separating out NASA's low Earth orbit space flight activities as a standalone challenge rather than including it (as we did in 2017) as part of "Deep Space Exploration." Finally, as in previous years the challenges are not listed in priority order.

Space Flight Operations in Low Earth Orbit

For the past 20 years, the International Space Station (ISS or Station) has served as NASA's primary platform for conducting space flight operations and research in low Earth orbit. From 1998 through 2011, NASA primarily relied on its Space Shuttle fleet to ferry astronauts and materials to the Station. With the Shuttle's retirement in 2011, NASA initially relied on European and Japanese vehicles to ferry cargo and the Russian Soyuz spacecraft to transport crew while partnering with U.S. corporations to develop privately owned and operated cargo and crew transportation systems.[1] Unlike the Shuttle, NASA does not own these systems but instead purchases flights from these companies to carry NASA supplies and crew to the ISS. The ISS Program is currently authorized by Congress and scheduled to continue operations until October 1, 2024.

NASA's current plan beyond 2024 is to begin leveraging private industry to help lower the government's costs for maintaining access to low Earth orbit. This would include potentially transitioning responsibility for operating the Station—in whole or in part—to a commercial entity and allow NASA to become one of many public and private users. NASA expects this transition could offset some of the Agency's $3 to $4 billion annual investment in ISS operations, provide more cost-effective Station operations through increased private sector investment, and spur greater commercial development of low Earth orbit.

International Space Station

A significant amount of research aboard the ISS is related to: (1) understanding and mitigating the health and performance risks associated with human space travel (such as protecting against bone loss and eyesight degeneration) to overcome challenges that may develop during long-duration exploration missions and (2) testing new technologies necessary for cislunar and deep space exploration.

In July 2018, we reported that research for at least 6 of 20 human health risks that require the ISS for testing and 4 of 40 technology gaps will not be completed by the end of fiscal year (FY) 2024 when funding for the Station's operation is scheduled to end.[2] In addition, research into 2 human health risks and 17 technology gaps is not scheduled to be completed until around 2024, which increases the risk that even minor schedule slippage could push completion past when the funding runs out at the end of that fiscal year. As a result, NASA may be forced to choose among a variety of options, including extending operation of the ISS past 2024, relying on alternate testing methods (i.e., non-space-based), or accepting higher levels of risk for future missions.

International Space Station

Source: NASA.

NASA's contract with Roscosmos for seats on the Soyuz to transport U.S. astronauts to the ISS ensures access to the Station continues through early 2020. Consequently, delays in NASA's efforts to develop and certify commercial crew vehicles could leave the United States without a means to transport its astronauts to the Station. Moreover, while the amount of research conducted on the ISS has increased over the past 8 years, several factors continue to limit the Station's full utilization. In particular, many of the investigations require hands-on participation by crew members in some capacity, especially those related to human health research. However, because the amount of time available for crew to conduct these investigations is limited, they are not able to utilize the ISS to its full research capacity. In addition, a limited number of external payload sites and limited capability to store research samples on the Station affects utilization rates. Moreover, launch failures of two commercial resupply missions—one from Orbital ATK in October 2014 and one from Space Exploration Technologies Corporation (SpaceX) in June 2015—led to compressed launch schedules in FYs 2016 and 2017 and affected researchers' ability to obtain samples

[2] NASA OIG, *NASA's Management and Utilization of the International Space Station* (IG-18-021, July 30, 2018).

and data from the ISS. Lastly, NASA must also share its research capacity on the ISS with the Center for the Advancement of Science in Space (CASIS) and honor its agreements with international partners, commitments that reduce the amount of research resources available to NASA.[3]

The United States has invested more than $90 billion in the ISS over the last 25 years, and the Station continues to account for about half of NASA's annual human space flight budget.[4] In FY 2017, NASA's cost to operate the Station—including on-orbit vehicle operations, research, crew transportation, and cargo resupply missions—was almost $3 billion, which the Agency projects will increase to approximately $3.5 billion in the 2020s. Balancing continued ISS research to mitigate human exploration risks with the need to develop and test key systems required for reaching Mars will challenge the Agency's resources well into the next decade.

Our audit work found that NASA's plan to transition the ISS to private operation under the timetable currently envisioned presents significant challenges in stimulating private sector interest for such a costly and complex enterprise. Likewise, any extension of the ISS past 2024 would require continued funding of $3 to $4 billion annually to operate and maintain the Station—a significant portion of funding which could otherwise be redirected to develop systems needed for NASA's cislunar, lunar, or deep space ambitions. In addition, extending the Station's life beyond 2024 challenges the Agency to manage the risks associated with continued operation of its aging systems and infrastructure. Moreover, any extension will require the support of NASA's international partners whose continued participation hinges on issues ranging from geopolitics to differing space exploration goals. Lastly, at a future date NASA will need to decommission and deorbit the ISS, either in response to an emergency or at the end of its useful life. However, the Agency has not finalized its plans and currently does not have the capability to ensure the ISS will safely reenter the Earth's atmosphere and land in a targeted location in the South Pacific Ocean.

Commercial Transportation to the International Space Station

Since the last flight of the Space Shuttle in 2011, NASA has relied on commercial contractors to deliver cargo and the Russian Soyuz to transport crew to the ISS while the Agency works with two companies to develop crew transportation capabilities. Both cargo and crew contractors have faced delays and setbacks. Two failed missions lost critical ISS cargo and impacted resupply schedules, while crew vehicle development and certification delays have pushed back the first demonstration flights from 2016 to no earlier than 2019, which as discussed previously could result in a gap in NASA access to the Station. Together, commercial cargo and crew transportation account for about 50 percent of total ISS annual spending.[5] Under the existing contracts for commercial resupply services, NASA plans to award more than $20 billion for commercial cargo and crew transportation services to the ISS through 2024. As of the end of 2017, NASA awarded $17.8 billion towards this total—$9.3 billion for cargo and $8.5 billion for crew activities.[6]

[3] CASIS is the organization chosen by NASA to manage non-NASA research activities on the U.S. portion of the ISS, known as the National Laboratory.

[4] This figure includes $30.7 billion for 37 supporting Space Shuttle flights.

[5] ISS Program funding does not include commercial crew development activities, which are funded separately through the Commercial Crew Program.

[6] A NASA award includes past and future expenditures that have already been committed through a contract task order or Space Act Agreement milestone. This does not include minimum mission guarantee costs that are not yet on task orders.

Cargo Resupply

NASA's first Commercial Resupply Services (CRS-1) contracts for cargo missions—valued at $1.9 billion and $1.6 billion for Orbital ATK and SpaceX, respectively—are nearing completion.[7] Through January 2020, the companies are scheduled to complete 31 missions to deliver supplies and equipment to the Station (upmass) and, depending on the requirements of the mission, either return equipment and research experiments to Earth or dispose of waste (downmass).[8]

For CRS-1, NASA selected two companies to ensure redundancy if one was unable to perform due to technical or other reasons. This strategy proved effective when both companies experienced mission failures and schedule delays—issues that NASA managers said were expected given the complexities involved in developing new launch vehicles and spacecraft. Orbital ATK encountered the first CRS-1 failure when its third mission failed seconds after liftoff on October 28, 2014.[9] Eight months later, SpaceX's seventh CRS-1 mission failed during launch on June 28, 2015.[10] The failure of a second SpaceX Falcon 9 launch vehicle in September 2016 during a static fire test for a non-NASA customer also impacted the CRS-1 schedule.[11]

Despite these setbacks, NASA officials generally view the CRS-1 contracts as successful, with roughly 45,000 kilograms (kg) of cargo delivered to the ISS from October 2012 through December 2017 and another 33,000 kg in upmass capability planned for delivery through the final CRS-1 mission in 2020. Through December 2017, NASA spent $5.12 billion on CRS-1 activities and is projected to spend an additional $810 million through completion of the contract's final cargo resupply mission in 2020.

In January 2016, NASA awarded follow-on cargo resupply contracts known as CRS-2 to Orbital ATK, SpaceX, and the Sierra Nevada Corporation (Sierra Nevada). Each company is guaranteed at least six cargo missions under the CRS-2 contract. As of December 2017, NASA had awarded $2.6 billion on these contracts with a combined, not-to-exceed value of $14 billion. NASA officials explained they selected three rather than two companies during the second round of the cargo resupply contracts to increase cargo capabilities and ensure more redundancy in the event of a contractor failure or schedule delay.

We examined the CRS contracts in an April 2018 audit report with a special emphasis on the CRS-2 contracts.[12] We found that during the CRS-2 solicitation and award process, NASA followed federal procurement rules and applied lessons learned from the CRS-1 contract to provide the ISS Program with better cargo capabilities, more transport flexibility, additional insurance coverage for NASA payloads, and clearer government insight into subcontractor activities. Further, we noted that NASA could

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[7] Between 2006 and 2008, NASA entered into a series of funded Space Act Agreements with Orbital ATK, SpaceX, and other private companies to stimulate development of space flight systems capable of transporting cargo to the ISS. CRS-1 contracts were awarded in 2008 while development was still underway.

[8] The SpaceX capsule returns intact and therefore can carry experiments and other cargo back to Earth. In contrast, Orbital ATK's capsule burns up upon reentry to Earth's atmosphere and therefore can only be used to remove waste from the Station.

[9] For more information about the Orbital ATK failure, see NASA OIG, *NASA's Response to Orbital's October 2014 Launch Failure: Impacts on Commercial Resupply of the International Space Station* (IG-15-023, September 17, 2015).

[10] For more information about the SpaceX failure, see NASA OIG, *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).

[11] The failure destroyed AMOS-6, a private communications satellite owned by Spacecom.

[12] NASA OIG, *Audit of Commercial Resupply Services to the International Space Station* (IG-18-016, April 26, 2018).

potentially obtain additional savings under the CRS-2 contracts by competing future cargo resupply missions among the three companies after each meets their guaranteed minimum of six missions. Despite a requirement to compete task orders among all three contractors, NASA approved sole-source awards for all 31 CRS-1 missions and the 8 CRS-2 missions awarded as of December 2017.[13] With the addition of a third contractor, we believe NASA has more flexibility to compete task orders among the three companies or potential new entrants through the CRS-2 contract's On-Ramp clause, which allows the Agency to recompete contracts for any missions beyond the guaranteed six. In addition, we believe NASA could realize substantial savings if Sierra Nevada uses a less expensive launch vehicle than the Atlas V currently planned for the company's first two missions.

Our audit found that initial 2016 projections showed the CRS-2 contract was approximately $400 million more expensive than the CRS-1 contract while delivering roughly 6,000 kg less upmass capability. The higher costs for CRS-2 were the result of increased prices from SpaceX, the selection of three contractors rather than two, and $700 million in integration costs awarded through 2017. Of those integration costs, we questioned as premature $4.4 million paid to Sierra Nevada to begin certifying its second Dream Chaser spacecraft configuration. We believe ISS Program officials should have delayed these payments until after the successful demonstration of the first Dream Chaser configuration. In light of the CRS-2 contract's overall higher costs, the ISS Program evaluated whether to change the flight cadence for CRS-2 flights to potentially save $300 million by taking advantage of pricing discounts without decreasing the number of missions. By August 2018, the ISS Program had updated its flight cadence reflecting a reduction in cost by $205 million with additional savings anticipated.

We also reported that all three contractors face technical and schedule risks as they prepare for their CRS-2 missions. Development and launch of the Dream Chaser spacecraft poses the greatest risk to NASA due to its lack of flight history and Sierra Nevada's plan to not conduct a demonstration flight. Additionally, Sierra Nevada intends to build only one Dream Chaser, which raises concerns about potential schedule delays should an anomaly or failure occur. For SpaceX, certification of the company's unproven cargo version of its Dragon 2 spacecraft carries risk while the company works to resolve ongoing concerns related to software traceability and systems engineering processes. Finally, while Orbital ATK's planned use of a slightly modified Cygnus spacecraft reduces risk, the company plans to rely on the relatively new Antares 230 rocket configuration that could be affected by congressional bans on use of Russian engines.

Crew Transportation

Since the Space Shuttle Program ended in 2011, the United States has lacked a domestic capability to transport crew to the ISS, instead relying on Roscosmos to ferry astronauts at prices of up to $82 million per astronaut. The goal of NASA's Commercial Crew Program is to provide safe, reliable, and cost-effective crew transportation to and from the ISS and low Earth orbit. Through 2017, NASA spent about $3.9 billion on commercial crew activities.[14]

[13] Sole-source awards are contracts awarded without competitive bidding.

[14] These numbers do not reflect amounts NASA paid to Russia for crew transportation aboard the Soyuz.

Boeing's Launch Site at Cape Canaveral Air Force Station

Source: NASA.

NASA's efforts to facilitate the development of a commercial crew transportation capability began in earnest in February 2010. However, it was not until September 2014 that NASA awarded The Boeing Company (Boeing) and SpaceX firm-fixed-price contracts to complete development of their crew transportation systems and, assuming they meet the Agency's safety and performance requirements, receive certification to fly astronauts to the ISS.[15]

In September 2016, we reported that the Commercial Crew Program faced multiple challenges that would delay the first routine flight carrying NASA astronauts to the ISS until late 2018—more than 3 years after NASA's original 2015 goal.[16] In our 2016 audit, we found that while past funding shortfalls contributed to the delay, technical challenges with the contractors' spacecraft designs were driving schedule slippages. For Boeing, these included issues related to the effects of vibrations from intense sound waves generated during launch and challenges regarding vehicle mass. For SpaceX, delays resulted from a change in capsule design to enable a water-based rather than ground-based landing and related concerns that the capsule would take on excessive water.

Both companies must satisfy NASA's review process to meet Agency requirements for ensuring vehicles are safe for astronauts, known as "human rated." As part of the certification process, Boeing and SpaceX conduct safety reviews and report to NASA on potential hazards and how they plan to mitigate these risks. Our 2016 audit found significant delays in NASA's evaluation and approval of these hazard reports and related requests for variances from NASA requirements that increase the risk that costly redesign work may be required late in development, further delaying vehicle certification.

SpaceX Launch Site at Kennedy Space Center

Source: SpaceX.

Given the delays in the Commercial Crew Program, NASA extended its contract with Roscosmos for astronaut transportation and entered into a new agreement with Boeing to purchase flights to the ISS on the Soyuz to ensure access to the Station continues through early 2020.[17] However, a recent Government Accountability Office (GAO) report cited an April 2018 analysis from the Commercial Crew Program indicating the average certification date was more likely to occur in December 2019 for Boeing

[15] A firm-fixed-price contract provides a price that is not subject to adjustment on the basis of the contractor's costs in performing the contract. This contract type places maximum risk on the contractor for whether the contract generates a profit or loss.

[16] NASA OIG, *NASA's Commercial Crew Program: Update on Development and Certification Efforts* (IG-16-028, September 1, 2016).

[17] Boeing received the Soyuz flight opportunities as part of a legal settlement with the Russian company Energia, which manufactures the Soyuz spacecraft and has the legal rights to sell seats and associated services.

and January 2020 for SpaceX.[18] Since NASA does not currently plan to purchase transportation on the Soyuz past 2020, the Agency could face a gap in its access to the ISS if commercial crew providers are not certified to transport astronauts by that time. To avoid such a gap, NASA may have to exercise contingency plans, such as refining the remaining Soyuz launch schedule, extending crew time on the Station, or using crewed flight tests as operational flights to transport U.S. astronauts.

Deep Space Exploration

NASA's long-term goal for its human exploration program is a crewed mission to Mars in the late 2030s or early 2040s. In December 2017, the President directed NASA to change its mid-term objectives from uncrewed and crewed asteroid exploration missions to a crewed return to the Moon that involves international and commercial partners.[19] To meet these goals, the Agency must develop more sophisticated rockets, capsules, and related hardware; manage the ISS to maximize its use as a platform for research and development of new technologies; place a spaceport called the Gateway in lunar orbit; and mitigate human health risks of extended deep space travel—all within the constraints of a relatively static budget profile.

In the near term, successful development of the Space Launch System (SLS), the Orion Multi-Purpose Crew Vehicle (Orion), and launch infrastructure under development by the Agency's Exploration Ground Systems Program (EGS) are critical to achieving NASA's human exploration goals beyond low Earth orbit.[20] However, the first unmanned flight of the integrated SLS, Orion, and EGS systems on Exploration Mission-1 (EM-1)—initially planned for 2017 and currently expected to launch by June 2020—and the first crewed flight, Exploration Mission-2 (EM-2)—planned for no earlier than mid-2022—face significant challenges to meet their current launch dates. NASA plans flybys of the Moon before returning to Earth for both EM-1 and EM-2.

To support in-space testing, a return to the Moon, and deep space exploration, the Agency is building a lunar-orbiting outpost called the Gateway, consisting of core functionalities that include power and propulsion, communications, habitation, robotics, an airlock, and logistics resupply capabilities. As a key element of NASA's planned mission to Mars, this space-based staging platform will assist in preparing astronauts and the space flight systems needed for deep space exploration. In September 2018, NASA solicited proposals from the private sector to develop the Gateway's power and propulsion element, which is expected to launch on a commercial rocket in 2022. The Gateway will provide capabilities for lunar exploration throughout the buildup period as additional elements are launched, with Gateway completion planned in 2026.

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[18] GAO, *NASA Commercial Crew Program: Plan Needed to Ensure Uninterrupted Access to the International Space Station* (GAO-18-476, July 11, 2018).

[19] U.S. Space Policy Directive-1, published December 11, 2017, states that, "The Administrator of NASA shall lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and to bring back to Earth new knowledge and opportunities. Beginning with missions beyond low-Earth orbit, the United States will lead the return of humans to the Moon for long-term exploration and utilization, followed by human missions to Mars and other destinations."

[20] Previous top management and performance challenges reports and NASA OIG audits refer to EGS as the Ground Systems Development and Operations Program or GSDO. NASA changed its name in January 2018, and therefore, EGS will be used throughout this report in all references.

While the Agency's exploration plans, known as the National Space Exploration Campaign, currently include a series of robotic surface landings followed by human missions to the Moon, their number and duration remains undecided.[21] NASA's plans for Mars missions will also be impacted—in terms of cost and schedule—by diverting funds previously intended for deep space transport to lunar lander support, delaying a potential Mars crewed mission.

In the long term, NASA's plans for achieving a crewed Mars mission remain high level in nature, serving as more of a strategic framework than a detailed operational plan, particularly as the Agency's exploration focus has shifted to the Moon. For example, the Agency's current mission planning for Mars lacks objectives; does not identify key system requirements other than SLS, Orion, EGS, and the Gateway; and does not suggest target mission dates for crewed orbits of Mars or planet surface landings. If the Agency is to reach its goal of sending humans to Mars in the late 2030s or early 2040s, significant development work on key systems—such as a deep space habitat, in-space transportation, and Mars landing and ascent vehicles—must be accomplished in the 2020s. In addition, NASA will need to begin developing more detailed cost estimates for its Mars exploration program after EM-2 to ensure the commitment from Congress and other stakeholders exists to fund an exploration effort of this magnitude over the next several decades. Finally, a decision whether to continue spending $3 to $4 billion annually to maintain the ISS after 2024—roughly half of its exploration budget—will affect NASA's funding profile for human exploration efforts well into the 2020s, and therefore has significant implications for the Agency's Mars plans.

Space Launch System

The SLS is a two-stage, heavy-lift rocket that will transport cargo and crew into space for missions beyond low Earth orbit. NASA is using RS-25 engines originally built for the Space Shuttle Program to power the SLS Core Stage and is designing the vehicle with an evolvable architecture that can accommodate longer and more ambitious missions. The initial version (Block 1) will be capable of lifting 70 metric tons to low Earth orbit and use a modified Delta IV rocket upper stage to propel the Orion capsule on a trajectory around the Moon during EM-1. Later versions of the SLS will add a more powerful upper stage (Block 1B) and advanced rocket boosters (Block 2) with a capability to lift 130 metric tons to low Earth orbit and 37 metric tons to Mars.

We reported in April 2017 that the SLS Program faced several technical challenges leading up to the EM-1 launch that negatively affected its schedule margin.[22] As a result of these challenges, NASA subsequently announced a schedule delay for the EM-1 mission from November 2018 to no earlier than December 2019 with 6 months of schedule risk to June 2020 given that significant testing of the SLS system and its subsystems has yet to be completed. Although the SLS Program factored in a schedule margin of 11 months to allow time to address any unexpected technical issues or other factors, welding problems with SLS Core Stage tanks and delays in completing the engine section and stage controller have consumed this schedule margin. Even with this additional delay, testing and delivery of the Core Stage remains a significant challenge on the critical path with no schedule margin remaining to manage

[21] NASA, *National Space Exploration Campaign Report* (September 2018).

[22] NASA OIG, *NASA's Plans for Human Exploration Beyond Low Earth Orbit* (IG-17-017, April 13, 2017).

problems that may arise during the integration and test phase before an integrated SLS/Orion launch.[23] Completion of the Core Stage is a critical schedule issue in meeting the planned EM-1 launch date, which in turn may affect the SLS's subsequent missions—EM-2 and potentially the Europa Clipper—both planned for launch in 2022.[24]

In October 2018, we reported cost increases and schedule delays for the SLS Core Stage development can be traced largely to management, technical, and infrastructure issues driven by Boeing's poor performance. Additionally, we projected these delays could increase contract costs to at least $8.9 billion through 2021—double the amount initially planned to deliver two Core Stages. We also found poor contract management practices by NASA contributed to the SLS Program's cost and schedule overruns and questioned nearly $64 million in award fees already provided to Boeing. The SLS Program has taken positive steps to address management and procurement issues related to the Boeing Stages contract, including making key leadership changes; requesting reviews of Boeing's management, financial, and estimating systems; adding routine, in-depth performance reviews; and changing the procurement process to improve internal controls.

The rising cost of the SLS Program presents challenges for NASA moving forward. Currently, the Program will exceed its $9.7 billion budget commitment by 15 percent in 2019. The Agency plans to spend roughly $2 billion a year on SLS development and is already using its monetary reserves to address technical challenges for EM-1. According to guidance developed at Marshall Space Flight Center (Marshall), the standard monetary reserve for a program such as the SLS during development should be between 10 and 30 percent.[25] The SLS Program did not carry any program reserves in FY 2015 and only $25 million in FY 2016—approximately 1 percent of its development budget. Starting in FY 2018, the Program increased reserves to roughly 5 percent and the 2018 reserve of $123 million was used in part to cover increased costs for the two SLS Core Stages. However, this level of monetary reserves will not be sufficient if, as expected, additional technical issues arise during SLS development and testing phases. For example, if the EM-1 launch is delayed to June 2020, NASA will need to add $1.2 billion to the SLS stages contract based on Boeing's current expenditure rate.

In May 2018, NASA decided to use the initial Block 1 configuration for crewed EM-2 in mid-2022 instead of using Block 1B with its more powerful upper stage known as the Exploration Upper Stage. In addition, EM-2 will use the same mobile launcher used on the first SLS mission, EM-1, instead of waiting for major modifications to accommodate the larger Block 1B. Moreover, NASA received an additional $350 million from Congress in 2018 to build a second mobile launcher for Block 1B in order to accommodate the more powerful rocket's increased size. However, these changes will require that NASA human-rate two separate upper stages for Block 1 and Block 1B in order to fly crewed missions. In addition, it is unclear if the $350 million appropriated is sufficient to complete the second mobile launcher in time to meet the adjusted 2024 launch date for the SLS's Block 1B version.

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[23] Critical path is the sequence of tasks that determines the longest duration of time needed to complete a project. It is important to identify the critical path and resources needed to complete the critical tasks along the path if a project is to be completed on time and within its allocated resources.

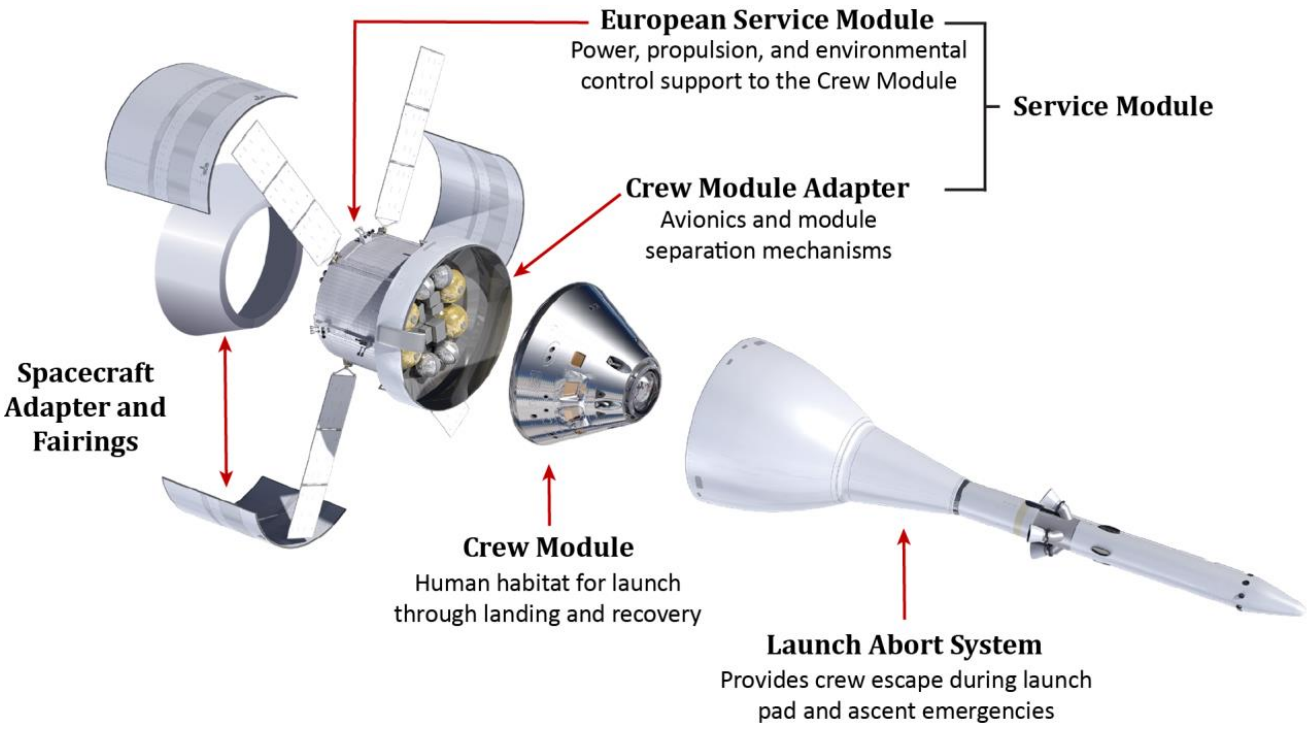
[24] The Europa Clipper is a NASA science mission that plans to send a spacecraft to Europa, one of Jupiter's moons, to determine whether the icy moon could harbor conditions suitable for life. In May 2018, we initiated an audit to assess NASA's management of the Europa Clipper mission.

[25] Marshall Procedural Requirements 7120.1, *MSFC Engineering and Program/Project Management Requirements* (October 20, 2016).

Orion Multi-Purpose Crew Vehicle

The Orion capsule—which will be mounted atop the SLS and serve as the crew vehicle for up to four astronauts—has four major components: a crew module; a service module; a spacecraft adapter that connects the vehicle to the rocket; and a launch abort system (see Figure 1).

Figure 1: Orion Components



Source: NASA (artist's rendering).

NASA began developing Orion in 2006 as part of the Agency's former deep space exploration effort known as the Constellation Program and had spent about $5.7 billion on the effort by the time the Program was canceled in 2010. Since then, NASA has spent more than $1 billion annually, or about 6 percent of the Agency's overall budget, on the Orion Program. In September 2016, we estimated the Agency will have invested approximately $17 billion for all Orion activities, including Constellation Program funding, by the time the spacecraft makes its first crewed flight on EM-2.[26]

The most significant immediate challenge NASA faces with the Orion Program continues to be delivery of the European Service Module, which contains the primary power and propulsion elements for the vehicle needed for EM-1. In September 2016, we reported that the service module had undergone design changes and, as a result, would be delivered to NASA at least 5 but possibly up to 10 months later than originally planned.[27] The module is now scheduled to be delivered in November 2018. Because the new Orion service module differs from the module flown during the first Orion test flight in December 2014, assembly, integration, and processing of the new module may delay transfer of the Orion to the EGS Program for integration with the SLS. Consequently, delivery, test, and integration of the service module is another critical schedule issue to meet the current EM-1 launch date.

Looking ahead, one of the key challenges NASA faces is ensuring the Orion capsule's Environmental Control and Life Support System functions properly. NASA is testing portions of this critical life support system on both the ISS and in laboratories on Earth, and will fly substantial parts of the system (thermal control pumps, heat exchangers, radiators, gas containment and delivery systems, and cabin pressurization controls) on EM-1. However, the first flight test of the complete Environmental Control and Life Support System will be during EM-2 with a crew aboard. The Aerospace Safety Advisory Panel, a committee that advises NASA and Congress on safety issues, expressed concern in its 2015 and 2016 annual reports about the system's lack of flight testing before EM-2. The Panel suggested the mission remain in low Earth orbit until NASA is confident that the life support systems are performing properly.[28] In its 2016 annual report, the Panel notes that NASA had selected a mission profile in which the crew spends its first 24 hours in an elliptical high Earth orbit to check the Environmental Control and Life Support System and other systems for possible malfunction.

The Orion Program currently has 9 percent in monetary reserves leading up to EM-2. Orion strategy places reserves at the end of the Design, Development, Test, and Evaluation phase to create funded schedule margin. When additional reserves are required above what is held in a particular year, the Program content is addressed to move non-critical path items and identify the needed reserve. This enables the Program to balance development risks and allows efficient utilization of funding. However, the impact of the delay in EM-1's launch date to June 2020 on Orion's overall funding profile remains under assessment.

Exploration Ground Systems Program

NASA's EGS Program is constructing and modifying infrastructure at Kennedy Space Center formerly used by the Space Shuttle and Constellation programs to launch the combined SLS/Orion. These tasks include refurbishing the crawler transporter that will transport the SLS to the launch pad, modifying the current mobile launcher, building a second mobile launcher for Block 1B, retrofitting the Vehicle Assembly Building, and updating Launch Pad 39B. In 2015 and 2017, we reported that modifications to the Vehicle Assembly Building and mobile launcher needed to support SLS have left EGS with only 1 month of schedule margin to address any additional issues that arise.[29] Similarly, GAO reported in July 2016 that although the Program is making progress in modifying facilities and equipment to support SLS and Orion, it is encountering technical challenges that require additional time and money, which in turn has reduced cost and schedule reserves, threatening the EM-1 launch readiness date.[30] Although the subsequently announced delay in EM-1's launch date may have mitigated some of these concerns, development of software needed to launch SLS and Orion remains a key concern.

In March 2016, we reported that the software used by the EGS Program, known as the Spaceport Command and Control System (SCCS), had significantly exceeded its initial cost and schedule estimates.[31] Subsequently, GAO reported in May 2018 that EGS's software efforts continue to face

[28] Aerospace Safety Advisory Panel, *Annual Report for 2015* (January 13, 2016) and *Annual Report for 2016* (January 11, 2017).

[29] IG-17-017 and NASA OIG, *NASA's Launch Support and Infrastructure Modernization: Assessment of the Ground Systems Needed to Launch SLS and Orion* (IG-15-012, March 18, 2015).

[30] GAO, *NASA Human Space Exploration: Opportunity Nears to Reassess Launch Vehicle and Ground Systems Cost and Schedule* (GAO-16-612, July 27, 2016).

[31] NASA OIG, *Audit of the Spaceport Command and Control System* (IG-16-015, March 28, 2016).

technical challenges.[32] SCCS is a software system that will control pumps, motors, valves, power supplies, and other ground equipment; record and retrieve data from systems before and during launch; and monitor the health and status of spacecraft as they prepare for and during launch. Our report noted that compared to FY 2012 projections, development costs had increased approximately 77 percent to $207.4 million and the release of a fully operational version had slipped by 14 months from July 2016 to September 2017 for an EM-1 launch in November 2018. Given the new launch date of no earlier than December 2019, and with the expectation the date may slip further to at least June 2020, EGS has extended the SCCS completion date to July 2019 in order to align with the new launch window.

Furthermore, EGS will not be able to complete all necessary software validation and verification efforts until SLS and Orion complete development, testing, and delivery of their software. Development of EGS software is the third most critical task, schedule-wise, to meeting the current EM-1 launch date of June 2020.

NASA's Science Portfolio

NASA's Science Mission Directorate focuses on answering questions related to the origins and destiny of the universe, the Sun and its effects on Earth and the rest of the solar system, the Earth's climate, the history of the solar system, and the potential for life elsewhere. With a budget that has increased more than 20 percent over the past 5 years—from $5.1 billion in FY 2014 to $6.2 billion in FY 2018—the Directorate manages more than 100 space flight projects in various stages of development and operations, as well as research, applications, technology development, and airborne- and ground-based observation activities. Successfully managing NASA's science portfolio is dependent in large part on addressing challenges related to project management, challenges that are exacerbated by internal and external influences that we highlighted in a September 2012 report.[33]

Internal Influences on the Science Portfolio

Historically, NASA has faced challenges in successfully managing its science portfolio and completing projects as planned. When milestones and deliverables are not completed on time or within budget, especially for its largest, most expensive projects, the ripple effects can be felt throughout NASA's entire science portfolio. Since our last top management and performance challenges report, NASA's science missions have celebrated several significant milestones and accomplishments. For example, December 2017 was the 22nd launch anniversary of the Solar and Heliospheric Observatory (SOHO), the Agency's oldest heliophysics mission in operation. SOHO provided the first ever images of structures and flows below the Sun's surface and dramatically improved space weather forecasting capabilities. In August 2018, the Spitzer Space Telescope—one of NASA's four Great Observatories—had its 15th birthday in space, observing some of the most distant galaxies in the universe and compiling a detailed map of the Milky Way.[34] The telescope has also been instrumental in several significant discoveries, including the seven rocky planets in the TRAPPIST-1 system 39 light-years away from Earth. In addition, after

[32] GAO, *NASA: Assessments of Major Projects* (GAO 18-280SP, May 1, 2018).

[33] NASA OIG, *NASA's Challenges to Meeting Cost, Schedule, and Performance Goals* (IG-12-021, September 27, 2012).

[34] NASA's four Great Observatories are the (1) Hubble Space Telescope, launched from Space Shuttle Discovery in April 1990 and still operating; (2) Compton Gamma Ray Observatory, launched from Space Shuttle Atlantis in April 1991 and deorbited in June 2000; (3) Chandra X-ray Observatory, launched from Space Shuttle Columbia in July 1999 and still operating; and (4) Spitzer Space Telescope, launched in August 2003 on a Delta 7920H rocket and still operating.

nearly 2 years of space travel, the Origins, Spectral Interpretation, Resource Identification, Security, Regolith Explorer spacecraft sent back its first image of Bennu, its target asteroid. Further, multiple long-orbiting NASA Earth-observing satellites, including Terra and Aqua, have helped researchers study and emergency-response crews deal with numerous wildfires in the United States and across the globe.

In the last year, the Agency launched three science missions that we highlighted in our 2017 report as vital to NASA effectively managing its science portfolio:

- In May 2018, after a 26-month delay that increased mission costs by $154 million, the Interior Exploration using Seismic Investigations Geodesy and Heat Transport (InSight) launched from Vandenberg Air Force Base in California and is scheduled to land on Mars in November 2018.[35] The lander is designed to investigate the crust, deep interior, and tectonic activity of Mars to better understand how rocky planets like Earth and Mars formed. Using a German-built penetrating "mole," InSight will pound a probe 16 feet into the Martian crust to take thermal measurements while a French-built seismometer will attempt to sense and measure "Marsquakes."
- In August 2018, the $1.6 billion Parker Solar Probe lifted off on a Delta IV Heavy rocket from Cape Canaveral Air Force Station in Florida on its mission to orbit the Sun closer than any other spacecraft while investigating its corona and outer atmosphere. The mission will sample plasma and the coronal magnetic field to investigate coronal heating and the origin and evolution of solar wind. The mission will also provide a better understanding of the radiation environment in which future space explorers will live.
- In September 2018, after several delays that resulted in its life-cycle costs increasing from $860 million to more than $1 billion that required funds to be drawn from other projects in the Earth Science Division portfolio, the Ice, Cloud, and land Elevation Satellite-2 satellite launched from Vandenberg Air Force Base on a Delta II rocket.[36] The mission is designed to collect data on the Earth's ice sheets and track changes in glaciers and sea ice, which will allow scientists to see where ice is flowing, melting, or growing, and to investigate the global impacts of these changes.

Since 2013, our top management and performance challenges reports have documented the criticality of successful completion of the James Webb Space Telescope (JWST) relative to NASA's overall science portfolio in light of the longstanding challenges with the program.[37] The successor to the Hubble Space Telescope, JWST is designed to help understand the origin of the first stars and galaxies in the universe, the evolution of stars, the formation of stellar systems, and the nature of celestial objects. However, this program has a storied and troubled development history. Early cost and schedule estimates—ranging from $1 billion to $3.5 billion, with an expected launch date between 2007 and 2011—proved overly optimistic and, following a change in the launch vehicle and other revisions, in 2005 NASA estimated life-cycle costs at $4.5 billion with a launch date in 2013. Soon after, a NASA review team found the 2013 launch date unachievable. Consequently, in 2009 NASA rebaselined JWST with a

[35] In November 2015, a leak was discovered in the seismometer instrument that caused NASA to delay its original March 2016 launch and increased project life-cycle costs to $829 million.

[36] Project managers underestimated the technical complexity of building the satellite's sole instrument, the Advanced Topographic Laser Altimeter System (ATLAS). In May 2014, NASA revised the baseline originally established in December 2012 to reflect a $1.06 billion life-cycle cost and a planned launch date in June 2018. In July 2016, one of the two flight lasers manufactured for the ATLAS instrument failed during thermal vacuum testing and caused NASA to delay the launch another 3 months.

[37] NASA OIG, *NASA's Top Management and Performance Challenges November 2013* (December 2, 2013).

life-cycle cost estimate of $4.9 billion and a June 2014 launch date. Again, it soon became clear that neither the new cost estimate nor the 2014 launch date were attainable. Subsequently, NASA restructured the JWST program and in September 2011 established a revised baseline life-cycle cost estimate of $8.84 billion and an October 2018 launch date. In late September 2017, the Agency delayed the JWST launch to no earlier than March 30, 2019, and soon thereafter commissioned an Independent Review Board to evaluate the program. In June 2018, NASA announced that the launch of JWST would be delayed until March 2021—2 ½ years later than its previous baseline launch date.

The Review Board found many of the same management challenges we identified in our September 2012 report on project management challenges and also cited human errors and excessive optimism in the integration and test plan that greatly affected the program's cost and schedule.[38] In spite of these challenges that resulted in the need for $1 billion to pay for additional work and a launch delay to March 2021, the Board concluded that "JWST should continue based on its extraordinary scientific potential and critical role in maintaining U.S. leadership in astronomy and astrophysics."

Although NASA has funding to continue JWST's development and testing in FY 2019, the Agency will need to identify $837 million in additional funding for development and operations in FY 2020 and beyond. Reallocating funds to cover these costs are likely to come from other projects in the Agency's science portfolio and result in delays in the launch or development of those projects.

External Influences on the Science Portfolio

While the success of NASA's science missions and projects are largely driven by internal factors within the Agency, the selection, balance, and operations of those missions are heavily influenced by external stakeholders, including the President, Congress, the science community, and, to a lesser extent, other federal and international agencies. The President and Congress provide direction through the authorization and appropriation processes, which have a strong influence on the composition of the Agency's science portfolio. The science community—as represented by the National Research Council (NRC)—establishes mission priorities based on a broad consensus within various science research disciplines.[39] These priorities are set forth in the NRC's decadal surveys on the subject matter areas encompassed by the Science Mission Directorate's four divisions: Astrophysics, Earth Science, Heliophysics, and Planetary Science. Each survey lists the NRC's recommendations by priority (e.g., the 2011 Planetary Science Decadal Survey prioritized proposed NASA large missions in the following order: a Mars sample return first, followed by a Jupiter Europa orbiter, and finally a Uranus orbiter and probe mission).[40] Managing differing priorities from numerous stakeholders amidst funding uncertainties can result in cost increases and schedule delays with a cascading effect on NASA's entire science portfolio.[41]

[38] IG-12-021.

[39] The NRC—the research arm of the National Academy of Sciences, National Academy of Engineering, and National Academy of Medicine—issues reports to help improve public policy, understanding, and education in matters of science, technology, and health.

[40] NRC, *Vision and Voyages for Planetary Science in the Decade 2013-2022* (2011).

[41] IG-12-021.

On a macro scale, specific priorities identified by the President and Congress coupled with the outcome and timing of the annual appropriation process tend to create challenges for NASA in managing a science portfolio composed of projects that take many years to develop and launch.[42] For example, towards the end of FY 2017 Congress unexpectedly directed NASA to spend $15 million more than planned on the Wide Field Infrared Survey Telescope (WFIRST), $12 million more on science education, and $1.4 million more on the Stratospheric Observatory for Infrared Astronomy (SOFIA), which required the Astrophysics Division to find equivalent savings from its other projects.[43] This included delaying the scheduled launch date of the Imaging X-ray Polarimetry Explorer mission by 6 months from late 2020 to April 2021. NASA also reduced program funding for flying astrophysics experiments on balloons. A few months later, NASA's FY 2019 budget request proposed canceling the WFIRST mission even though Congress had previously supported the project, which is listed as the NRC's highest priority large space initiative in the 2010 Decadal Survey of astronomy and astrophysics.[44]

Another challenge to efficient management of NASA's science portfolio is conflicting and fluid stakeholder priorities. While Congress directs NASA to follow the priorities set out in the decadal surveys, congressional appropriations bills sometimes mandate specific spending, operational, and schedule requirements that do not align well with decadal survey goals and can challenge NASA's ability to manage its portfolio. For example, NASA's FY 2015 appropriations stated, "$100,000,000 shall be for pre-formulation and/or formulation activities for a mission that meets the science goals outlined for the Jupiter Europa mission in the most recent planetary science decadal survey," which provided the Agency significant discretion on how to meet the mission goals set out in the decadal survey.[45] However, in FY 2018 Congress stipulated that the $595 million appropriated that year to meet the science goals for the Europa mission were to be used to launch an orbiter on an SLS no later than 2022 and a Europa lander on an SLS no later than 2024.[46] In its mid-term assessment, the NRC stated that a Europa lander mission had not been prioritized or discussed in detail in the 2013-2022 Decadal Survey and recommended it as a prospective flagship mission in the next Planetary Science Decadal Survey.[47]

Flagship missions, in addition to drawing funding from other Agency priorities, have other effects on the science portfolio that might not be readily apparent. At a June 2018 hearing before the House of Representatives Subcommittee on Space, witnesses testified to the shortage of a technically skilled workforce and its impact on development of NASA's science missions.[48] Most of NASA's large interplanetary projects are developed at the Jet Propulsion Laboratory (JPL) in California and the

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[42] In last year's top management and performance challenges report, we highlighted an example where the President's FY 2018 budget request recommended termination of several Earth Science missions. Congress subsequently provided funding to continue those missions. In the President's FY 2019 budget request, those same missions (except for one NASA canceled in January 2018 due to cost overruns) are again proposed for termination.

[43] WFIRST is planned to be the next large-scale orbiting telescope. It is designed to explore the nature of dark energy, complete the exoplanet census, and directly detect exoplanets. SOFIA is an airborne astronomical observatory—specifically, a Boeing 747 with a built-in telescope—that provides the international research community access to infrared data unattainable from either ground-based or space telescopes.

[44] NRC, *New Worlds, New Horizons in Astronomy and Astrophysics* (2010).

[45] Consolidated and Further Continuing Appropriations Act, 2015, Pub. L. No. 113-235 (2014).

[46] Consolidated Appropriations Act, 2018, Pub. L. No. 115-141 (2018).

[47] NRC, *Visions into Voyages for Planetary Sciences in the Decade 2013-2022: A Midterm Review* (2018).

projects currently in development—Mars 2020, Surface Water and Ocean Topography (SWOT), and Europa Clipper—are sharing personnel in an effort to meet technical requirements and schedule timelines.[49] If Congress continues to mandate a Europa lander be launched by 2024, the additional mission costs and personnel resources required to achieve this goal would significantly impact the Agency's overall Science Mission Directorate portfolio.

Finally, in a July 2014 report we recommended NASA establish a timeline to evaluate SOFIA within the Senior Review or a similar process during its primary operational phase because its initial, planned operations phase is inordinately long in comparison to most science missions—20 years compared to 5 years.[50] However, soon after NASA proposed a timeline for the Senior Review, Congress directed NASA not to include SOFIA in the 2016 Astrophysics Senior Review and has included this restriction with each subsequent SOFIA appropriation. These types of restrictions limit NASA's ability to utilize a peer review process designed to help objectively assess and manage each of the projects in its science portfolio.

Information Technology Governance and Security

Information technology (IT) plays an integral role in every facet of Agency operations, and hundreds of thousands of individuals—from NASA personnel to members of academia to the public—rely on NASA IT systems every day. In 2017, NASA spent approximately $1.7 billion (8.2 percent) of its $20.8 billion in appropriations on IT investments and operations. The Agency's portfolio of IT assets includes over 500 information systems used to control spacecraft, collect and process scientific data, and enable NASA personnel to collaborate with colleagues around the world. For more than 10 years, we have identified securing NASA's IT systems and data as a top management challenge. Although the Agency has made progress in this area, we remain concerned about the state of the Agency's IT governance, its acquisition of IT systems, cybersecurity vulnerabilities, and IT security incident detection and handling capabilities.

Information Technology Governance

Effective IT governance must balance compliance, cost, risk, security, and mission success to meet the Agency's strategic goals and the needs of external stakeholders. However, for more than 2 decades NASA has struggled to implement an effective IT governance approach that appropriately aligns authority and responsibility commensurate with the Agency's overall mission.

[49] Scheduled to launch in 2020, the Mars 2020 rover plans to investigate a region of Mars where the ancient environment may have been favorable for microbial life, probing Martian rocks for evidence of past life. Scheduled to launch in 2021 and jointly developed and managed by NASA, the French Space Agency, and the Canadian Space Agency, the SWOT satellite is designed to make the first-ever global survey of Earth's surface water in order to improve ocean circulation models, weather and climate predictions, and aid in freshwater management around the world. We have issued reports on Mars 2020—*NASA's Mars 2020 Project* (IG-17-009, January 30, 2017)—and SWOT—*NASA's Surface Water and Ocean Topography Mission* (IG-18-011, January 17, 2018)—and are currently assessing the Agency's management of the Europa mission.

[50] NASA OIG, *SOFIA: NASA's Stratospheric Observatory for Infrared Astronomy* (IG-14-022, July 9, 2014). The Senior Review is a peer review process that evaluates the continued value of projects that have completed or are nearing completion of their initial planned operating phase.

We have examined the issue of NASA's IT governance for the past 15 years.[51] In 2005, we reported that the Agency Chief Information Officer (CIO) and IT security officials had very limited oversight and influence over IT purchases and IT security decisions at NASA Centers. In 2013, we reported the Agency CIO continued to have limited visibility and control and found the decentralized nature of NASA's operations and its longstanding culture of autonomy hindered its ability to implement effective IT governance.

Given the criticality of these issues, we reexamined the Agency's governance reform efforts in an October 2017 follow-on audit and found a continued lack of progress in improving the Agency's IT governance, casting doubt on the Office of the Chief Information Officer's (OCIO) ability to effectively oversee the billions NASA spends on IT.[52] Specifically, the CIO continues to have limited visibility into IT investments across NASA and the process the Agency developed to correct those shortcomings is flawed. Moreover, the OCIO continues its decade-long struggle to establish an effective enterprise architecture (the map of IT assets, business processes, and governance principles that drive ongoing investment and management decisions). While the OCIO has made changes to its three senior advisory boards over the past few years, these boards have yet to make strategic decisions that substantively impact how IT at NASA is managed. Consequently, slow implementation of the OCIO's revised IT governance structure left many Agency IT officials operating under the previous inefficient and ineffective framework. Further, lingering confusion regarding IT security roles coupled with poor IT inventory practices negatively impact NASA's security posture. Finally, the OCIO continues to have limited influence over IT management within the Mission Directorates and at Centers due to the autonomous nature of NASA's operations and its lack of credibility on IT issues in the eyes of many of its customers.

GAO also continues to examine the Agency's longstanding IT governance issues. Most recently, in May 2018 GAO identified weaknesses in NASA's IT management practices for strategic planning, workforce planning, and governance.[53] Moving forward, continued senior leadership attention is needed to ensure NASA improves its IT governance system to provide secure, efficient, and cost-effective IT systems for Agency personnel, contractors, and the public.

Securing Information Technology Systems and Data

NASA maintains a significant online presence with approximately 3,200 publicly accessible 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.

NASA must ensure that its IT systems and associated components are safeguarded, assessed, and monitored to protect against inevitable attacks. Like most federal agencies, NASA is subject to computer security incidents related to malicious software on or unauthorized access to Agency computers. These incidents include individuals testing their skills to break into NASA systems, well-organized criminal enterprises hacking for profit, and intrusions that may be sponsored by foreign intelligence services

[51] NASA OIG, *NASA's Information Technology Governance* (IG-13-015, June 5, 2013) and *Review of Organizational Structure and Management of Information Technology and Information Technology Security Services at NASA* (IG-05-013, March 30, 2005).

[52] NASA OIG, *NASA's Efforts to Improve the Agency's Information Technology Governance* (IG-18-002, October 19, 2017).

[53] GAO, *NASA Information Technology: Urgent Action Needed to Address Significant Management and Cybersecurity Weaknesses* (GAO-18-337, May 22, 2018).

seeking to further their countries' objectives. For example, a bad actor gained access to several JPL network applications and systems in an attack that started in April 2017 when several security controls failed, including misconfigurations of user roles and ineffective vulnerability scans. This attack, which was not identified until a year later, is believed to have been initiated when a misconfigured foreign partner's user account was exploited to gain entry to the JPL network. The incident is currently under investigation.

While NASA is continually taking actions to improve its security posture, the Agency has yet to develop an Agency-wide risk management process specific to information security.[54] Further complicating this situation is the high turnover of key personnel in the Agency's OCIO—specifically, the CIO and Senior Agency Information Security Officer roles—resulting in a lack of leadership continuity and effective program planning.

We have conducted a substantial body of audit work over the past decade examining the security and acquisition of NASA IT systems, including incident detection and response by NASA's Security Operations Center (SOC), IT supply chain risk management, cloud computing, and security of industrial control systems.

Managing IT security incidents at NASA is a highly decentralized activity involving the Agency's Headquarters and nine Centers. In November 2008, NASA created the SOC at Ames Research Center to identify and respond to Agency-wide security threats to Agency networks and IT systems. Since its inception a decade ago, the SOC has fallen short of its original intent to serve as NASA's cybersecurity nerve center. An effective Agency-wide SOC should have insight over and access to all equipment and data connected to NASA's systems to mount an effective defense and mitigate cyberattacks. However, in a May 2018 audit report we found that the effectiveness of NASA's SOC has been limited by a lack of clarity in its oversight authority; undefined relationships between different functional areas within the OCIO, Centers, and Mission Directorates; and its current contract structure.[55] In sum, we found the SOC lacks the key structural building blocks necessary to effectively meet its IT security responsibilities.

During FY 2018, we also examined the effectiveness of NASA's supply chain risk management efforts, which includes identifying, assessing, and neutralizing risks associated with IT and communications products or services.[56] As the globalization of vendors and suppliers of IT and communications products and services continues to expand, so do the risks associated with counterfeit or sabotage products entering federal supply chains. While NASA's supply chain risk management efforts have improved since we last examined them in 2013, weaknesses in the Agency's IT risk management and governance practices continue to impede NASA's progress in establishing secure IT and communications product and service supply chains.[57] Moreover, with NASA's increasing use of commercially-supplied IT and communications products and services, it is imperative the Agency strengthen its supply chain risk management and assessment practices to safeguard its data, systems, and networks.

The cloud computing marketplace has grown exponentially over the past 5 years, as has the complexity of cloud services and the threats and risks associated with storing government data in the cloud. NASA uses cloud computing to enable on-demand network access to a shared pool of configurable computing

[54] NASA OIG, *Review of NASA's Information Security Program* (IG-16-016, April 14, 2016).

[55] NASA OIG, *Audit of NASA's Security Operations Center* (IG-18-020, May 23, 2018).

[56] NASA OIG, *Audit of NASA's Information Technology Supply Chain Risk Management Efforts* (IG-18-019, May 24, 2018).

[57] NASA OIG, *NASA's Progress In Adopting Cloud-Computing Technologies* (IG-13-021, July 29, 2013).

resources such as computer servers, storage, and software applications, in its scientific, mission, and support programs. In a 2016 report, we noted weaknesses in the Agency's risk management and governance practices that impeded its progress toward fully realizing the benefits of cloud computing.[58] These weaknesses, coupled with the fact that much of the Agency's cloud computing activity occurs outside of approved cloud computing services, puts Agency information stored in the cloud environment at risk.[59] With NASA's increasing use of the cloud, it is imperative the Agency strengthen its risk management and governance practices to safeguard its data.

In addition to traditional IT systems, the security of NASA's operational technology (physical processes controlled remotely with sophisticated and interconnected IT equipment) is imperative. Many of these systems are part of the Agency's critical infrastructure used to test rocket propulsion systems, control and communicate with spacecraft, and operate ground support facilities, or are associated with electrical power, heating and cooling systems, and other supporting infrastructure. As this infrastructure becomes more interconnected and complex, NASA faces an increased risk of cyber threats that could compromise missions and underlying Agency IT systems and networks. In a February 2017 report, we found that despite its significant presence across the Agency and its criticality to the success of the Agency's mission, NASA had not adequately defined operational technology, developed a centralized inventory of operational technology systems, or established a standard protocol to protect systems that contain operational technology components.[60] Further, NASA lacked an integrated approach to managing risk associated with its critical infrastructure that incorporates physical and cybersecurity considerations in all phases of risk assessment and remediation. Increased collaboration among NASA Mission Directorates, OCIO, Office of Protective Services, and Office of Strategic Infrastructure is crucial to accurately identifying critical assets and improving the security of NASA's operational technology environment.

In addition to our audit work, we continue to aggressively review and investigate issues surrounding breaches of NASA's IT systems. The OIG also works with NASA's Office of Counterintelligence to monitor and investigate attempts by unauthorized individuals to access sensitive export-restricted Agency software. We successfully investigated a former NASA contract employee who deleted decades' worth of scientific data derived from one-of-a-kind experiments on the ISS in retaliation for being dismissed by the Agency. The individual fled overseas, but our investigative efforts led to his arrest and conviction. The deleted scientific data was eventually restored at great expense to NASA, underscoring the significant damage a trusted insider with elevated IT access can cause.

Infrastructure and Facilities

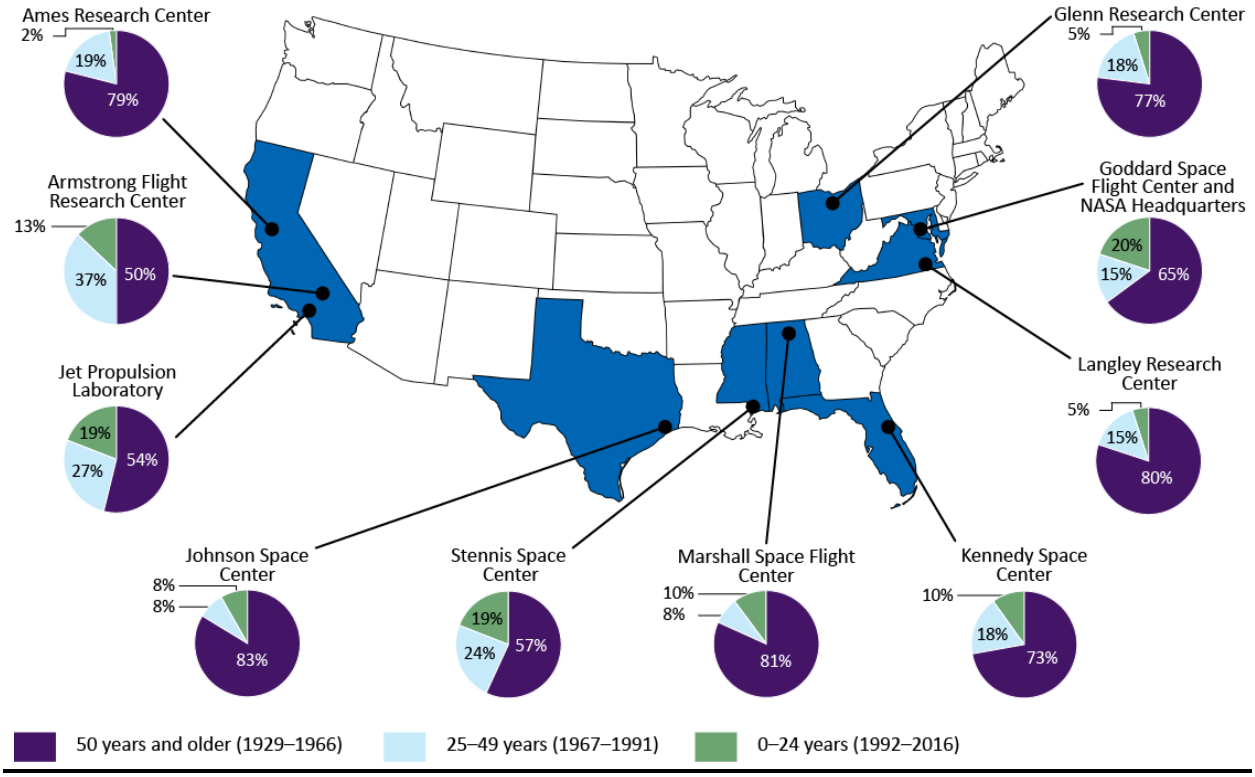
NASA controls approximately 5,000 buildings and structures with an estimated replacement value of at least $34 billion, making the Agency one of the largest property holders in the federal government. However, more than 80 percent of the Agency's facilities are 40 or more years old and are beyond their design life (see Figure 2).

[58] NASA OIG, *Security of NASA's Cloud Computing Services* (IG-17-010, February 7, 2017).

[59] The Federal Risk and Authorization Management Program (FedRAMP) includes a security assessment framework that guides the completion of system security plans based on security requirements issued by the National Institute of Standards and Technology.

[60] NASA OIG, *Audit of Industrial Control System Security within NASA's Critical and Supporting Infrastructure* (IG-17-011, February 8, 2017).

Figure 2: NASA's Facilities (as of March 2017)



Source: NASA OIG analysis of Agency data (some percentages sum to greater or less than 100 percent because of rounding).

While NASA strives to keep these facilities operational—and when not operational in sufficient condition so they do not pose a safety hazard—the Agency has not been able to fully fund required maintenance for its facilities for many years, with NASA estimating its deferred maintenance costs at $2.6 billion in 2018. The Agency faces ongoing operational challenges in this area as it juggles a long history of decentralized governance, intense political interest in its Centers and their real property assets, and competition for budget resources.

Over the last 8 years, we have dedicated substantial resources—issuing 17 audit reports—examining different facets of NASA's infrastructure challenges, including the Agency's efforts to "rightsize" its workforce, facilities, and other supporting assets; the construction of new test stands at Marshall; NASA's plans for underused test facilities at Plum Brook Station in Ohio; management of historic properties; management of its Pressure Vessels and Pressurized Systems and Explosive Safety Programs; the Agency's environmental remediation efforts; and its efforts to reduce unneeded infrastructure and facilities. Common themes throughout all of these reviews are slow implementation of corrective actions, inconsistent implementation of Agency policies, and a need for stronger life-cycle cost considerations in facility construction decisions.

NASA established the Technical Capabilities Assessment Team (TCAT) in June 2012 to assess the Agency's technical capabilities (including infrastructure and personnel resources) and make recommendations for investing in, consolidating, or eliminating capabilities based on mission

requirements.[61] In our March 2017 report on that effort, we found 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 assets.[62] Rather, most decisions have been iterative steps on the path to making determinations about technical capabilities, leaving us concerned that the Agency's efforts have been slow to produce meaningful results. 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. Although these assessments are ongoing, NASA commissioned the Aerospace Corporation to independently evaluate the status of its effort. Its review identified varying degrees of engagement across the Agency and as a result, NASA officials are assessing the model's concept of operations and future direction. Regardless of the outcome of their assessment, the Agency must be willing to make difficult decisions to invest, divest, or consolidate unneeded infrastructure; effectively communicate those decisions to stakeholders; and withstand the inevitable pressures from federal, state, and local officials to retain capabilities and structures "just in case."

In May 2017, we reported on NASA's construction of two test stands at Marshall and found that inadequate planning ultimately increased project costs.[63] NASA built the test stands to test the liquid hydrogen and liquid oxygen tanks from the Core Stage of the SLS rocket. To meet schedule commitments, test stand design and construction began before the tank design was finalized, and as a result, NASA had to pay the contractor a premium of $7.6 million for the additional labor needed to work around-the-clock to meet the original ambitious schedule. Subsequently, when the project's requirements matured, NASA needed an additional $20.3 million to make modifications to the original test stand designs. Because NASA failed to establish adequate funding reserves to cover these increased costs, project officials had to secure $35.5 million in additional funding over the planned budget. Finally, NASA did not adequately consider alternative locations before selecting Marshall as the site for the new test stands and therefore cannot be sure it made the most cost-effective decision.

Test Stand 4693 at Marshall Space Flight Center

Source: NASA.

Contracting and Grants

In FY 2017, NASA spent approximately $17.5 billion or 73 percent of its $24 billion of available resources, which includes reimbursable authority, on contracts to procure goods and services.[64] The Agency

[61] To institutionalize capability management into its annual planning and budgeting processes, NASA replaced TCAT with the Capability Leadership Model (CLM) in 2015. CLM is designed to advance NASA's technical capabilities to meet long-term missions, optimize deployment of capabilities across its major facilities, and transition capabilities no longer needed.

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

[63] NASA OIG, *Construction of Test Stands 4693 and 4697 at Marshall Space Flight Center* (IG-17-021, May 17, 2017).

[64] NASA has various authorities allowing the provision of goods, services, or underutilized facilities to enable other government and non-government partners to access NASA's technical capabilities and unique resources in return for reimbursement. In FY 2017, $2.3 billion of NASA's total spending authority came from funds collected through reimbursable agreements.

awarded an additional $1 billion in grants and cooperative agreements. Accordingly, NASA managers face the ongoing challenge of ensuring the Agency receives fair value for its money and that recipients spend NASA funds appropriately to accomplish agreed-upon goals. The OIG seeks to assist NASA in these efforts by examining Agency-wide procurement and grant-making processes; auditing individual contracts, grants, and cooperative agreements; and investigating potential misuse of Agency contract and grant funds. Additionally, we monitor the impact of contracts and grants awarded to assist NASA in accomplishing its aeronautics, exploration, and science missions as well as to provide support in areas like information technology.

Given NASA's continued reliance on contractors to provide essential services, the Agency will remain susceptible to contract fraud schemes, including collusion among bidders, employers, and contractors; corrupt payments in the form of bribes and kickbacks; bid manipulation; failure to meet contractual specifications; substitution of products or materials of lesser quality than specified in the contract; use of counterfeit, defective, or used parts; submission of false, inflated, or duplicate invoices; false claims regarding a contractor's abilities or level of experience; and conflicts of interest. To assist in identifying such issues, in 2015 the OIG established an Advanced Data Analytics Program that uses statistical and mathematical techniques to gather, analyze, and interpret Agency and open-source data to assist investigative and audit staff in identifying contract, grant, and procurement fraud and mismanagement.

During the past year, the OIG continued to uncover fraud and misconduct related to NASA contracts and grants. For example, a university agreed to pay $1.7 million in a civil settlement to resolve allegations it failed to properly track time and effort reporting under multiple federal grants based on a NASA OIG investigation. This investigation also revealed that several of the university's faculty members misappropriated federal funds for personal gain. In another NASA OIG investigation, the president of a Houston, Texas, software company was charged with one count of major fraud, six counts of false statements, and one count of false claims for inflating costs and double-billing against several NASA contracts, resulting in damages in excess of $2.6 million.

Contracting

Over the years, our audit work has identified multiple issues with NASA's contracting process, including its use of service contracts. In a May 2016 audit, we noted that vague statements of work can lead to duplication across contracts and found that in some instances task orders issued on a cost-reimbursable basis appeared more suitable to a fixed-price arrangement.[65] Similarly, NASA's management of acquisitions continues to remain on GAO's high-risk list. In addition, GAO found agencies that spend the most on service contracts may not be fully utilizing independent government cost estimates—the government's best estimate of a contract's potential costs.[66] GAO stated that while there are benefits to using contractors to provide services to help address surge capacity needs, it cautioned about the risks of over-reliance on contractors and the need for increased management attention on certain types of services such as professional and management support services.[67] In light of these challenges, in

[65] NASA OIG, *Audit of NASA's Engineering Services Contract at Kennedy Space Center* (IG-16-017, May 5, 2016).

[66] GAO, *Service Contracts: Agencies Should Take Steps to More Effectively Use Independent Government Cost Estimates* (GAO-17-398, May 17, 2017).

[67] GAO, *Contracting Data Analysis: Assessment of Government-wide Trends* (GAO-17-244SP, March 9, 2017).

February 2018 we initiated an audit to examine NASA's process for acquiring and managing service contracts. More recently, in August 2018 we initiated an audit of a specific service contract—the Agency's Strategic Assessment Contract—to assess whether NASA is appropriately managing the contract to accomplish its intended objectives relative to cost, schedule, and scope.

Grants

NASA also awards approximately $1 billion in grants and cooperative agreements annually to facilitate research by educational institutions or other nonprofit organizations as well as fund scholarships, fellowships, and stipends to students and teachers. The Agency faces the ongoing challenge of ensuring grant and cooperative agreement funds are administered appropriately and that recipients are accomplishing agreed-upon goals. We continue to conduct audits and investigations to assist NASA in meeting this oversight challenge.

As part of our broader examination of NASA's collaborations with universities and other nongovernmental entities, in April 2018 we reported on the Agency's management of the Goddard Institute for Space Studies (GISS).[68] The Institute plays an important role in developing long-range predictions related to Earth's atmosphere and climate through its development of global climate models and prolific publication of scientific research. However, in our review we found flaws in GISS's review process for releasing scientific information and publications. Further, we are concerned with the sufficiency of NASA's financial oversight of GISS (in FY 2016, NASA provided 96 percent of GISS's $19.1 million annual funding). Specifically, we found $1.63 million in questionable costs for GISS's agreements and contracts and loose accountability related to the purchase and tracking of computer equipment obtained using a government purchase card. Finally, although the Institute has significant ad hoc collaborations with public and private institutions, GISS could enhance its climate modeling and research activities by coordinating with agencies that conduct similar work, potentially avoiding duplicative costs.[69]

In February 2018, we examined NASA's management of its $484 million cooperative agreement with the nonprofit National Space Biomedical Research Institute (NSBRI) and how the Institute's work contributed to the Agency's biomedical research.[70] We found that NSBRI delivered research products that helped NASA make progress toward the goal of mitigating human health and performance risks associated with space travel. However, while most NSBRI charges complied with applicable laws and the award's terms, the Agency improperly permitted NSBRI to use $7.8 million of research funds to renovate and pay rent for laboratory space in a private building during the final 7 years of its 20-year agreement. In successor agreements, NASA needs to exercise stronger oversight to ensure efficient operations and prevent unnecessary duplication of research and administrative costs.

[68] NASA OIG, *NASA's Management of GISS: The Goddard Institute for Space Studies* (IG-18-015, April 5, 2018). GISS, located in New York City, is a laboratory in Goddard's Earth Science Division established in May 1961 to conduct basic research in space sciences.

[69] GAO, *Results-Oriented Government: Practices That Can Help Enhance and Sustain Collaboration among Federal Agencies* (GAO-06-15, October 21, 2005).

[70] NASA OIG, *Audit of the National Space Biomedical Research Institute* (IG-18-012, February 1, 2018).

Finally, in a January 2018 audit we examined the 13-year, $196 million cooperative agreement awarded to the Center for the Advancement of Science in Space (CASIS) to manage non-NASA research activities on the U.S. portion of the ISS known as the National Laboratory.[71] Given the importance and expense of research in low Earth orbit, we reviewed CASIS's performance and assessed the quality of NASA's oversight of the organization. More than halfway through the 13-year cooperative agreement, we found that CASIS has not yet met expectations with regard to achieving the goals and objectives of the agreement—maximum utilization of the National Laboratory, a balanced project portfolio, and a robust market for small business commercial providers. Further, we found NASA needs to increase its oversight of CASIS by evaluating its performance semiannually and ensuring plans include metrics and targets for all performance categories.

[71] NASA OIG, *NASA's Management of the Center for the Advancement of Science in Space* (IG-18-010, January 11, 2018). In August 2011, NASA awarded a 10-year, $136 million cooperative agreement to CASIS to manage the National Laboratory. In July 2017, NASA extended the CASIS cooperative agreement to September 2024, increasing its total cost to $196 million.

National Aeronautics and
Space Administration

Office of the Administrator
Washington, DC 20546-0001

November 8, 2018

TO: Inspector General

FROM: Administrator

SUBJECT: Agency Response to Office of Inspector General Report, "NASA's 2018 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, "NASA's 2018 Top Management and Performance Challenges."

NASA firmly believes that the oversight provided by the OIG affords Agency leadership and management with significant contributions in terms of insight and perspective with regard to NASA's broad portfolio of programs, projects, and mission support activities. The audits and investigations conducted by the OIG during this past year have served to strengthen the Agency's efforts to ensure responsible stewardship of scarce taxpayer resources in the execution of NASA's diverse and ambitious mission.

We concur with the OIG's assessment that the six areas outlined in the report comprise significant challenges to the Agency both in the short term and from a longer-term perspective. These areas, by their very nature, are complex and pose inherent challenges to the Agency.

The following highlights some of NASA's efforts and initiatives intended to reduce the overall risk to mission posed by the challenges you have identified as a means of demonstrating NASA's commitment in addressing its most significant management and performance challenges:

1. Space Flight Operations in Low Earth Orbit

International Space Station:

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

ISS Increment 41/42 (first half of FY15) to Increment 55/56 (second half of FY18), the amount of crew time has increased by approximately 79 percent. In addition, the number of investigations increased by approximately 27 percent from FY16 to FY17 (Increment 49 through Increment 56).

This is possible by the combined ongoing efforts of the ISS Program, the National Lab operator Center for the Advancement of Science in Space (CASIS), 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 learned 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 is 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 get experiments to orbit in as little as four months. Seeing 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, available by the end of 2018.

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).

Commercial Transportation to the ISS – Cargo Resupply:

Over the past year, SpaceX and Orbital ATK, now owned by Northrop Grumman, have remained very responsive to NASA's needs to resupply the ISS. Both commercial service providers have flown their expected cargo missions to the ISS over the past year. NASA is also working with the newest of the cargo resupply providers, Sierra Nevada Corporation (SNC), to safely incorporate their logistical capabilities into the ISS logistics flow. NASA continues to work with all suppliers to assess the risk to ISS operations and cargo launches within NASA's procedures documented in NPD 8610.7, "Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA-Sponsored Payloads/Missions" and NPD 8610.23, "Launch Vehicle Technical Oversight Policy."

Commercial Transportation to the ISS – Commercial Crew:

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.

2. Deep Space Exploration

NASA's National Space Exploration Campaign Report, delivered to Congress in September 2018, describes NASA's approach to meeting the objectives of Space Policy Directive-1 (SPD-1). SPD-1 directs NASA "to lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and to bring back to Earth new knowledge and opportunities. Beginning with missions beyond LEO, the U.S. will lead the return of humans to the Moon for long-term exploration and utilization, followed by human missions to Mars and other destinations." The National Space Exploration Campaign builds on the 18 continuous years of U.S. and international partners living and working together on the ISS. It outlines the objectives, critical decisions, and milestones for the near- and mid-term missions that will implement SPD-1, including building the Lunar Gateway as a first step in the sustainable exploration and development of the Moon. With this framework established, NASA is developing program plans, schedules, and budgets to achieve these objectives.

The Space Launch System (SLS), Orion crew spacecraft, and Exploration Ground Systems (EGS) form the critical transportation backbone for NASA's Exploration campaign. Exploration Mission-1 (EM-1) in 2020 will be the first integrated test flight of these systems in cislunar space. While the majority of the work is on track, as has been previously noted, NASA is seeing specific areas of targeted challenges consistent with a first-time design, development, test, and build of a human spacecraft system for deep space, including challenges associated with developing the world's largest friction stir weld facility and advanced welding methods, understanding and fixing unexpected contamination issues for propellant tubing, and adapting long-standing operational work management processes to incorporate the flexibility needed to accommodate the uncertainties of a first-time build. The assembly complexity of the Core Stage engine section, which is similar to the aft compartment of a Space Shuttle Orbiter with an extra engine and thrust vector control, was not completely appreciated. NASA has implemented actions and is taking further steps to improve management and performance in the SLS, Orion, and EGS programs, and the OIG's recommendations are consistent with the work NASA already has underway. Improvements NASA has made include:

- Revising the schedule management approach to improve visibility and correlation to lower-level tasks and to better account for risk in schedule projections. Activities are being added that help prepare the response to problems that will occur in preparation of the hardware for flight.

- Revising the governance approach to expedite decision-making processes while maintaining improved NASA oversight and integration in the resolution process.
- Revising technical plans to simplify work instructions, reduce errors and non-conformances, and improve flow and traceability.

- Working with contractors and international partners to offer improved technical and affordable solutions to challenges and to better align priorities and schedules, including judiciously increasing workforces to optimize the right skill sets in the right areas to address critical path issues.

NASA believes that it is essential to take the time to effectively resolve first-time build challenges now, which leads to near-term schedule and cost challenges, but yields significant benefits for out-year flight element manufacturing. NASA's goal for returning humans to cislunar space on EM-2 remains on track, and NASA is looking at ways to accelerate that schedule into mid-2022.

Progress made to date is highlighted below:

Space Launch System:

The Space Launch System (SLS) is the most powerful, most capable launch system in the history of space flight. NASA is designing and implementing a manufacturing capability to efficiently produce, test, and qualify space flight hardware for long-term use, to human rating standards, on a scale never achieved before, and this work represents a national investment in a long-term commitment to deep space exploration. Throughout the SLS development and production efforts, NASA's primary goal has been to implement processes and procedures that will support long-term production needs in a safe manner.

This year, NASA's Super Guppy aircraft delivered the EM-1 Orion stage adapter, the second of five major elements of the first SLS flight vehicle, to Kennedy Space Center (KSC). At Michoud Assembly Facility (MAF), the five major structural pieces of the SLS core stage are completing final outfitting and assembly. Construction of the forward skirt and intertank are complete, and the liquid oxygen and hydrogen tanks are nearing completion. The structural test article for the hydrogen tank will ship to the Marshall Space Flight Center (MSFC) by the end of the year for testing that will simulate the forces of flight. Structural qualification testing of the engine section was completed some time ago, and intertank structural qualification is under way. Teams have also been applying the thermal insulation to flight hardware for protection from

extreme temperatures it will face during launch. Process improvements to the application process are reducing the time needed for this work.

The SLS team is putting the finishing touches on the 30-foot-tall launch vehicle stage adapter that will connect the core stage to the interim cryogenic propulsion stage, which was delivered to KSC last year. All four EM-1 RS-25 core stage engines are complete and ready for shipping to MAF for integration with the EM-1 core stage. The SLS booster team in Utah has finished eight of the ten EM-1 solid rocket motor segments and will complete the last two segments before the end of the year. EM-2 flight hardware fabrication and assembly is also well under way on the SLS core stage, boosters, and core stage engines. The liquid engines team is green-run hot-fire testing engine controllers to be used as far out as the fourth flight of SLS, as well as testing new hardware made with advanced manufacturing technologies that will reduce engine costs by better than 33 percent.

Orion:

The Orion team has completed the majority of the work to assemble the EM-1 crew module. Thousands of components like Orion's windows, avionics, wire harnessing, and parachutes that make up more than 30 subsystems have been integrated and tested through evaluations like thermal cycle testing, proof tests on propulsion lines, and functional tests to ensure systems work as planned. The team recently installed the heatshield that will protect the EM-1 crew module upon reentry from the lunar vicinity through Earth's atmosphere. The Orion European Service Module, which provides propulsion, power, water, and oxygen was shipped from Bremen, Germany, on November 5, 2018, and arrived at Kennedy Space Center (KSC) on November 6, 2018, to begin the next phase of integration and test.

Testing on a structural test article in Denver for sound and vibration evaluations has confirmed Orion can withstand the extreme acoustic and vibration environments of the launch and separation event in space. At sea, NASA and the Department of Defense have honed the procedures and skills they will use to recover Orion upon splashdown in the Pacific Ocean. Flight controllers also conducted tests to ensure that Orion can communicate with mission control through NASA's satellite network. Welding of the Orion EM-2 crew module pressure vessel was completed at MAF and the assembly has been shipped to KSC for outfitting.

The Agency tested Orion's parachute system for the final time in mid-September, bringing NASA another step closer to verifying the spacecraft is ready to bring crews home in any scenario. Work is progressing at several NASA Centers in preparation for a test of Orion's launch abort system in the spring of 2019 that will verify the crew can be carried to safety in an emergency during launch.

Exploration Ground Systems:

EM-1 will be the first integrated test flight of Orion, SLS, and the supporting ground systems. Launching from KSC in Cape Canaveral, Florida, in 2020, EM-1 will prepare the way for future missions with astronauts.

During 2018, major critical launch infrastructure neared completion in preparation for launch. EGS completed construction on the main flame deflector at the launch pad and launch control teams conducted realistic launch simulations. Over the summer, software teams completed critical updates to use for command and control from the firing room to support the first mission.

In August, EGS installed the final umbilical on the mobile launcher. In September, for the first time since the mobile launcher has been modified for the SLS, the massive tower rolled out atop the Crawler-Transporter 2 to Launch Pad 39B for a fit check that verified all physical connections between the launcher and pad systems before rolling into the Vehicle Assembly Building for further analysis and detailed adjustments.

3. NASA's Science Portfolio

The Science Mission Directorate (SMD) develops and implements an extensive portfolio of scientific programs and projects that are inherently complex and present unique challenges. We appreciate the OIG's recognition of the inherent challenges involved with managing a portfolio with incongruous guidance from our stakeholders.

External Influences:

In developing its diverse science portfolio, NASA receives guidance, sometimes conflicting, from a variety of stakeholders including the President, Congress, the National Research Council, and others. SMD strives to develop a balanced portfolio to achieve three overall, interdisciplinary objectives: 1) Safeguarding and improving life on Earth; 2) Searching for life elsewhere; and 3) Expanding our knowledge through research from here at home into the deep universe.

As noted by the National Academies of Sciences, Engineering, and Medicine, NASA's planetary science program continues on track. The Agency has met or exceeded many of the goals set by the Academies in the 2013-2022 decadal survey[1]. The Mars Exploration Program continues to be a key component of our Planetary Science Division. NASA will continue to look for additional opportunities, after Mars 2020, to capitalize on the experience base gained through recent Mars missions.

In Astrophysics, the near future will be dominated by several missions in partnership with other space agencies. Currently in development, with especially broad scientific utility, is the James Webb Space Telescope. Also in work are detectors for the European Space Agency's (ESA) Euclid mission and hardware for the Japanese

[1] Review of Progress Toward Implementing the Decadal Survey Vision and Voyages for Planetary Sciences http://sites.nationalacademies.org/ssb/currentprojects/ssb_177619

Aerospace Exploration Agency's (JAXA) X-Ray Imaging and Spectroscopy, previously named XARM (XRISM), to provide breakthroughs in the study of structure formation of the universe, outflows from galaxy nuclei, and dark matter.

Internal Influences:

Recently completed and launched on time and under budget, NASA's Parker Solar Probe is on its way to orbit the Sun closer than any other spacecraft while investigating its corona and outer atmosphere. SMD's internal processes provided some of the guidance necessary to launch this mission on time and under budget. The mission will sample plasma and the coronal magnetic field to investigate coronal heating and the origin and evolution of solar wind. The mission will also provide a better understanding of the radiation environment in which future space explorers will live.

Similarly, the Global Ecosystem Dynamics Investigation instrument heads toward an earlier launch to the ISS than previously expected. A first-of-its-kind laser instrument designed to map the world's forests in 3-D will help fill in critical gaps in scientists' understanding of how much carbon is stored in the world's forests, the potential for ecosystems to absorb rising concentrations of carbon dioxide in Earth's atmosphere, and the impact of forest changes on biodiversity.

As we look toward the future, SMD has begun exploring ways to not only conduct lunar science but to also use the area around and the surface of the Moon as a science platform to look back at the Earth, observe the Sun, or view the vast universe. These and other new missions, combined with those in operations, enable SMD to develop a balanced portfolio, implementing the cutting-edge missions necessary to advance science and produce the incredible discoveries for which NASA is known.

4. Information Technology Governance and Security

NASA's information technology (IT) provides the foundation 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 these operations. 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: 1) assessing what we have by ensuring that all NASA IT can be identified, monitored, protected, and, if necessary, removed from the environment; 2) executing the Agency's IT governance to be a robust, engaged, and deliberative collaboration between the Chief Information Officer (CIO) and every NASA stakeholder, complying with the Federal Information Technology Acquisition Act (FITARA) and all other laws, directives, and

requirements; and; 3) reducing duplications and inefficiencies, resulting in appropriate enterprise solutions.

NASA's Business Services Assessment (BSA) for IT, initiated in 2015, provided the foundation for the Office of the Chief Information Officer (OCIO) to establish quality enterprise IT, collaborate with federated IT, and obtain insight and visibility into diversified IT. The NASA IT Strategic Plan published in December 2017, articulated the plan to manage NASA IT as a strategic resource for the next four years. Utilizing these established foundations, FY 2018 focused on defining and assessing the full IT life cycle, including investment management, meeting FITARA legislation, and achieving management of cyber risk, with assistance from the Department of Homeland Security (DHS).

Information Technology Governance:

In FY 2018, NASA built upon the existing IT governance framework to include expanding NASA's IT portfolio, as reported to OMB as part of the FY 2020 budget formulation process. The Information Technology Council (ITC), NASA's senior IT decision-making body and chaired by the CIO, set NASA's IT direction, made resource decisions to obtain the most effective and efficient IT capabilities, and established opportunities to achieve greater understanding and granularity on all NASA IT spend.

OCIO participation in mission governance, boards, councils, and working groups improved as well. The OCIO, missions and Centers (including the Agency and Mission Directorate Program Management Councils), are actively working to ensure and improve consideration of IT, including cybersecurity, in mission program and project life cycles. The NASA CIO is an engaged and key member of Agency Councils, including the newly established NASA Acquisition Strategy Council, to ensure oversight of IT spend in acquisitions.

Securing Information Technology Systems and Data:

The Agency's cybersecurity posture continues to improve and address NASA's unique IT security challenges. FY 2018 improvements included: 1) gaining further insight into cybersecurity risk mitigation in NASA's mission environment; 2) establishing an Office of Cybersecurity Services (OCSS) for consolidated and effective cybersecurity service delivery; 3) gaining insight of critical, high, medium, and low criticality Operational Technology (OT) systems; and 4) establishing the NASA Cybersecurity Integration Team (CIT) to identify and mitigate top Agency IT risks across all of NASA's enterprise, including the NASA Missions and High Value Assets (HVAs). NASA re-designed the IT Supply Chain Risk Management service to better identify, assess, and neutralize risks associated with IT and communications products or services. The deployment of the DHS Continuous Diagnostics and Mitigation (CDM) Phase I Program to the corporate network offers another example of a major FY 2018 accomplishment. This deployment improved the Agency's cybersecurity posture, hardware and software asset management, vulnerability management, and configuration

management. Additionally, NASA completed CDM Phase II deployment, which further strengthened the Agency's Identity, Credential, and Access Management (ICAM) capabilities.

NASA continues to improve cybersecurity monitoring and detection capabilities within the NASA Security Operations Center (SOC). NASA's SOC, which is responsible for NASA cyber incident response, reports all cyber incidents to the United States Computer Emergency Readiness Team (US-CERT), pursuant to the Federal Incident Notification Guidelines. As a result of organizational and technological improvements, NASA experienced a significant decrease in the number of cyber incidents, as noted in the table below. In FY 2017 and 2018, NASA reported the following number of incidents to the DHS US-CERT Incident Reporting System by incident category:

Category	Name	Description	Number of FY17 Incidents	Number of FY18 Incidents
CAT 1	Unauthorized Access	In this category, an individual gains logical or physical access without permission to a Federal agency network, system, application, data, or other resource.	**745**	**214**
CAT 2	Denial of Service (DoS)	An attack that successfully prevents or impairs the normal authorized functionality of networks, systems, or applications by exhausting resources. This activity includes being the victim or participating in the DoS.	**21**	**7**
CAT 3	Malicious Code	Successful installation of malicious software (e.g., virus, worm, Trojan horse, or other code-based malicious entity) that infects an operating system or application.	**344**	**76**
CAT 4	Improper Use	A person violates acceptable computing use policies.	**173**	**8**
		Total	***1,283***	***305***

There is continued work to realizing fully integrated IT governance, particularly IT Authority and Investment Management for NASA's full IT portfolio, as well as maintaining the successful management of cyber risk. This work is dependent on the Agency's continued support, partnership, and collaboration with internal and external partners. With the development and implementation of the Agency initiative known as the Mission Support Future Architecture Program (MAP), we look forward to sustained IT transformation and the expected benefits. Through robust partnerships, collaborations, and governance, NASA welcomes the opportunities available in the shared responsibility for the full life cycle of IT, including who purchases, deploys, has insight and oversight, and protects the NASA IT environment.

5. Infrastructure and Facilities

NASA continues to recognize the imbalance between the infrastructure that it maintains and the funding available to properly sustain it. To respond to and manage that imbalance, NASA has implemented a strategy to reduce its infrastructure over time, eliminate facilities that it no longer needs, consolidate capabilities when it makes sense, and make focused investments in critical capabilities. NASA continues to invest annually in new construction that is more energy efficient and which consolidates personnel and activities into a smaller footprint, thereby reducing operational costs. These investments evaluate life-cycle costs in accordance with NASA Procedural Requirements (NPR) 8820, "Facility Project Requirements (FPR)," to identify the most efficient solution set.

NASA's demolition and disposal program has demolished over 2.62 million square feet since 2013. Over that time period, NASA has also eliminated $71.4 million in deferred maintenance and 566 structures. In the last eight years, NASA has disposed of four sites (Palmdale Orbiter Processing Site, Camp Parks, White Sands Space Harbor, and Glenn Research Center North Campus). NASA continues to work to dispose of the Santa Susana Field Lab and Crows Landing sites. Toward that effort, NASA has demolished more than 61 structures at Santa Susana and 27 structures at Crows Landing. During 2018, NASA engaged the U.S. Army Corps of Engineers' demolition expertise, to manage demolition contracts for NASA including a 530,000 square foot office building at Michoud Assembly Facility (MAF) which will be demolished over the next year.

NASA manages its demolition program through a five-year plan. Centers select facilities that they would like to demolish over that timeframe and a team of Demolition Managers prioritize the proposed projects based on the fiscal year's anticipated funding cost estimates, return on investment, time awaiting demolition, footprint reduction, operations and maintenance costs, etc. Included in the five-year plan are assets that were identified through the Space Environments Testing Divestment decision in 2015. In addition, Demolition Managers implement the annual demolition program in the most cost effective manner by leveraging funded project cost savings towards additional demolitions in any given year. NASA's 2017 disposal plan indicates that NASA expects to reduce its infrastructure by four percent over the next five years. The Agency's Demolition Program is a key component of NASA's Strategic Rightsizing Goal established in 2017 of a 25 percent infrastructure reduction over 20 years. This planning goal is now being incorporated in Center Master Plans as a requirement before approval of the Center's Future Development Concept. The Agency's reduction goal is aimed at driving NASA's infrastructure to a size that is in line with estimated funds available to sustain it.

NASA's Technical Capabilities Assessment Team (TCAT) studies resulted in NASA establishing a new more centralized model for managing its technical capabilities. The NASA Technical Capability Leadership model provides cross-Agency reviews of

capabilities, allowing NASA to identify redundancies or capabilities that are obsolete. Since the implementation of the new management model and the establishment of capability management offices such as the Space Environments Testing Management Office (SETMO), NASA has made the following progress consolidating space environmental testing capabilities: ten assets demolished; four assets excessed; and an additional six assets added to the demolition program.

NASA has diligently responded to each of the 17 OIG reports related to infrastructure challenges published over the last seven years. NASA continually evaluates the effectiveness of its policies, issuing amendments as necessary and updating policy to reflect changing regulations and environments. NASA has completed actions on all, but two OIG recommendations from reports published prior to 2017 and is nearing publication of new policy for managing technical capabilities to close the remaining two recommendations.

6. Contracting and Grants

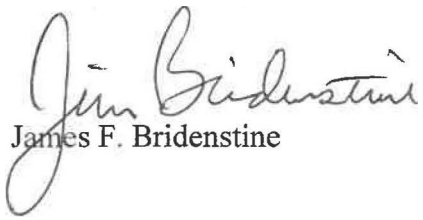
NASA's Office of Procurement appreciates the investigative and audit work conducted by the OIG and acknowledges the importance of this effort, particularly where fraud is uncovered and process improvements can be made. NASA continues to make strides intended to improve the contracting processes throughout the Agency. NASA continues to strengthen procurement policy implementing the NASA FAR Supplement (NFS) quality review process. This quality review process is a systematic approach for continually reviewing and updating relevant NFS parts and eliminating outdated and unnecessary policy. We continue to strengthen acquisition planning to ensure that the right contract vehicle is utilized for the requirement; issuing strategic sourcing policy and associated Web site to assist in optimizing the use of existing contract vehicles; and reducing the number of new acquisitions.

NASA is continuing its efforts regarding strengthening the overall administration and management of its grants program. The grants management function, now organized under the Office of the Chief Financial Officer (OCFO), will continue actions to enhance the NASA grants monitoring function. The OCFO is in the process of formulating grants monitoring training modules which will be presented to the NASA grants community. Likewise, the OCFO is in the initial stages of incorporating data analytics into NASA's grants monitoring model. Our continued updates to the NASA Grant and Cooperative Agreement Manual (GCAM), along with updates to our financial assistance instruments, ensures compliance with the requirements of 2 CFR 200, Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards.

Finally, in those instances where fraud is suspected or uncovered with respect to contracts and grants, 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, Acquisition Integrity Program (NASA AIP). NASA's AIP is a comprehensive

coordination of fraud remedies programs, which handles such matters in coordination with the Department of Justice; pertinent law enforcement agencies, including the NASA Office of Inspector General; other Federal agencies; and other NASA stakeholders including the Office of Procurement.

If you have any questions regarding NASA's response to the 2018 Top Management and Performance Challenges, please contact Paul Roberts, Audit Liaison Program Manager, on (202) 358-2260.



James F. Bridenstine

cc:
Chief Financial Officer/Mr. DeWit
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Associate Administrator for Science Mission Directorate/Dr. Zurbuchen
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FY 2018 INSPECTOR GENERAL ACT AMENDMENTS REPORT

Background

The Inspector General Act Amendments of 1988 (P.L. 100-504) require that Federal agencies report on the actions taken in response to Office of Inspector General (OIG) audit reports and corresponding audit recommendations. Specifically, the 1988 Amendments require agency reporting on: a) Management Action Taken on OIG Reports containing Monetary Benefits (see Table 1) and; b) Management Action Not Taken on OIG Audit Reports in Excess of One-Year (see Table 2).

In addition to the requirements in the 1988 Amendments, the Office of Management and Budget (OMB) delineates specific "action requirements" levied on Federal agencies in its Circular No. A-50, "Audit Follow-up." The Circular requires that agencies ensure that final management decisions on OIG audit recommendations are reached within six months after the issuance of an audit report and that corresponding corrective actions begin as soon as practicable.

To enhance the readability and utility of NASA's FY 2018 reporting under the Inspector General Act Amendments of 1988, the following definitions are provided:

Corrective Action consists of management's planned or proposed remediation efforts intended to mitigate an audit finding.

Disallowed Costs are questioned costs that management has sustained or agreed should not be charged to the Government.

Final Management Action is the point in time when corrective action, taken by management in conjunction with a final management decision, is completed.

Final Management Decision is reached when management evaluates the OIG's findings and recommendations and determines whether or not to implement a proposed recommendation.

Funds to be Put to Better Use (FPTBU) are potential cost savings, identified by the OIG, that could be realized through the implementation of an audit recommendation.

Questioned Costs are those costs identified by the OIG as being potentially unallowable because of either: a) a purported violation of law, regulation, contract, grant, cooperative agreement, or other device governing the incurrence of cost; b) a finding that, at the time of the audit, such cost is not supported by adequate documentation; or c) a finding that the cost incurred for the intended purpose is unnecessary or unreasonable.

Resolution is the point at which NASA and the OIG agree on action(s) to be taken in response to an audit recommendation or, in the event of disagreement, the point at which the Audit Follow-up Official (AFO) determines the matter to be resolved.

NASA's Audit Follow-up Program

NASA's Mission Support Directorate (MSD) serves as the Agency's Office of Primary Responsibility for policy formulation, oversight, and functional leadership of NASA's audit follow-up program. MSD implements audit follow-up program activities through an Agency-wide network of Audit Liaison Representatives (ALRs) who, in turn, are responsible for executing audit follow-up program activities at the Mission Directorate, Field Center, and Mission Support Office levels. In conjunction with NASA's network of ALRs, MSD provides the infrastructure to support NASA's audit follow-up program. The program utilizes NASA's Audit and Assurance Information Reporting System (AAIRS) to track and monitor OIG audit reports and corresponding recommendations, as well as to support internal and external reporting.

NASA leverages the results of OIG audits to improve the overall efficiency and effectiveness of the Agency's programs, projects, and functional activities. NASA is also committed to ensuring timely and responsive final management decisions, along with timely and complete final management action on all audit recommendations issued by the NASA OIG. To this end, NASA has implemented a comprehensive program of audit follow-up intended to ensure that audit recommendations issued by the OIG are resolved and implemented in a timely, responsive, and effective manner. NASA's audit follow-up program is a key element in improving the overall efficiency and effectiveness of NASA's programs, projects and operations.

In accordance with requirements outlined in OMB Circular A-50, MSD monitors audit recommendations issued by the OIG to ensure that a final management decision is reached within six months of the issuance

of a final audit report. A final management decision is reached when either: a) management agrees to implement corrective actions in response to an OIG audit recommendation; or b) management determines that implementing a particular audit recommendation is imprudent, impractical, not cost beneficial, etc. In those instances where a final management decision cannot be reached, resolution is achieved in conjunction with NASA's AFO, consistent with provisions of OMB Circular A-50.

When a final management decision has been made to implement an audit recommendation, corrective action is pursued as rapidly as practicable. In some instances, the corrective actions associated with a final management decision may span multiple fiscal years due to factors such as the complexity or cost of the planned corrective action or unexpected delays in the formulation, review, and approval of NASA policies, procedural requirements, or regulations. In these instances, MSD works with the OIG and respective Mission Directorate, Field Center, or Mission Support Office to ensure communication and coordination regarding necessary revisions to timelines and milestones associated with the implementation of these recommendations.

FY 2018 Audit Follow-up Results

The Inspector General Act Amendments of 1988 require that heads of Federal agencies report on management action taken, or remaining to be taken, in response to OIG audit reports containing monetary benefits. For the purposes of this report, monetary benefits consist of: a) Questioned Costs; or b) Funds to be Put to Better Use (FPTBU), as defined above. NASA's FY 2018 results of management action on OIG reports with monetary benefits are found in Table 1, below.

The 1988 Amendments also require that Federal agencies report on those OIG recommendations for which a final management decision had been made in a prior fiscal year, but final management action is still ongoing. NASA's FY 2018 results of management action not taken on OIG reports in excess of one-year are found in Table 2, below.

In addition to the statutory reporting requirements delineated in the 1988 Amendments, OMB Circular A-50 requires that final management decisions on OIG audit recommendations be made within six months of the issuance of a final audit report.

NASA's FY 2018 reporting in conjunction with the requirements of the Inspector General Act Amendments of 1988 and OMB Circular A-50, follows:

1. Management Action on OIG Reports with Monetary Benefits

The cumulative prior year carry-over amount of outstanding management action on monetary benefits consisted of $97,932,317 in questioned costs which were initially identified in three OIG audit reports[1] issued in FY 2017.

During FY 2018, the OIG issued four audit reports[2] to NASA containing monetary benefits consisting of $13,950,034 in questioned costs. As a result, monetary benefits pending management action in FY 2018 totaled $111,882,351 in OIG identified questioned costs.

Final management action by NASA was taken on two OIG audit reports issued in fiscal years 2017 and 2018[3] in the amount of $85,241,396. However, management action on the monetary benefits identified in five OIG audit reports issued during FY 2017 and 2018[4] consisting of $26,640,955 in questioned costs, remains outstanding as of September 30, 2018.

Disposition of the remaining $26,640,955 in OIG identified questioned costs which are outstanding, pending final management action as of September 30, 2018, is expected during FY 2019.

Table 1 below, summarizes NASA's actions taken with respect to monetary benefits identified in OIG audit reports issued during FY18, as well as residual (carry-over) monetary benefits identified in OIG audit reports issued in prior fiscal years, that required management action during FY 2018.

[1] "NASA's Management and Development of Spacesuits" (IG-17-018; April 26, 2017); "Construction of Test Stands 4693 and 4697 at Marshall Space Flight Center" (IG-17-021; May 17, 2017); and "NASA's Research Efforts and Management of Unmanned Aircraft Systems" (IG-17-025; September 18, 2017).
[2] "Audit of National Space Biomedical Research Institute" (IG-18-012; February 1, 2018); "NASA's Management of GISS: The Goddard Institute for Space Studies" (IG-18-015; April 5, 2018); "Audit of Commercial Resupply Services to the International Space Station" (IG-18-016; April 26, 2018); and "NASA's IT Supply Chain Risk Management Efforts" (IG-18-019; May 24, 2018).

Table 1: Management Action on OIG Audit Reports with Monetary Benefits For the Year Ended September 30, 2018

Category		Questioned Costs		Funds to be Put To Better Use		Total Monetary Benefits (Dollars)
		Number of Reports	Dollars	Number of Reports	Dollars	
Line 1	Beginning Balance: Audit reports with monetary benefits issued in prior years requiring final management action (prior year carry-over into FY 2018)	3	$97,932,317	0	$0	$97,932,317
Line 2	Plus: Audit reports with monetary benefits issued during FY 2018 requiring final management action	4	$13,950,034	0	$0	$13,950,034
Line 3	Total audit reports with monetary benefits requiring final management action during FY 2018 [line 1 + 2]	7	$111,882,351	0	$0	$111,882,351
Line 4	Less: Audit reports with monetary benefits on which final management action was taken during FY 2018	2	$85,241,396	0	$0	$85,241,396
Line 5	Ending Balance: Audit reports with monetary benefits awaiting final management action at the end of FY 2018 [line 3 - line 4] (carry-over into FY 2019)	5	$26,640,955	0	$0	$26,640,955

2. Management Action Not Taken on OIG Reports in Excess of One-Year

As of September 30, 2018, a total of 64 recommendations in 26 OIG audit reports remain open, pending OIG closure, in excess of one year since the issuance of the corresponding final audit reports. Although these recommendations remain open in excess of one year after issuance of the corresponding audit reports, NASA management either has, or continues to, aggressively pursue those actions needed to fully implement the OIG's recommendations. Specifically, NASA has completed corrective actions on 11 of these 64 recommendations (17 percent), and is currently awaiting the OIG's determination with regard to sufficiency of those actions for closure. Management actions on the remaining 53 recommendations (83 percent) are planned for completion between the first-quarter of FY 2019 and fourth-quarter of FY 2020. Corrective actions associated with these 64 open recommendations span the following three broad categories:

1) Policy Development/Revision (39 percent);
2) Oversight/Monitoring/Program Review (42 percent);
3) Program/ Project Operations (19 percent)

By way of comparison and perspective, as of September 30, 2017, a total of 50 recommendations in 20 OIG audit reports were open, pending completion of final management action, in excess of one year since the issuance of the corresponding final audit reports. During the five-year period ended September 30, 2018, the number of OIG audit recommendations open in excess of one year after report issuance has ranged between 50 and 64.

[3] "NASA's Management and Development of Spacesuits" (IG-17-018; April 26, 2017); and "Audit of Commercial Resupply Services to the International Space Station" (IG-18-016; April 26, 2018).

[4] "Construction of Test Stands 4693 and 4697 at Marshall Space Flight Center" (IG-17-021; May 17, 2017); "NASA's Research Efforts and Management of Unmanned Aircraft Systems" (IG-17-025; September 18, 2017); "Audit of National Space Biomedical Research Institute (IG-18-012; February 1, 2018); "NASA's Management of GISS: The Goddard Institute for Space Studies" (IG-18-015; April 5, 2018); and "NASA's IT Supply Chain Risk Management Efforts" (IG-18-019; May 24, 2018).

Table 2 below summarizes those OIG audit reports and associated recommendations issued prior to FY 2018 for which final management action on open recommendations has not yet been completed in excess of one year since the issuance of the corresponding final audit reports.

Table 2: OIG Audit Reports and Recommendations in Excess of One - Year (As of September 30, 2018)

Report No. (Report Date)	Report Title	Recommendations		
		Open	Closed	Total
IG12017 (8/8/2012)	*Review of NASA's Computer Security Incident Detection and Handling Capability*	2	1	3
IG13008 (02/12/2013)	*NASA's Efforts to Reduce Unneeded Infrastructure and Facilities*	2	3	5
IG14015 (02/27/2014)	*NASA's Management of Its Smartphones, Tablets, and Other Mobile Devices*	1	1	2
IG14026 (07/22/2014)	*Audit of the Space Network's Physical and Information Technology Security Risks*	1	3	4
IG14031 (09/18/2014)	*Extending the Operational Life of the International Space Station Until 2024*	1	2	3
IG15013 (03/26/2015)	*NASA's Management of the Deep Space Network*	3	9	12
IG15015 (05/15/2015)	*NASA's Compliance with the Improper Payments Information Act for Fiscal Year 2014*	2	8	10
IG15023 (09/17/2015)	*NASA's Response to Orbital's October 2014 Launch Failure: Impacts on Commercial Resupply of the International Space Station*	1	6	7
IG16001 (10/19/2015)	*NASA's Education Program*	1	4	5
IG16013 (02/18/2016)	*Audit of NASA Space Grant Awarded to the University of Texas at Austin*	2	2	4
IG16014 (03/17/2016)	*NASA's Management of the Near Earth Network*	2	12	14
IG16015 (03/28/2016)	*Audit of the Spaceport Command and Control System*	1	0	1
IG16016 (04/14/2016)	*Review of NASA's Information Security Program*	1	0	1
IG16017 (05/05/2016)	Audit of NASA's Engineering Services Contract at Kennedy Space Center	1	3	4
IG16021 (05/12/2016)	NASA's Compliance with the Improper Payments Information Act for Fiscal Year 2015	2	3	5
IG16025 (06/28/2016)	NASA's Response to SpaceX's June 2015 Launch Failure: Impacts on Commercial Resupply of the International Space Station	2	4	6
IG17003 (11/2/2016)	NASA's Earth Science Mission Portfolio	1	1	2
IG17010 (2/7/2017)	Security of NASA's Cloud Computing Services	5	1	6
IG17011 (2/8/2017)	Audit of Industrial Control System Security within NASA's Critical and Supporting Infrastructure	5	1	6
IG17012 (3/7/2017)	NASA's Management of Electromagnetic Spectrum	1	1	2
IG17015 (3/21/2017)	NASA's Efforts to Rightsize its Workforce, Facilities, and Other Supporting Asset	3	1	4
IG17016 (3/29/2017)	NASA's Parts Quality Control Process	7	1	8
IG17017 (4/13/2017)	NASA's Plans for Human Exploration beyond Low Earth Orbit	4	2	6
IG17020 (5/15/2017)	NASA's Compliance with the Improper Payments Information Act for Fiscal Year 2016	4	5	9
IG17021 (5/17/2017)	Construction of Test Stands 4693 and 4697 at Marshall Space Flight Center	3	0	3
IG17025 (9/18/2017)	NASA's Research Efforts and Management of Unmanned Aircraft Systems	6	0	6
26	**Totals**	**64**	**74**	**138**

3. Final Management Decisions Made Within Six Months of Report Date

During FY 2018, the OIG issued 18 audit reports containing 161 recommendations addressed to NASA which required a final management decision within six months of the respective final report dates, in accordance with OMB Circular A-50. Final management decisions were made within six months of issuance of the corresponding final audit reports on each of the 161 (100 percent) OIG recommendations issued during FY 2018.

In addition to the 161 OIG recommendations that were issued to NASA and resolved during FY 2018, final management decisions were made on two prior year recommendations in two OIG audit reports[5] that were issued in the second half of FY 2017. Final management decisions on these two prior year recommendations was made within six months of the respective final report dates, as required by OMB Circular A-50.

No OIG recommendations are pending final management decisions as of September 30, 2018.

For the five-year period ended September 30, 2018, the OIG issued 813 audit recommendations in 90 audit reports to NASA requiring a final management decision within six months of the respective final report dates. Final management decisions were made within six months of the respective final report dates on 800 (98 percent) of these recommendations.

4. Audit Recommendation Closure Efficiency

During FY 2018, a total of 192 OIG audit recommendations (including 146 recommendations issued in prior years) were closed based on responsive management action taken by NASA. Of the 192 recommendations closed by the OIG during FY 2018:

- 143 recommendations (74 percent) were closed within one year of issuance of the associated audit report;
- 34 recommendations (18 percent) were closed between one and two years of issuance of the associated audit report; and
- 15 recommendations (8 percent) were closed in excess of two years of issuance of the associated audit report

For comparative purposes, during FY 2017, a total of 137 OIG audit recommendations (including 132 recommendations issued in prior years) were closed based on responsive management action taken by NASA. Of these 137 recommendations closed by the OIG during FY 2017:

- 84 recommendations (61 percent) were closed within one year of issuance of the associated audit report;
- 31 recommendations (23 percent) were closed between one and two years of issuance of the associated audit report; and
- 22 recommendations (16 percent) were closed in excess of two years of issuance of the associated audit report

For the five year period ended September 30, 2018, a total of 831 OIG audit recommendations were closed based on responsive management action taken by NASA. Of these 831 recommendations, 48 percent were closed by the OIG within one year of issuance of the respective audit reports; 41 percent were closed by the OIG within two years of issuance of the respective audit reports; and 11 percent were closed by the OIG in excess of two years of issuance of the respective audit reports.

[5] "NASA's Compliance with the Improper Payments Information Act for Fiscal Year 2016" (IG-17-020; May 15, 2017); and "Construction of Test Stands 4693 and 4697 at Marshall Space Flight Center" (IG-17-021; May 17, 2017).

IMPROPER PAYMENTS INFORMATION ACT (IPIA) ASSESSMENT

Payment Integrity

The Improper Payments Information Act of 2002 (IPIA) (Public Law (P.L.) 107-300) [A] requires Federal agencies to review their programs and activities for improper payments, identify programs and activities subject to significant improper payments, generate an annual estimate of improper payments for susceptible programs and activities, and report the results of improper payment activities to the President and Congress annually. IPIA aims to detect and prevent improper payments made by Federal Government agencies in order to verify that taxpayer dollars are spent properly and efficiently.

Since its inception, executive agency responsibilities for improper payments have expanded and evolved in order to further reduce improper disbursement of government funds. Throughout this evolution, NASA has stayed committed to preventing and reducing improper payments through its Improper Payments Program. In order to amend the IPIA and prevent further loss of taxpayer dollars, Congress also enacted the *Improper Payments Elimination and Recovery Act of 2010 (IPERA) (P.L. 111-204)* [B]. IPERA, as compared to IPIA, expanded the scope and level of detail required for improper payment reporting amongst executive agencies. It also introduced the Office of Management and Budget (OMB) risk factors contributing to program susceptibility to significant improper payments and repealed the *Recovery Auditing Act (Section 831, Defense Authorization Act, for FY 2002; P.L. 107-107)* [C] by adding requirements for executive agencies to report on the actions taken to recover improper payments.

On January 10, 2013, the *Improper Payments Elimination and Recovery Improvement Act of 2012 (IPERIA) (P.L. 112-248)* [D] was signed into law, further amending IPIA and IPERA. As designed, IPERIA was intended to strengthen and intensify efforts to identify, prevent, and recover payment error, waste, fraud and abuse with Federal spending [1]. The law aimed to improve upon agency efforts to identify and estimate improper payments, further develop improper payment recovery efforts, and support "Do Not Pay" efforts. To provide implementation guidance in executing the legislative principles of IPIA, IPERA and IPERIA, OMB issued *Memorandum M-13-20, Protecting Privacy while Reducing Improper Payments with the Do Not Pay Initiative* [E] in 2013; *Memorandum M-15-02, Requirements for the Effective Estimation and Remediation of Improper Payments in 2014* [F]; and *Memorandum M-18-20, Requirements for Payment Integrity Improvement* [G] in FY 2018. Memorandum M-18-20 modified previous versions of *OMB Circular A-123 Appendix C, Requirements for Payment Integrity Improvement* and changed the framework of improper payment compliance to create an integrated, inclusive, and a less arduous set of compliance regulations. Similar to previous version of OMB Circular A-123 Appendix C, the updated guidance consolidates and provides implementation requirements from the following:

- IPIA (P.L. 107-300)
- IPERA (P.L. 111-204)
- IPERIA (P.L. 112-248)
- Bipartisan Budget Act of 2013 (P.L. 113-67)
- Federal Improper Payments Coordination Act of 2015 (FIPCA) (P.L. 114-109)

In 2013, additional improper payment legislation was ratified via the *Disaster Relief Appropriations Act (Disaster Relief Act)(P.L. 113-2)* [H]. The Disaster Relief Act, as signed, provided $50.5 billion in aid for Hurricane Sandy disaster victims and their communities and detailed additional stewardship requirements for agencies receiving Hurricane Sandy appropriations. In order to provide implementation guidance for the principles presented in the Disaster Relief Act, OMB issued *Memorandum M-13-07, Accountability for Funds Provided by the Disaster Relief Appropriations Act* [I] which provided that all programs and activities receiving funds under the act shall be deemed to be "susceptible to significant improper payments" for the purposes of the IPIA (as amended). In February 2018, the *Bipartisan Budget Act of 2018 (P.L. 115-123)* [J] also became law. Similar to the Disaster Relief Act, it provided $84.4 billion in emergency supplemental appropriations to respond to and recover from recent natural disasters. To provide guidance in administering and monitoring these funds, OMB released *Memorandum M-18-14, Implementation of Internal Controls and Grant Expenditures for the Disaster-Related*

[1] Improper Payments Elimination and Recovery Improvement Act of 2012 (IPERIA) (P.L. 112-248)

Appropriations [K]. The Memorandum mandates that Agency programs that disburse more than $10,000,000 in emergency appropriations in one fiscal year shall be considered susceptible to significant improper payments for purposes of IPIA (as amended), and such programs shall report an improper payment estimate beginning in the FY 2019 reporting cycle.

Under the parameters set forth in IPIA, IPERA, and IPERIA, agencies are required to perform a risk assessment of its programs and activities, identify programs and activities that are susceptible to significant improper payments, sample and estimate annual improper payments for susceptible programs and activities, and report the results to the President and Congress via the Agency Financial Report (AFR) or Performance and Accountability Report (PAR). Throughout the evolution improper payment legislation and reporting, NASA has worked diligently to prevent and reduce improper payments, while maintaining compliance with legislative requirements through its Improper Payments Program. In FY 2018, the Agency executed the aforementioned responsibilities via the Improper Payment Risk Assessment. For additional details related to NASA Improper Payments, including all information previously reported in the AFR that is not included in the FY 2018 AFR, please visit *https://paymentaccuracy.gov/*. [L]

Improper Payment Risk Assessment

NASA executed its FY 2018 Improper Payment Risk Assessment Methodology under the requirements set forth in OMB Circular A-123 Appendix C, Requirements for Payment Integrity Improvement. On an annual basis, NASA reviews and updates the risk assessment methodology to account for implementation of recommendations made by auditors (i.e. Office of the Inspector General (OIG), Government Accountability Office (GAO), etc.), changes to improper payment legislation and guidance, changes to NASA's operating environment, and other circumstances. Prior to executing the FY 2018 Improper Payment Risk Assessment, the Agency determined enhancements to the methodology were warranted. In response to a recommendation made by the NASA OIG, the Agency determined it was appropriate to increase the weighting and emphasis placed on the External Monitoring risk condition (i.e. external and independent reports, reviews, and audits) and to decrease the weighting and emphasis assigned to risk conditions that do not vary from program to program. Additionally, NASA updated the risk assessment to include OIG activities, which were previously excluded from the Improper Payment Risk Assessment.

Once updated, NASA performed its FY 2018 Improper Payments Risk Assessment employing the updated risk assessment methodology. This methodology incorporates seven (7) risk conditions, each with a set of related criteria designed to account for eleven (11) OMB-designated and NASA-specific risk factors. OMB requires that each agency assess programs or activities deemed not susceptible to significant improper payments at least once every three years. Historically, NASA has not identified significant improper payments or found its programs to be susceptible to significant improper payments via risk assessment; therefore, NASA took the approach of assessing such programs once every three years. In order to meet this requirement, NASA assesses approximately one third of all programs annually, selecting each program based on the most recent year of assessment and prior year assessment results. Accordingly, in FY 2018, the Improper Payment Risk Assessment Methodology was completed for 30 of NASA's 88 programs in two major phases: Identify and Select Programs and Assess Improper Payment Risk.

1. Identify and Select NASA Programs

To develop a list of NASA programs eligible to be assessed for the FY 2018 Improper Payment Risk Assessment, NASA extracted the population ($21.4 billion) of FY 2017 disbursements from its financial management system. The universe of payments subject to analysis included disbursements to vendors, NASA employees, and other government agencies issued by NASA between October 1, 2016 and September 30, 2017. The disbursements were then analyzed and categorized by NASA mission and program. A review of the FY 2017 budget was performed and programs listed within the budget were compared to the programs identified within the Agency's financial management systems. Based on FY 2017 budgetary resources, materiality of disbursements, and the nature of program funding, the following programs were grouped resulting in 88 distinct programs:

- All five (5) programs within the Education Mission Directorate were combined into one program (EDUC). Historically, few to none of the Education programs met the traditional level of materiality required for assessment ($80 million) and therefore would not have been selected for testing. However once combined, the program had a higher probability of being deemed susceptible to significant improper payments.

- All 14 programs within the Institutions and Management Mission Directorate were combined into one program (INST). Currently, none of the programs in this mission are included in the budget and are not clearly allocated to any specific program or activity. Although geared toward management and support of mission-specific functions, Institutions and Management personnel are responsible for approval, monitoring and oversight of their budget and payments. Accordingly, management combined the mission into one program and assessed improper payment risks using the same measurement criteria and assumptions as mission-specific programs.

- Beginning in FY 2017, the Commercial Crew and Commercial Cargo programs were realigned from the Exploration Systems Mission to the Space Operations Mission, leaving disbursements from the programs spread over two (2) missions and four (4) programs. Similar to prior years, the programs are combined into one program based on their past history of being consolidated within NASA's budget (prior to FY 2011) and continued association under the Commercial Spaceflight theme in subsequent fiscal years.

OMB Circular A-123, Appendix C provides that if an agency determines a program or activity is not susceptible to significant improper payments, the agency must re-assess that program's improper payment risk at least once every three years. In order to implement this approach, NASA elected to select approximately one third of NASA's programs for assessment in FY 2018 (30 of 88 programs). OMB Memorandum M-13-07, *Accountability for Funds Provided by the Disaster Relief Appropriations Act*, mandates that any programs or activities that receive appropriations under the Disaster Relief shall be deemed "susceptible to significant improper payments for the purposes of IPIA"[2]. The Hurricane Sandy project (within the Institutional Construction of Facilities program) is the only NASA program or activity receiving such funds; however, under OMB Circular A-123 Appendix C[3], the Hurricane Sandy project met the requirements for relief from improper payment reporting. NASA requested, and OMB granted, a waiver from the reporting requirements stipulated by the Disaster Relief Act and the Hurricane Sandy project (Institutional Construction of Facilities program) on an annual assessment cycle. NASA selected the remaining programs based on whether the program was new to the Agency, whether there were any significant changes in the program within the fiscal year, and based on when the program was last assessed. Once selected, the programs were confirmed by NASA management. The list of programs selected for assessment in FY 2018 is included below.

Figure 1: Programs Assessed during the FY 2018 Improper Payment Risk Assessment

Advanced Exploration Systems
Agency IT Services
Agency Management
Airspace Systems
Astrophysics Explorer
Astrophysics Research
Aviation Safety
Discovery
Earth Science Multi-Mission Operations
Earth Science Research
Education
Environmental Compliance and Restoration
Exploration Construction of Facilities
Exploration Ground Systems
Office of the Inspector General Program
Institutional Construction of Facilities
Institutions and Management
Integrated Aviation Systems Program

[2] Office of Management and Budget (OMB) Memorandum M-13-07, Accountability for Funds Provided by the Disaster Relief Appropriations Act and Disaster Relief Appropriations Act (Disaster Relief Act) (Public Law 113-2), section 904(b).

[3] According to IPIA and OMB's IPIA implementation guidance (OMB Circular A-123 Appendix C, Requirements for Payment Integrity Improvement), if a program has documented a minimum of two (2) consecutive years of improper payments that are below the thresholds, the Agency may request relief from annual reporting requirements for the program or activity.

Integrated Systems Research
National Historic Preservation
Prizes & Challenges
Education Programmatic - Reimbursable
Exploration Systems Mission Directorate Institutional - Reimbursable
Office of the Inspector General Intuition - Reimbursable
Science Technology Programmatic - Reimbursable
Science Mission Directorate Institution - Reimbursable
Safety and Security Mission Services - Institutional Reimbursable
Science Construction of Facilities
Space Operations Construction of Facilities
Transformative Aeronautics Concepts Program

2. Assess Improper Payment Risk

NASA has designed an Improper Payment Risk Assessment Methodology which utilizes static sets of criteria categorized by risk conditions. These risk conditions and the related criteria are intended to provide a framework for analyzing quantitative and qualitative risk factors for each of NASA's programs. The risk assessment methodology employs eleven (11) risk factors total – the seven (7) OMB risk factors outlined in Circular A-123, Appendix C and five (5) additional risk factors. The following risk conditions and risk factors compose NASA's Improper Payment Risk Assessment Methodology:

Risk Conditions

i. Internal Control over Payment Processing
ii. Internal Monitoring and Assessments
iii. External Monitoring and Assessments
iv. Human Capital Risk
v. Program Profile
vi. Payment Profile
vii. Dollar Materiality

OMB Risk Factors

i. Whether the program or activity reviewed is new to the agency;

ii. The complexity of the program or activity reviewed, particularly with respect to determining correct payment amounts;

iii. The volume of payments made annually;

iv. Whether payments or payment eligibility decisions are made outside of the agency;

v. Recent major changes in program funding, authorities, practices, or procedures;

vi. The level, experience, and quality of training for personnel responsible for making program eligibility determinations or certifying that payments are accurate; and

vii. Significant deficiencies in the audit reports of the agency including, but not limited to, the agency OIG or the GAO audit report findings, or other relevant management findings that might hinder accurate payment certification.

Additional Risk Factors

viii. Inherent risks of improper payments due to the nature of agency programs or operations;

ix. Results from prior improper payment work;

x. Other Risk Susceptible Programs determined by OMB on a case by case basis that certain programs may be subject to annual PAR/AFR reporting; and

xi. Disaster Relief Appropriations Legislation
In order to evaluate susceptibility of each program to improper payments, using the framework and risk factors shown above, NASA reviewed various types of information and reports, conducted surveys, and executed analyses related to NASA programs. Three (3) separate risk assessment questionnaires were developed and distributed in order to address the 11 risk factors included in the risk assessment. Specific information obtained and reviewed includes the following:

- FY 2017 and FY 2016 audit reports, findings, and recommendations (i.e. reports from the OIG, GAO, and other independent bodies)

- FY 2015 – FY 2017 OMB Circular A-123 Appendix A, Internal Control over Financial Reporting Summary Reports

- NASA Budgetary Estimates and Trends from FY 2013 – FY 2017

- FY 2017 Payment Processing Questionnaire
- FY 2017 Procurement Questionnaire
- FY 2017 Disaster Relief Questionnaire
- Applicable OMB Memoranda
- FY 2017 and FY 2016 Program Disbursements
- NASA Quality Assurance Division (QAD) Internal Control Program
- Statement on Standards for Attestation Engagements (SSAE) 18 Reports
- FY 2016, 2015, and 2014 IPIA Compliance Audit Results and Recommendations

Using the information reviewed and the risk assessment criteria, the risk conditions for each program were assigned a risk rating. NASA then calculated a weighted average risk rating for each program based on the risk scores and weights assigned to each risk condition. As a result of the FY 2018 Risk Assessment, none of the 30 programs evaluated were considered to be susceptible to significant improper payments. Accordingly, the Agency was not required to perform improper payment sampling and estimation for FY 2018.

Barriers

Given the results of the FY 2018 Improper Payment Risk Assessment, NASA is not required to develop a corrective action plan or identify applicable barriers for FY 2018. NASA will continue to monitor and assess its payment processes and processing environment in order to minimize Agency vulnerability to improper payments. Should the Agency identify improper payments, a root cause analysis will be performed, formulation of corrective actions will be considered, and barriers will be identified.

Accountability

Although none of NASA's programs have improper payments exceeding the statutory thresholds outlined in OMB Circular A-123 Appendix C, NASA management works diligently to hold Agency personnel and other stakeholders accountable for the prevention of improper payments and to verify the Agency has proper infrastructure, internal controls, and systems. Given no improper payments were identified, further reporting on accountability is not required.

Agency Information Systems and Other Infrastructure

As the backbone of defense and prevention of improper payments, NASA is dedicated to the establishment, maintenance, and ongoing assessment of robust information systems, Agency infrastructure and related internal controls, especially over Agency payments. NASA will continue to monitor its information systems and infrastructure and apply internal control standards (Control Environment, Risk Assessment, Control Activities, Information and Communications, and Monitoring) to its programs and activities to reinforce the ability of the Agency internal control program to prevent, detect, and recover improper payments. As NASA did not identify any programs with improper payments exceeding the statutory thresholds of Appendix C during the FY 2018 Improper Payment Risk Assessment, additional reporting on information systems and other infrastructure is not required.

Sampling and Estimation

Under the parameters set forth in IPIA, IPERA, and IPERIA, agencies are required to perform a risk assessment of its programs and activities, identify programs and activities that are susceptible to significant improper payments, and produce improper payment estimates for programs determined to be susceptible to significant improper payments. In FY 2018, the Agency did not identify any programs as susceptible to significant improper payments; therefore, no further sampling or improper payment estimation was performed or reported.

Recapture of Improper Payments Reporting

On July 22, 2010, the President signed into Law the *Improper Payments Elimination and Recovery Act of 2010 (IPERA) (P.L. 111-204)* [B]. IPERA requires all Federal agencies to conduct payment recapture audits as part of its overall program to ensure effective internal controls over payments. NASA continues to perform recapture audits over fixed price contracts only as part of its overall program to ensure effective internal control over payments.

This approach is in accordance with the amended OMB Circular A-123, Appendix C guidance, which allows agencies to make the determination to exclude classes of contracts payment from recapture audit activities if the agency determines that recapture audits are inappropriate or not a cost-effective method for identifying and recovering improper payments. NASA does not consider it cost-effective to conduct payment recapture audits for cost type contracts or grants and cooperative agreements as these payments are made through our centralized procure to pay process which provides reasonable assurance of proper payment.

NASA attributes much of the positive results of its improper payment program to the centralized procurement and payment activities executed at the NASA Shared Services Center. Centralized processing provides a sound internal control environment that mitigates the risk of improper payments across the Agency.

In FY 2014, NASA awarded the contingency based Recapture Audit contract to an industry leading consultant. For FY 2018, the Recapture Audit scope entailed the review of FY 2017 disbursements to identify and recover overpayments, duplicate payments, erroneous payments, lost credit memos, and internal transaction errors of NASA's fixed price contracts that expend $1 million or more annually. There were no overpayments identified nor recaptured through the payment recapture audit and there are no outstanding identified overpayments from previous year's audits.

In addition to the Recapture Audit activities described above, the Agency conducted activities outside of the FY 2018 Agency Recapture Audit. Examples of such activities include Agency post-payment review/ audits, single audit and self-reported overpayments. As a result of the activities conducted outside of the Recapture Audit NASA recovered $1.5 million, which is 76.2 percent of the total overpayments identified for payments outside of the recapture audit.

NASA has taken steps through Improper Payment Reviews and recapture audits to continue efforts already embedded in the control environment for reducing and recovering improper payments. The recapture audit process is monitored by the Office of the Chief Financial Officer to ensure compliance with NASA's Recapture Audit Guidance. In addition, all collection and disbursement functions are centralized which ensures consistent application of the control environment and reduction of improper payments. There are no statutory or regulatory barriers limiting NASA's ability to reduce improper payments.

Do Not Pay Initiative

The Office of Management and Budget (OMB) issued Memorandum M-12-11 dated April 12, 2012, *Reducing Improper Payments through the "Do Not Pay List"* requiring agencies to submit a "Do Not Pay (DNP) List" Implementation Plan by August 31, 2012.

NASA fully integrated into the Treasury's DNP portal process on September 27, 2014, utilizing the following data sources: the Social Security Administration Death Master File (SSA-DMF) and the System for Award Management Exclusion Record-Private (SAM-EPLS).

The cumulative results of the monthly reviews for the period of October 2017 through September 14, 2018 were 130,320 payments made by Treasury on behalf of NASA with a dollar value of $13.977 billion. Treasury uses only the vendor name in SAM to identify any matches for potential improper payments. NASA researches any identified matches, validating the data using the Tax Identification Number (TIN), full name or address in addition to the vendor name.

The review by NASA resulted in one matched payment totaling $77,858, which was deemed as proper and reported back to Treasury as such.

Fraud Reduction Reporting

The Fraud Reduction and Data Analytics Act (FRDA) of 2015 requires Federal Agencies to establish financial and administrative controls to identify and assess fraud risks and design and implement control activities in order to prevent, detect, and respond to fraud, including improper payments. NASA aims to detect and prevent improper payments via fraud reduction through the improper payment program (IPP). NASA identifies, reviews, classifies, determines root causes for, and develops Agency corrective actions for instances of fraud identified via the improper payment risk assessment. Cases of fraud are also considered when determining whether NASA's programs are susceptible to significant improper payments as required by Circular A-123, Appendix C, *Requirements for Payment Integrity Improvement*. When suspected instance of fraud are identified, the Agency coordinates with the appropriate parties by referring those instances for investigation and adjudication to the appropriate parties such as NASA's Office of Inspector General or the Department of Justice.

In addition to NASA's IPP, the Agency has taken additional steps to ensure appropriate strategies and procedures are in place to reduce fraud. Leveraging GAO's "A Framework for Managing Fraud Risks in Federal Programs" as a guide, NASA has implemented several activities to prevent and/or detect possible instances of fraud across the Agency and will continue to enhance processes to identify and mitigate fraud risks. Fraud prevention and detection activities include Acquisition Integrity and Improper Payments Programs, regular fraud risk assessments, an enhanced Statement of Assurance process to include assessment and evaluation of fraud risk management control activities, external and internal audits and investigations, and a Data Breach Response Process. NASA has deployed several fraud-awareness initiatives across the Agency, including mandatory fraud prevention training for all employees, anti-fraud campaigns to increase awareness of reporting mechanisms and coordination and collaboration with the Office of Inspector General to further assess the Agency's risk posture. NASA has an extensive Counterfeit Parts Awareness and Inspection program that includes regular investigation and examination of parts, components and materials to mitigate the risk of misrepresentation by a supplier or vendor. As such, NASA employs many of the leading practices outlined in GAO's Framework to ensure effective fraud risk management across NASA.

NASA's Mission Support Offices, Mission Directorates and NASA Centers participate in annual fraud assessments related to the GAO's "Standards for Internal Control in the Federal Government" (the "Green Book"); and OMB Circular A-123 with respect to the leading practices for managing fraud risk. These assessments aid in the evaluation of all aspects of fraud, including fraud prevention, fraud detection through continuous monitoring and evaluations, fraud corrective action plans and the communication of fraud control activities across the Agency.

NASA's comprehensive OMB Circular A-123 Appendix A assessment approach includes assessment of all risks, including fraud risk, associated with each business cycle; evaluating whether internal controls mitigate those risks to acceptable levels; and conducting risk-based internal control reviews to determine whether controls are operating as intended. To identify potential risk areas for fraud, NASA analyzes known fraud cases and inherent risk of errors and irregularities due to fraud that could potentially impact business cycles.

NASA also employs an Ethics Program that requires all NASA employees to: (1) Comply with all applicable ethics laws, regulations, Executive orders, and other guidance, and avoid even the appearance of impropriety; and (2) Complete annual and other periodic training as required. The Agency widely communicates and encourages employees to report instances observed or allegations of fraud, waste, abuse and mismanagement. One reporting mechanism is the Office of Inspector General's Hotline.

NASA remains committed to combating fraud though its strong risk management and internal control structure, which allows its organizational structure to be conducive to effective fraud risk management.

IPIA References

[A] The Improper Payments Information Act of 2002 (IPIA) (Public Law (P.L.) 107-300)
https://www.congress.gov/107/plaws/publ300/PLAW-107publ300.pdf

[B] Improper Payments Elimination and Recovery Act of 2010 (IPERA) (P.L. 111-204)
https://www.gpo.gov/fdsys/pkg/BILLS-111s1508enr/pdf/BILLS-111s1508enr.pdf

[C] Recovery Auditing Act (Section 831, Defense Authorization Act, for FY 2002; P.L. 107-107)
https://www.gpo.gov/fdsys/pkg/PLAW-107publ107/pdf/PLAW-107publ107.pdf

[D] Improper Payments Elimination and Recovery Improvement Act of 2012 (IPERIA) (P.L. 112-248)
https://www.gpo.gov/fdsys/pkg/PLAW-112publ248/pdf/PLAW-112publ248.pdf

[E] Memorandum M-13-20, *Protecting Privacy while Reducing Improper Payments with the Do Not Pay Initiative*
https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2013/m-13-20.pdf

[F] Memorandum M-15-02, *Requirements for the Effective Estimation and Remediation of Improper Payments in 2014*
https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2015/m-15-02.pdf

[G] Memorandum M-18-20, *Requirements for Payment Integrity Improvement*
https://www.whitehouse.gov/wp-content/uploads/2018/06/M-18-20.pdf

[H] Disaster Relief Appropriations Act (Disaster Relief Act) (P.L. 113-2)
https://www.congress.gov/113/plaws/publ2/PLAW-113publ2.pdf

[I] Memorandum M-13-07, *Accountability for Funds Provided by the Disaster Relief Appropriations Act*
https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2013/m-13-07.pdf

[J] Bipartisan Budget Act of 2018 (P.L. 115-123)
https://www.congress.gov/115/bills/hr1892/BILLS-115hr1892enr.pdf

[K] Memorandum M-18-14, *Implementation of Internal Controls and Grant Expenditures for the Disaster-Related Appropriations*
https://www.whitehouse.gov/wp-content/uploads/2018/03/M-18-14.pdf

[L] For additional details related to NASA Improper Payments
https://paymentaccuracy.gov/

UNDISBURSED BALANCES IN EXPIRED GRANT ACCOUNTS

NASA monitors and tracks grants' undisbursed balances in expired accounts through a monthly review of internal control activities designed to identify undisbursed balances in expired accounts. The Continuous Monitoring Program (CMP) ensures ongoing review and validation of financial data and the effectiveness of internal controls over the entire financial management process, including grants. When grants undisbursed balances in expired accounts are identified, appropriate action is taken to ensure optimum use of grant resources.

NASA generates financial management reports to aid in the tracking and monitoring of undisbursed amounts. An aging report of open obligations is generated on a monthly basis to determine the last day activity occurred. For open obligations in which no activity has occurred in a six month period and/or there is no supporting documentation, further review is performed to determine the validity of obligation balances and the existence of valid source documentation. Additionally, further analysis is performed to determine if funds can be de-obligated. If obligations are valid, the aging reports are updated to reflect that obligations have been confirmed with procurement as valid.

NASA will continue to track undisbursed balances in expired grant accounts through its monthly review of internal control activities designed to identify funds for de-obligation. This involves the continuous monitoring of undisbursed balances, identifying balances that should be de-obligated, and performing timely close-out of grants and other activities. Additionally, NASA's financial management and procurement offices will continue to collaborate in monitoring and tracking undisbursed balances.

Currently, NASA does not have undisbursed balances in expired accounts that may be returned to the Treasury of the United States. The following chart reflects the total number and dollar amount of undisbursed grants in expired appropriations. All amounts have been obligated to a specific project.

Fiscal Year	Total Number of Expired Grants with Undisbursed Balances	Total Amount of Undisbursed Balances for Expired Grants (In Millions of Dollars)
2015	979	$5.3
2016	954	$6.8
2017	917	$7.1

GRANTS OVERSIGHT & NEW EFFICIENCY (GONE) ACT REQUIREMENTS

NASA monitors and tracks grants undisbursed balances in expired accounts through a monthly review of internal control activities designed to identify undisbursed balances in expired accounts. The Continuous Monitoring Program (CMP) ensures ongoing review and validation of financial data and the effectiveness of internal controls over the entire financial management process, including grants. When grants undisbursed balance in expired accounts are identified, appropriate action is taken to ensure optimum use of grants resources.

NASA awards numerous grants and cooperative agreements to institutions with provisional indirect rate agreements. Final indirect rate determination often happens years after a grant award expires and some grantees prefer to delay final billing and federal financial reporting until their rates have been finalized. NASA policy requires grantees to submit final reporting within 90 days after the awards expire, but the grantees argue that they cannot submit final financial reporting until final rates have been established. This causes significant delays in the closeout of those awards. Of the 19 awards expired more than two years, 16 (84%) of them were provisional indirect rate awards.

We have significantly reduced the number of grants expired for more than two years by utilizing unilateral closeout procedures where appropriate and by encouraging provisional rate grantees to estimate final billing (at the provisional rate) prior to final indirect rate determination. We will continue to utilize these procedures to facilitate the timely closeout of grants.

NASA's financial management and procurement offices will continue to collaborate in monitoring and tracking undisbursed balances.

Currently, NASA does not have undisbursed balances in expired grants that may be returned to the Treasury of the United States. Per OMB Circular A-136, *Federal Reporting Requirements*, the following table reflects the total number and dollar amount of undisbursed grants and cooperative agreements, for which closeout has not yet occurred and the period of performance has elapsed by more than two years.

CATEGORY	2-3 Years	>3-5 Years	>5 Years
Number of Grants/Cooperative Agreements with Zero Dollar Balances	4	3	1
Number of Grants/Cooperative Agreements with Undisbursed Balances	9	1	1
Total Amount of Undisbursed Balances	$145,627	$3,873	$711

REDUCE THE FOOTPRINT

The National Aeronautics and Space Administration (NASA) is committed to the goal of reducing the total square footage of its domestic office and warehouse inventory compared to its FY 2015 baseline. This reduction in square footage contributes to reducing the costs associated with real property in accordance with Section 3 of the Office of Management and Budget (OMB) Memorandum 12-12, *Promoting Efficient Spending to Support Agency Operations,* and OMB Management Procedures Memorandum 2013-02, the "Reduce the Footprint" policy implementation guidance. NASA continues to meet its national responsibilities, fully leveraging retained assets to increase their functionality in support of mission success while disposing of unneeded assets, increasing the use of under-utilized assets, minimizing operating costs, and improving efficiency.

From 2018 to 2022, NASA plans to dispose over 5 percent of its owned other-than-office-and-warehouse buildings (over 1.7 million square feet), while acquiring about 1 percent (400,000 square feet), resulting in about a 4 percent net consolidation (1.3 million square feet). Rooted in policy and strategy, NASA applies several processes for consolidating its footprint:

- NASA Centers are required to show how they will renew and consolidate their footprint in their master plans, projecting changes in both valuation and footprint over twenty years;
- Capital investment candidates must conform to an approved master plan and an underlying business case (routinely removing more facility than is constructed). Divestments that can result from candidate investments are a key element of the business cases for these investments; and
- Recognizing that divesting of legacy assets may be a low priority for NASA Centers compared with supporting current mission, NASA Headquarters funds the divestment of such assets centrally each year.

As of September 30, 2017, NASA's Reduce the Footprint portfolio footage was 15.573 million square feet. NASA incurred $93 million in operations and maintenance costs for owned and direct lease buildings.

In FY 2017, Operating and Maintenance (O&M) costs totaling $3.5 million were reported for 228 abandoned assets. Almost all of these assets are scheduled for disposal. NASA plans to reduce additional 477 assets following consolidation of their functions with other renovated or newly constructed assets in upcoming years.

NASA will continue identifying, implementing, and executing facility efficiency and effectiveness through management, development, and operational strategies that reduce life-cycle cost and risk while ensuring safety and mission success.

Reduce the Footprint Baseline Comparison	FY 2015 Baseline	FY 2017	Change (FY 2015 Baseline - FY 2017)
Square Footage (SF in Millions)	15.716	15.573	(0.143)

O&M Costs - Owned and Direct Lease Buildings	FY 2015 Reported Cost	FY 2017	Change (FY 2015 - FY 2017)
Operation and Maintenance Cost *($ in Millions)*	$78	$93	$ 15

*(The FY 2015 baseline changed from 15.519 to 15.716 due to changes in the OMB Circular A-136 FY18 guidance)

CIVIL MONETARY PENALTY ADJUSTMENT FOR INFLATION

For the Fiscal Year Ended September 30, 2018

The Federal Civil Penalties Inflation Adjustment Act of 1990, as amended, requires agencies to make regular and consistent inflationary adjustments of civil monetary penalties to maintain their deterrent effect. To improve compliance with the Act, and in response to multiple audits and recommendations, agencies should report annually in the Other Information section the most recent inflationary adjustments to civil monetary penalties to ensure penalty adjustments are both timely and accurate.

NASA reviewed each of the penalty amounts under its statutes and penalty amounts for inflation when required under law. The following table reflects the authorities imposing the penalties, the civil penalties, the adjustment years, the current penalty amount and location for penalty updates.

Authority (Statute)	Penalty (Name or Description)	Year Enacted	Latest Year Adjust-ment	Penalty Level ($ Amount)	Location
Program Fraud Civil Remedies Act of 1986	Penalty for False Claims	1986	2018	$11,181	Federal Register Vol.83 No.10 (16 Jan. 2018) Rules and Regulations www.federalregister.gov
Department of the Interior and Related Agencies Appropriations Act of 1989, Public Law 101-121, sec. 319	Penalty for use of appro-priated funds to lobby or influence certain con-tracts.	1989	2018	$19,639	Federal Register Vol.83 No.10 (16 Jan. 2018) Rules and Regulations www.federalregister.gov
Department of the Interior and Related Agencies Appropriations Act of 1989, Public Law 101-121, sec. 319	Penalty for use of appro-priated funds to lobby or influence certain con-tracts.	1989	2018	$196,387	Federal Register Vol.83 No.10 (16 Jan. 2018) Rules and Regulations www.federalregister.gov
Department of the Interior and Related Agencies Appropriations Act of 1989, Public Law 101-121, sec. 319	Penalty for failure to report certain lobbying transactions	1989	2018	$19,639	Federal Register Vol.83 No.10 (16 Jan. 2018) Rules and Regulations www.federalregister.gov
Department of the Interior and Related Agencies Appropriations Act of 1989, Public Law 101-121, sec. 319	Penalty for failure to report certain lobbying transactions	1989	2018	$196,387	Federal Register Vol.83 No.10 (16 Jan. 2018) Rules and Regulations www.federalregister.gov

SUMMARY OF FINANCIAL STATEMENT AND MANAGEMENT ASSURANCES

The following tables summarize the Agency's FY 2018 Financial Statement Audit and Management Assurances.

Table 1 summarizes the status of prior year - FY 2017 material weaknesses identified by the Financial Statement Auditor.

Table 2 summarizes the status of prior year material weaknesses identified by NASA Management.

Table 1: Summary of Financial Statement Audit

Audit Opinion	Unmodified
Restatement	No

Material Weaknesses	Beginning Balance	New	Resolved	Consolidated	Ending Balance
None	0	0	0	0	0
Total Material Weaknesses	0	0	0	0	0

Table 2: Summary of Management Assurances

Effectiveness of Internal Control over Financial Reporting (FMFIA 2)						
Statement of Assurance	Unmodified					
Material Weaknesses	Beginning Balance	New	Resolved	Consolidated	Reassessed	Ending Balance
None	0	0	0	0	0	0
Total Material Weaknesses	0	0	0	0	0	0

Effectiveness of Internal Control over Operations (FMFIA 2)						
Statement of Assurance	Unmodified					
Material Weaknesses	Beginning Balance	New	Resolved	Consolidated	Reassessed	Ending Balance
None	0	0	0	0	0	0
Total Material Weaknesses	0	0	0	0	0	0

Conformance with Financial Management System Requirements (FMFIA 4)						
Statement of Assurance	Systems conform					
Non-Conformances	Beginning Balance	New	Resolved	Consolidated	Reassessed	Ending Balance
None	0	0	0	0	0	0
Total Non-Conformances	0	0	0	0	0	0

Compliance with Financial Management System Requirements (FFMIA)		
	Agency	Auditor
1. System Requirements	No lack of compliance noted	No lack of compliance noted
2. Accounting Standards	No lack of compliance noted	No lack of compliance noted
3. USSGL at Transaction Level	No lack of compliance noted	No lack of compliance noted

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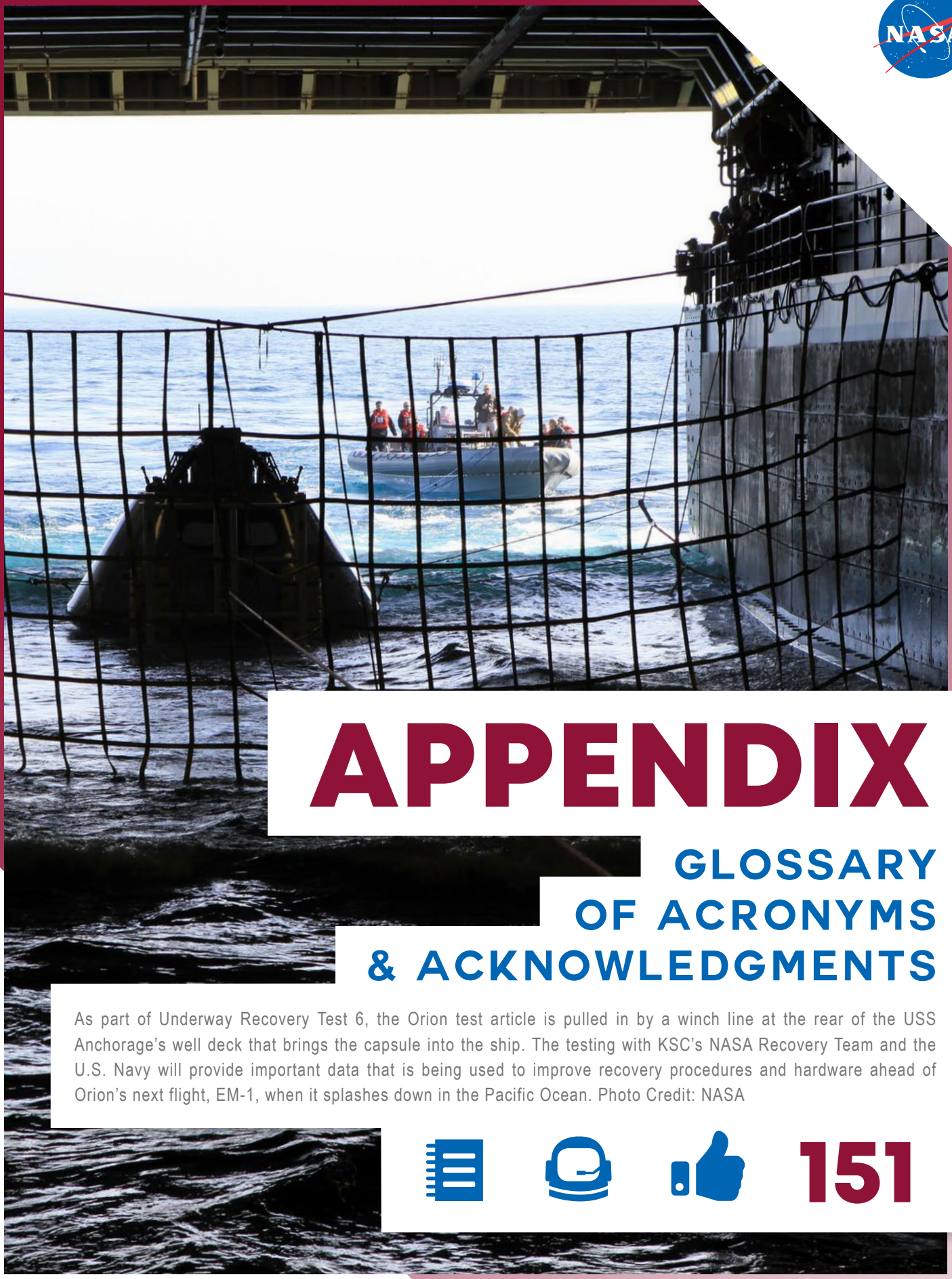

APPENDIX

GLOSSARY OF ACRONYMS & ACKNOWLEDGMENTS

As part of Underway Recovery Test 6, the Orion test article is pulled in by a winch line at the rear of the USS Anchorage's well deck that brings the capsule into the ship. The testing with KSC's NASA Recovery Team and the U.S. Navy will provide important data that is being used to improve recovery procedures and hardware ahead of Orion's next flight, EM-1, when it splashes down in the Pacific Ocean. Photo Credit: NASA

GLOSSARY OF ACRONYMS

3-D	Three Dimensional
AA	Associate Administrator
AA-2	Ascent Abort-2
AAIRS	Audit and Assurance Information Reporting System
ACME	Advanced Combustion via Microgravity Experiments
AFO	Audit Follow-up Official
AFR	Agency Financial Report
AFRC	Armstrong Flight Research Center
AICPA	American Institute of Certified Public Accountants
ALR	Audit Liaison Representative
AM	Additive Manufacturing
APG	Agency Priority Goal
APH	Advanced Plant Habitat
API	Annual Performance Indicator
APL	Applied Physics Laboratory
APR	Annual Performance Report
ARADS	Atacama Rover Astrobiology Drilling Studies
ARC	Ames Research Center
ARMD	Aeronautics Research Mission Directorate
ASC	Accounting Standards Codification
ATV	Automated Transfer Vehicle
BSA	Business Services Assessment
Caltech	California Institute of Technology
CAP	Cross-Agency Priority Goals
CASIS	Center for the Advancement of Science in Space
CDM	Continuous Diagnostics and Mitigation
CF	Core Financial
CFD	Computational Fluid Dynamics
CFO Act	Chief Financial Officers Act
C-I-A	Confidentiality, Integrity, and Availability
CIO	Chief Information Officer
CIT	Cybersecurity Integration Team

CLA	CliftonLarsonAllen LLP
CMP	Continuous Monitoring Program
COTS	Commercial Off-the-Shelf
CRS	Commercial Resupply Services
CRV	Current Replacement Value
CSRS	Civil Service Retirement System
DC	District of Columbia
DCIA	Debt Collection Improvement Act
DHS	Department of Homeland Security
DiD	Defense in Depth
DM	Deferred Maintenance
DM&R	Deferred Maintenance and Repairs
DNP	Do Not Pay
DoS	Denial of Service
EDT	Eastern Daylight Time
EDU	Engineering Design Unit
EDUC	Education
EGS	Exploration Ground Systems
EM	Exploration Mission
EPSCoR	Established Program to Stimulate Competitive Research
ERM	Enterprise Risk Management
ERP	Enterprise Resource Planning
ESA	European Space Agency
FAR	Federal Acquisition Regulation
FASAB	Federal Accounting Standards Advisory Board
FASB	Financial Accounting Standards Board
FBWT	Fund Balance with Treasury
FCI	Facility Condition Index
FECA	Federal Employees' Compensation Act
FEGLI	Federal Employees Group Life Insurance
FEHB	Federal Employee Health Group
FERS	Federal Employees Retirement System
FEVS	Federal Employee Viewpoint Survey
FFMIA	Federal Financial Management Improvement Act

FFRDC	Federally Funded Research and Development Center
FINDER	Finding Individuals for Disaster and Emergency Response
FIPCA	Federal Improper Payments Coordination Act of 2015
FITARA	Federal Information Technology Acquisition Act
FMFIA	Federal Managers' Financial Integrity Act
FPR	Facility Project Requirements
FPTBU	Funds to be Put to Better Use
FRDA	Fraud Reduction and Data Analytics Act
FY	Fiscal Year
GAAP	Generally Accepted Accounting Principles
GAO	Government Accountability Office
GCAM	Grant and Cooperative Agreement Manual
GISS	Goddard Institute for Space Studies
GOES	Geostationary Operational Environmental Satellite
GONE	Grants Oversight and New Efficiency Act
G-PP&E	General Property, Plant and Equipment
GPRAMA	Government Performance and Results Act Modernization Act of 2010
GPS	Global Positioning System
GRACE-FO	Gravity Recovery and Climate Experiment Follow-On
GRC	Glenn Research Center
GSFC	Goddard Space Flight Center
HEOMD	Human Exploration and Operations Mission Directorate
HERA	Human Research Exploration Analog
HQ	Headquarters
HTV	H-II Transfer Vehicle
HVA	High Value Asset
HVAC	Heating, Ventilating and Air Conditioning
IBNR	Incurred But Not Reported
ICAM	Identity, Credential, and Access Management
ICESat	Ice, Cloud and land Elevation Satellite
InSight	Interior Exploration using Seismic Investigations Geodesy and Heat Transport
INST	Institution
IPERA	Improper Payments Elimination and Recovery Act of 2010
IPERIA	Improper Payments Elimination and Recovery Improvement Act of 2012

IPIA	Improper Payments Information Act
IPP	Improper Payment Program
ISS	International Space Station
IT	Information Technology
ITC	Information Technology Council
JAXA	Japanese Aerospace Exploration Agency
JPL	Jet Propulsion Laboratory
JPSS	Joint Polar Satellite System
JSC	Johnson Space Center
JWST	James Webb Space Telescope
kg	Kilogram
KPH	Kilometers per Hour
KSC	Kennedy Space Center
LaRC	Langley Research Center
LEO	Low Earth Orbit
LSCUSP	Low Cost Upper Stage-Class Propulsion
M&R	Maintenance and Repairs
MAF	Michoud Assembly Facility
MAP	Mission Support Future Architecture Program
MD&A	Management Discussion and Analysis
MPH	Miles per Hour
MSC	Mission Support Council
MSD	Mission Support Directorate
MSFC	Marshall Space Flight Center
MSI	Minority Serving Institution
MSWG	Management System Working Group
MUREP	Minority University Research & Education Program
NASA	National Aeronautics and Space Administration
NASA AIP	Agency's Office of the General Counsel, Acquisition Integrity Program
NFR	Notice of Findings and Recommendations
NFS	NASA FAR Supplement
NISAR	NASA-Indian Space Research Organisation Synthetic Aperture Radar
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration

NPR	NASA Procedural Requirements
NRC	National Research Council
NSBRI	National Space Biomedical Research Institute
NSSC	NASA Shared Services Center
O&M	Operating and Maintenance
OCFO	Office of the Chief Financial Officer
OCIO	Office of the Chief Information Officer
OCSS	Office of Cybersecurity Services
OHCM	Office of Human Capital Management
OIG	Office of the Inspector General
OMB	Office of Management and Budget
OPM	Office of Personnel Management
Orion	Orion Multi-Purpose Crew Vehicle
OT	Operational Technology
P.L.	Public Law
PAR	Performance Accountability Report
PAT	Passive Aeroelastic Tailored
PDT	Pacific Daylight Time
PG	Performance Goal
PPS	Procurement for Public Sector
PSE	Program Support Equipment
QAD	Quality Assurance Division
R&D	Research and Development
RSI	Required Supplementary Information
RSSI	Required Supplementary Stewardship Information
SAM-EPLS	System for Award Management Exclusion Record-Private
SAP	Systems Applications and Products
SAT	Senior Assessment Team
SBR	Statement of Budgetary Resources
SCCS	Spaceport Command and Control System
SETMO	Space Environments Testing Management Office
SFFAS	Statement of Federal Financial Accounting Standards
SLS	Space Launch System
SMD	Science Mission Directorate

SNC	Statement of Net Cost
SOC	Security Operations Center
SoD	Segregation of Duties
SOFIA	Stratospheric Observatory for Infrared Astronomy
SOHO	Solar and Heliospheric Observatory
SP	Special Publication
Space Grant	National Space Grant and College Fellowship Program
SpaceX	Space Exploration Technologies Corporation
SPD	Space Policy Directive
SSA-DMF	Social Security Administration Death Master File
SSAE	Statement on Standards for Attestation Engagements
SSC	Stennis Space Center
STEM	Science, Technology, Engineering and Mathematics
STMD	Space Technology Mission Directorate
STR&D	Space Technology Research and Development
STS	Space Transportation System
SWOT	Surface Water and Ocean Topography
TCAT	Technical Capabilities Assessment Team
TIN	Tax Identification Number
Treasury	U.S. Department of the Treasury
U.S.	United States
US-CERT	United States Computer Emergency Readiness Team
USSGL	United States Standard General Ledger
VIPer	Volume of Integrated Performance
Webb	James Webb Space Telescope
WFIRST	Wide Field Infrared Survey Telescope
XRISM	X-Ray Imaging and Spectroscopy

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THANK YOU

The Agency Financial Report (AFR) was produced with the energies, time, and talents of the National Aeronautics and Space Administration in Washington, D.C. We offer our sincerest thanks and acknowledgments. In particular, we recognize the following individuals and organizations.

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We offer special thanks to our graphic designer, Rahn Johnson.

The primary mirror of NASA's James Webb Space Telescope (Webb), consisting of 18 hexagonal mirrors, looks like a giant puzzle piece standing in the massive clean room of NASA's Goddard Space Flight Center in Greenbelt, Maryland. Webb's primary mirror will collect light for the observatory in the scientific quest to better understand our solar system and beyond.

Webb is a space telescope that will be the successor to the Hubble Space Telescope. It will provide greatly improved resolution and sensitivity, and will enable a broad range of investigations across the fields of astronomy and cosmology. One of its major goals is observing some of the most distant events and objects in the universe, such as the formation of the first galaxies. These types of targets are beyond the reach of current ground- and space-based instruments. Photo Credit: NASA

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