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Office of Inspector General

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NASA's Construction of Facilities

September 8, 2021

Report No. IG-21-027

Office of Inspector General

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NASA Office of Inspector General
Office of Audits

RESULTS IN BRIEF

NASA's Construction of Facilities

September 8, 2021 IG-21-027 (A-20-005-00)

WHY WE PERFORMED THIS AUDIT

NASA facilities and infrastructure—including offices, laboratories, launch complexes, test stands, and wind tunnels—are necessary components for exploring the Moon and Mars, facilitating the commercial space industry, conducting aeronautics research, and studying Earth and space sciences. NASA manages $40 billion in facility assets with an inventory of more than 5,000 buildings and structures; however, over 75 percent of this infrastructure is beyond its design life and the Agency faces a deferred maintenance backlog of $2.66 billion as of 2020. To address these challenges and mitigate risks to current and future missions, NASA's Construction of Facilities (CoF) program focuses on modernizing NASA's infrastructure through consolidation into fewer, more efficient, sustainable facilities and repairing failing infrastructure to reduce overall maintenance costs.

NASA spent roughly $359 million each year over the past 5 years on its CoF program for institutional and programmatic projects. Institutional projects involve the repair or replacement of aging equipment, facilities, and infrastructure. Programmatic projects are Mission Directorate-funded projects for construction of specialized capabilities that directly support specific NASA missions. Given the age and changing needs for NASA's infrastructure, proper management of CoF funds is crucial to ensure that the right facilities are built or maintained in the right locations to meet mission requirements.

In this audit, we assessed the extent to which the Agency is effectively managing its facility construction efforts. Specifically, we examined whether NASA has processes in place to (1) justify, prioritize, and fund its CoF projects and (2) ensure that projects meet cost, schedule, and performance goals. To complete our work, we interviewed officials from the Facilities and Real Estate Division (FRED) at NASA Headquarters, Mission Directorates, and eight Centers. We also reviewed federal and Agency guidance and 20 CoF projects' justifications and performance.

WHAT WE FOUND

NASA's process for selecting and prioritizing CoF replacement and renovation projects is largely driven by Centers, regardless of their importance to the Agency's overall mission needs. Centers receive a percentage of the available institutional funds for building projects over a 5-year period based primarily on the current value of each Center's facilities. This process lacks the same rigor as the risk-based approach that NASA conducts for its repair project prioritization, and results in Centers with the highest replacement values receiving a bigger portion of available funds. FRED generally approves Centers' requested projects on a first-come, first-funded basis if the projects are within the Center's targeted funding levels, consistent with Center planning documents, and approved by the Agency's Mission Support Council. The process also does not effectively utilize business cases for Agency-level prioritization, despite their value towards providing the required business need and justification for initiating projects in terms of a cost-benefit analysis. Moreover, assumptions such as the scope of the projects used in the Agency's business cases did not consistently match the actual scope of the approved projects. For energy savings projects costing less than $10 million, Centers do not submit a business case to request funds. Instead NASA only considers a projected total cost savings per year with not all expenses, such as operations and maintenance, factored in as part of the life-cycle cost analysis.

In addition, NASA policy does not distinguish between the use of institutional and programmatic CoF funds. As a result, Centers often use funds that traditionally support institutional capabilities such as office buildings and utility systems to fund highly technical projects that Mission Directorates were unwilling to fund for various reasons including the difficulty in determining cost sharing arrangements for facilities with multiple users. Using institutional CoF funds to build specialized facilities for testing and development dilutes the funds available for making critical repairs and supporting other more traditional institutional requirements.

Several of the construction projects we reviewed also led to an expansion rather than consolidation of facilities and at times increased the amount of technical facility space such as laboratories while removing non-technical space such as warehouses. While NASA policy does not currently require the removal to come from facilities with space similar to what is being built, increasing technical space can be more expensive to maintain.

Further, Agency guidance does not require programs to identify facility needs or funding sources early in the development and implementation phases, increasing the risk that facility requirements will not be identified until later when it is more costly to address those issues. We also found NASA lacks an Agency-wide facility master plan that considers consolidation of activities between Centers. As a result, NASA may not be constructing the highest priority projects to meet future mission needs.

Of the 20 CoF projects we reviewed, 6 incurred significant cost overruns ranging from $2.2 million to $36.6 million and 16 of the projects are 3 months to more than 3 years behind their initial schedules. Costs increased primarily because requirements were not fully developed by the Agency before construction began, requirements were not fully understood by contractors, and contract prices were higher than originally estimated. Delays occurred because projects faced postponed start times and changing requirements, among other reasons. Finally, NASA did not provide effective oversight to determine whether the Agency's portfolio of CoF projects met cost, schedule, and performance goals. FRED has failed to consistently keep up with oversight requirements of approved and funded projects and current oversight guidance does not align with Agency facility goals. Increased costs and delays further limit NASA's CoF resources and hinder the Agency's ability to modernize its infrastructure into fewer, more sustainable and affordable facilities.

WHAT WE RECOMMENDED

To ensure NASA is effectively managing its facility construction efforts, we recommended NASA's Assistant Administrator for Strategic Infrastructure: (1) develop and institute an Agency-wide process to prioritize and fund institutional and programmatic CoF projects that align with Agency-level missions and require business case analyses to be completed and considered as part of the process prior to the projects' approval; (2) revise NASA Procedural Requirements 8820.2G to (a) define and establish parameters for the use of institutional and programmatic CoF funds and establish a cost-sharing method for facilities that will have more than one user, (b) require energy savings projects to consider life-cycle costs as part of their cost-benefit analyses, and (c) include requirements to reduce and consolidate the Agency's footprint that considers the demolition of like facilities when possible for discrete construction projects; (3) institute a process in coordination with the Mission Directorates to ensure facility requirements are identified and funding sources are specified during a program's development and implementation phases; and (4) reexamine policies regarding oversight of the CoF program to identify alternative approaches to more effectively oversee the program.

We provided a draft of this report to NASA management who concurred or partially concurred with our recommendations and described planned actions to address them. We consider the proposed actions responsive for recommendations 1, 2b, 2c, 3, and 4 and will close the recommendations upon their completion and verification. Recommendation 2a will remain unresolved pending further discussions with the Agency.

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Acronyms

ASAP	Aerospace Safety Advisory Panel
CoF	Construction of Facilities
COVID-19	Coronavirus Disease 2019
FRED	Facilities and Real Estate Division
FY	fiscal year
JPL	Jet Propulsion Laboratory
NPR	NASA Procedural Requirements
OIG	Office of Inspector General
OMB	Office of Management and Budget
REA	request for equitable adjustment
SLS	Space Launch System
VAB	Vehicle Assembly Building

INTRODUCTION

With its headquarters in Washington, D.C., and installations in 12 states, NASA manages $40 billion in assets with an inventory of more than 5,000 buildings and structures, making the Agency one of the largest property holders in the federal government. However, more than 75 percent of NASA's constructed infrastructure—such as offices, laboratories, launch complexes, test stands, and wind tunnels—are beyond their design life, requiring significant efforts and expense to mitigate risk to current and future missions. While NASA strives to keep its infrastructure operational, the Agency faces a deferred maintenance backlog of $2.66 billion as of 2020.[1] This has resulted in unscheduled rather than scheduled maintenance costing up to three times more to repair or replace equipment and facilities after they have failed. To address these challenges, NASA's Construction of Facilities (CoF) program focuses on modernizing NASA's infrastructure by consolidating into fewer, more efficient, sustainable facilities, and repairing failing infrastructure to reduce overall maintenance costs.

NASA spent roughly $359 million per year over the past 5 years on its CoF program and in fiscal year (FY) 2021 received $357 million to continue efforts to modernize, refurbish, and repair its facilities.[2] NASA has used those funds to revitalize infrastructure across the Agency, including upgrading facilities such as Launch Pad 39B and the Vehicle Assembly Building (VAB) at Kennedy Space Center to support its Artemis program that aims to return astronauts to the Moon and eventually Mars. Given the age and changing needs for NASA's infrastructure, proper management of CoF funds is crucial to ensure that the right facilities are built or maintained in the right locations to meet mission requirements.

This audit assessed the extent to which the Agency is effectively managing its facility construction efforts. Specifically, we examined whether NASA has processes in place to (1) justify, prioritize, and fund its CoF projects and (2) ensure that projects meet cost, schedule, and performance goals. See Appendix A for details on the audit's scope and methodology.

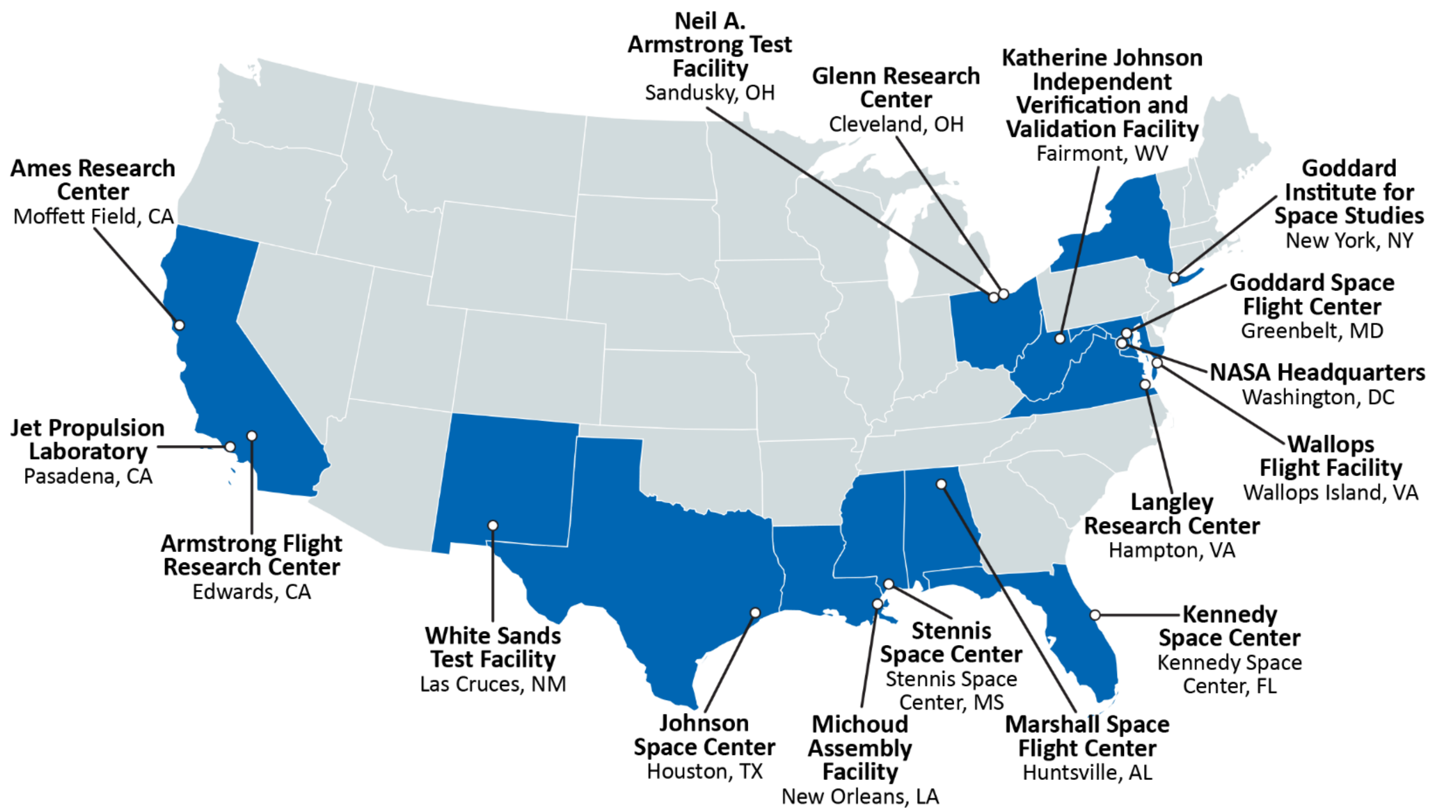
Background

NASA and its partners rely on the Agency's facilities and infrastructure as key components to explore the Moon and Mars, facilitate the commercial space industry, conduct aeronautics research, and study Earth and space sciences. NASA's 10 Centers and accompanying facilities are located throughout the United States (see Figure 1).

[1] Deferred maintenance is the total essential but unfunded maintenance work necessary to bring facilities and related equipment to acceptable maintenance standards.

[2] The Construction of Facilities program is funded by the Agency's Construction and Environmental Compliance and Restoration appropriation.

Figure 1: NASA Centers and Facilities



Source: NASA Office of Inspector General (OIG) presentation of Agency information.

NASA Space Centers

Johnson Space Center (Johnson), Kennedy Space Center (Kennedy), and Stennis Space Center (Stennis) provide facilities and infrastructure that support the Agency's human space flight programs. Located outside of Houston, Texas, Johnson maintains facilities and infrastructure such as laboratories and control rooms to train astronauts and provide command and control for human space flight missions and the International Space Station. Johnson also manages a satellite location in Las Cruces, New Mexico—White Sands Test Facility—that tests and evaluates potentially hazardous materials, space flight components, and rocket propulsion systems.

Neutral Buoyancy Laboratory at Johnson

2017 NASA astronaut candidate Jonny Kim prepares for underwater spacewalk training.

Source: NASA.

Located on Merritt Island, Florida, Kennedy has served as NASA's launch site for missions ranging from Apollo to the Space Shuttle as well as commercial launch partners such as the Space Exploration Technologies

Corporation. Kennedy's infrastructure includes high bay facilities and launch pads to assemble, process, and launch NASA's crewed and uncrewed space flight missions.[3] Finally Stennis, located in Hancock County, Mississippi, serves as NASA's primary rocket engine test site. Stennis maintains facilities and infrastructure such as test stands utilized to test rocket engines spanning from the Apollo era's Saturn V rocket stages to the core stage of NASA's new Space Launch System (SLS).[4]

NASA Space Flight Centers

Goddard Space Flight Center (Goddard) and Marshall Space Flight Center (Marshall) provide facilities and infrastructure that support scientific research and integration of aerospace technologies. Located in Greenbelt, Maryland, Goddard's infrastructure includes laboratories that develop uncrewed spacecraft and control rooms that communicate with NASA's Earth observation, astronomy, and space physics missions. Goddard also manages three satellite locations: Goddard Institute for Space Studies at Columbia University in New York conducts studies of natural and man-made changes in the Earth's environment; Katherine Johnson Independent Verification and Validation Facility in Fairmont, West Virginia, examines software developed for NASA missions; and Wallops Flight Facility on Wallops Island, Virginia, launches rockets, balloons, and aircraft in support of Goddard's Earth and space science research.

James Webb Space Telescope at Goddard

Rare view of the James Webb Space Telescope face-on, from Goddard's cleanroom observation window.

Source: NASA.

Located in Huntsville, Alabama, Marshall's infrastructure includes laboratories and test stands to advance propulsion technologies, develop science instruments, and refine engineering solutions to support NASA space flight missions. Marshall also manages a satellite location in New Orleans, Louisiana—the Michoud Assembly Facility—that manufactures and assembles large-scale space structures and systems such as the SLS core stage.

NASA Research Centers

Ames Research Center (Ames), Armstrong Flight Research Center (Armstrong), Glenn Research Center (Glenn), the Jet Propulsion Laboratory (JPL), and Langley Research Center (Langley) offer facilities and infrastructure that support research and testing for the Agency's aeronautics, exploration, and science programs. Located in Silicon Valley, California, Ames utilizes facilities and infrastructure such as advanced supercomputers, arc jets, and wind tunnels to develop and test technology for use on

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[3] A high bay is a tall vertical structure with a large open interior and entrance that allows rockets and other spacecraft to be processed and prepared for launch.

[4] NASA's Saturn V rocket was used during the Agency's Apollo program in the 1960s and 1970s to launch astronauts to the Moon. The SLS is a super heavy-lift rocket that will enable human exploration beyond low Earth orbit.

commercial and military aircraft as well as NASA rockets and spacecraft.[5] Located at Edwards Air Force Base in California, Armstrong serves as NASA's installation for atmospheric flight research. Armstrong provides facilities and infrastructure such as aircraft hangars to support a fleet of NASA aircraft and flight simulation facilities to conduct aeronautics research.

Unitary Plan Wind Tunnels at Ames

Source: NASA.

West of Cleveland, Ohio, Glenn maintains infrastructure including an aircraft hangar, vacuum chambers, and wind tunnels to research and test technologies related to propulsion, aeronautics, materials and structures, communications, power and energy storage, and biomedical technologies.[6] Glenn also manages a satellite location in Sandusky, Ohio—Neil A. Armstrong Test Facility— that includes unique facilities such as the Space Simulation Vacuum Chamber, which simulates the environment of space.

JPL, located north of Pasadena, California, is a federally funded research and development center owned by NASA and managed by the California Institute of Technology (Caltech).[7] JPL's laboratories and research facilities enable scientists and engineers to conduct research; build new instruments; and design, build, and operate uncrewed missions spanning from Explorer I in 1958 to the recent Mars 2020 Perseverance Rover.[8] Finally, Langley—located in Hampton, Virginia—maintains infrastructure such as laboratories, simulators, and wind tunnels to improve aviation, expand understanding of the Earth's atmosphere, and develop technology for space exploration.

State of NASA's Facilities and Infrastructure

A large portion of NASA's infrastructure was constructed in the 1960s during the Apollo era and more than 75 percent of the Agency's facilities are beyond their original design life. This aging infrastructure presents considerable risk to the Agency's overall mission success as facilities degrade and become obsolete and considerably more expensive to maintain. In addition, some portion of NASA's current needs for its facilities and infrastructure may shift as the Agency considers evolving on-site work requirements in light of an extended period of mandatory telework resulting from the Coronavirus Disease 2019 (COVID-19) pandemic and the continued commercialization of selected missions.

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[5] Supercomputers are the fastest and most powerful computers available at a given time. Arc jets allow researchers to study how high temperatures and vehicle velocities affect rockets and spacecraft as they exit and enter atmospheres on Earth and other planetary bodies. Wind tunnels are used to simulate the actions of an object in flight, which allows researchers to determine the behavior of an aircraft or its components at takeoff, while cruising, and during descent and landing.

[6] A vacuum chamber replicates extreme environments to certify performance of spacecraft, structures, components, and instrumentation.

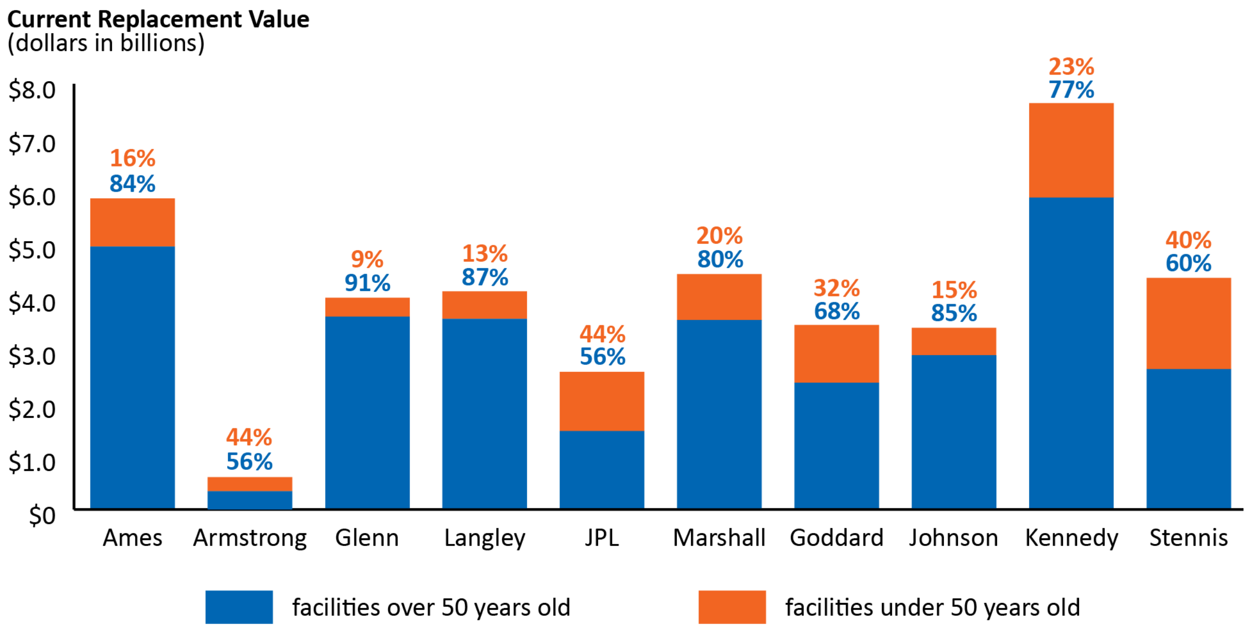
[7] Federally funded research and development centers meet special long-term research or development needs that cannot be met as effectively by existing in-house or contractor resources. Caltech is an independent, privately supported research university. While Caltech manages JPL, NASA retains ownership of the laboratories and facilities.

[8] Explorer I was the first successful launch of a satellite by the United States. NASA launched the Mars 2020 Perseverance Rover in July 2020 to search for signs of ancient microbial life on the planet. The rover has a drill to collect core samples of Martian rock and soil, then store them in sealed tubes for pickup by a future mission that would ferry the samples back to Earth for detailed analysis.

Age and Condition of NASA's Facilities and Infrastructure

Upon NASA's establishment in July 1958, the Agency subsumed many of the responsibilities, as well as the facilities and infrastructure, of the National Advisory Committee for Aeronautics, including those located at Ames, Armstrong, Glenn, and Langley.[9] Around the same time, NASA received property from the U.S. Army at sites that are now JPL and Marshall and began construction at other sites that are now Goddard, Johnson, Kennedy, and Stennis. As a result, much of the infrastructure across the Agency is at least 50 years old with some facilities dating as far back as the 1930s, nearly 90 years ago (see Figure 2).

Figure 2: Percentage of Facilities at Centers Over and Under 50 Years Old



Source: NASA OIG presentation of Agency data.

Note: Current replacement value is the estimated amount in current dollars it would cost to replace NASA's facilities.

NASA manages its aging facilities and infrastructure by performing annual assessments of their condition and deferred maintenance that are used to help guide future spending. The assessments involve visual inspections of assets and systems such as electrical, plumbing, and roofs by teams of independent assessors that includes architects, engineers, and facility specialists. The assessment teams rate each asset and system, considering input from facilities management staff and building managers. The results are entered into a parametric estimating model that produces a deferred maintenance cost estimate and facility condition index score.[10] The facility condition index assigns individual assets a condition rating between 1 and 5 with 1 indicating that an asset is not functional or unsafe for use and 5 indicating that a facility is excellent and requires only routine maintenance.

[9] The National Aeronautics and Space Act of 1958 (Pub. L. No. 85-568) provided for "research into the problems of flight within and outside the Earth's atmosphere" and established NASA. The National Advisory Committee for Aeronautics was founded in 1915 during World War I as part of the 1916 Naval Appropriations Act (Pub. L. No. 271, passed in March 1915) and managed and conducted aeronautics research, experiments, flight tests, and simulations.

[10] A parametric model uses the parameters of a project to estimate the use of resources such as labor, materials, and time required to perform the project.

In November 2020, NASA reported a deferred maintenance cost estimate of $2.66 billion for facilities and infrastructure across the Agency.[11] That amount continues what has been a relatively flat to downward trend since 2016, when deferred maintenance is considered as a percentage of the Agency's current replacement value (the cost to replace NASA facilities). The four Centers with the highest deferred maintenance cost estimates in order of magnitude were Ames, Kennedy, Langley, and Marshall, which combined to account for nearly 63 percent of the Agency-wide estimate. According to the deferred maintenance report, those four Centers contributed the most to the overall estimate because they are large Centers with high-value assets, including wind tunnels, launch facilities, and test facilities that are aging or have non-operational program support equipment. The NASA-wide facility condition index continued to trend upward, increasing from a 3.71 rating in 2016 to 3.77 in 2020, meaning that facilities continue to require many minor repairs and some larger repairs, and that systems normally function satisfactorily but occasionally are unable to function as intended. The report stated that NASA has been reviewing alternative approaches to reduce deferred maintenance and increase the facility condition index rating through varying levels of demolition of abandoned facilities, new construction, and targeted improvements to active high-value assets.

Shifting Needs for NASA's Facilities and Infrastructure

In response to the COVID-19 pandemic, NASA shifted its operations in March 2020 and required mandatory telework for nonessential civil service and contractor employees. By mid-April 2020, 90 percent of the Agency's workforce was working from home and 12 of the Agency's 17 major installations were closed while the remaining transitioned to "mission critical" operations only. As of July 2021, approximately 85 percent of NASA's workforce continues to work from home. As NASA returns to on-site work, the Agency is reexamining its physical footprint and workplace flexibilities to identify future needs for facilities and infrastructure given the likely move toward portions of the workforce continuing to work remotely. In addition, NASA's Aerospace Safety Advisory Panel (ASAP) recommended in February 2021 that NASA should more strategically consider its facilities needs as it adopts a more diverse set of approaches to managing human space flight programs, including developing a top-level plan for the size and composition of its infrastructure.[12] In ASAP's *Annual Report for 2020*, it highlighted the evolution in NASA's management of its human space flight programs from the Agency's establishment when programs were managed entirely in-house to the current broad mixture of acquisition strategies, partnerships, and operational paradigms that includes commercial approaches utilized for the Commercial Crew and Cargo Programs.[13] Going forward, as NASA considers its response to this plan and the Agency's work efforts evolve further, these issues could have a significant impact on the facilities and infrastructure the Agency decides to maintain as well as those that it decides to build in the future.

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[11] NASA, *Deferred Maintenance Assessment Report* (November 2020). The Facilities and Real Estate Division at NASA Headquarters annually performs the deferred maintenance assessment and produces a report to provide a useful metric of facility requirements during the budget evaluation process.

[12] ASAP was established as an independent safety review board that reports to both NASA and Congress. The board evaluates NASA's safety performance and provides continuous oversight of its aerospace programs. Congress requires the board to submit an annual report to the NASA Administrator and Congress that examines the Agency's compliance with the recommendations of the Columbia Accident Investigation Board, as well as NASA's management and culture related to safety.

[13] ASAP, *Annual Report for 2020* (January 2021). Established in 2005, the Commercial Crew and Cargo Programs are a partnership between NASA and the U.S. aerospace industry to develop and operate a new generation of spacecraft and launch systems capable of carrying crew and cargo to low Earth orbit and the International Space Station.

NASA's Construction of Facilities Program

NASA's CoF program makes capital repairs and improvements to the Agency's infrastructure and provides NASA projects and programs with the test, research, and operational facilities required to accomplish their missions. To accomplish this, the CoF program seeks to reduce and modernize NASA's infrastructure into fewer, more efficient, sustainable facilities and repair failing infrastructure to reduce overall maintenance costs, including repairing equipment and facilities that can no longer be effectively maintained and have suffered continuous degradations, recent failures, or deterioration from reduced maintenance over time. This includes refurbishment or repair projects; renewal projects to replace—when it is more cost-effective than to repair or renovate—inefficient, deteriorated buildings with efficient high-performance facilities; and demolition projects to eliminate facilities that are no longer needed. Together these activities are intended to reduce operating and deferred maintenance costs, improve facility conditions, reduce the Agency's facility footprint, and develop an energy efficient infrastructure to support NASA's missions.

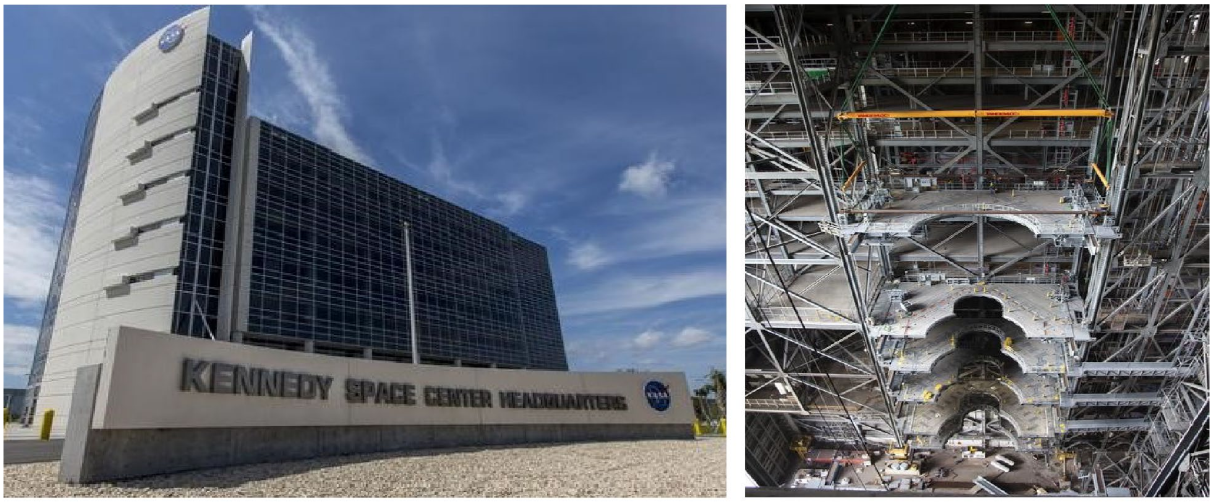
CoF Funding

NASA implements its CoF program through the Agency's Construction and Environmental Compliance and Restoration appropriation. The CoF program includes funding for institutional and programmatic projects. Institutional projects are categorized as facility planning and design, discrete revitalization and construction (costs more than $10 million), minor revitalization and construction (costs between $1 million and $10 million), demolition of facilities, and energy savings investments. Institutional projects primarily involve the repair or replacement of aging equipment, facilities, and infrastructure to minimize facility-related risks to mission success, property, and personnel as well as to consolidate core functions and reduce operating costs. For example, Kennedy utilized institutional CoF funds to construct its 7-story, 189,000 square foot Central Campus Headquarters Building beginning in 2014 until its completion in 2019 (see Figure 3).

Programmatic projects are Mission Directorate-funded discrete or minor projects for construction of specialized capabilities required for testing and development that directly support specific NASA missions.[14] For example, NASA's Human Exploration and Operations Mission Directorate utilized programmatic CoF funds to install platforms at Kennedy's VAB that will be used to prepare the SLS for the upcoming Artemis launches (see Figure 3).

[14] Mission Directorates transfer funding from their appropriations to the Construction Environmental Compliance and Restoration appropriation to execute a programmatic CoF project.

Figure 3: Kennedy Space Center Headquarters Building and Vehicle Assembly Building

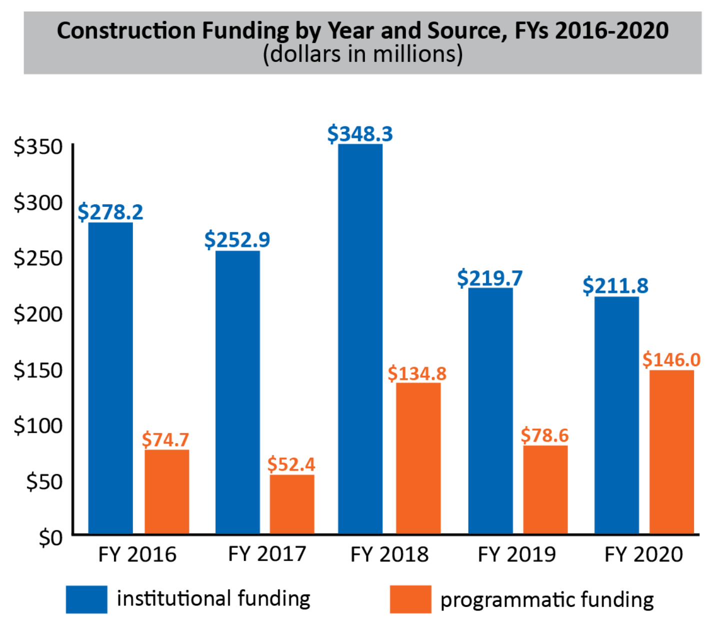


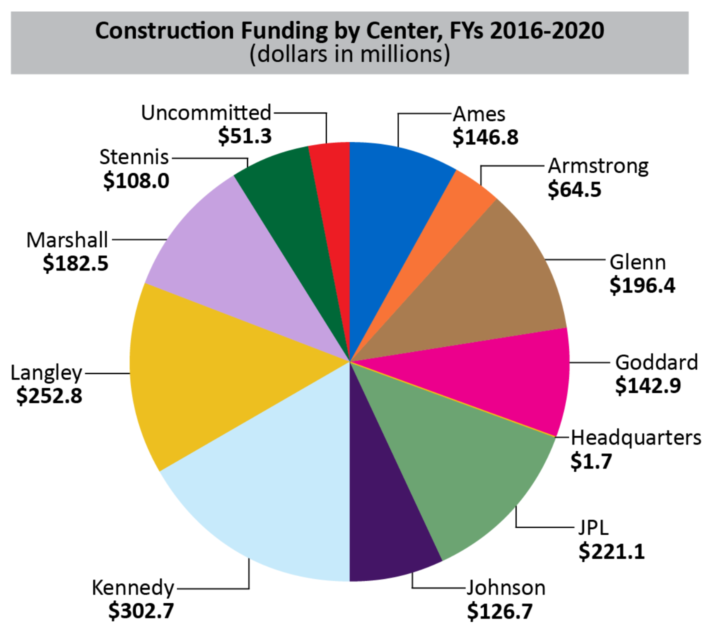
To the left is a view of the front of Kennedy's new headquarters buiding in April 2019. To the right shows the installation of platforms in High Bay 3 at Kennedy's Vehicle Assembly Building in August 2016.

Source: NASA.

Between FYs 2016 and 2020, NASA received nearly $1.8 billion in appropriated CoF funding for institutional and programmatic projects across the Agency (see Figure 4). Kennedy received the largest share of those funds totaling $302.7 million (17 percent) for projects to restore the Center's coastal shoreline and to modify ground support infrastructure in the VAB and at Launch Complex 39B. The next three largest CoF expenditures were Langley's $252.8 million (14 percent), JPL's $221.1 million (12 percent), and Glenn's $196.4 million (11 percent).

Figure 4: Construction Funding by Year, Source, and Center





Source: NASA OIG presentation of Agency data.

Langley utilized a large portion of its funds to construct the Measurement Systems Laboratory, a 175,000 square foot facility for research and development of new measurement concepts, technologies, and systems, and to begin construction on its Flight Dynamics Research Facility, a wind tunnel the Center will utilize for enhanced vertical spin testing of aircraft and spacecraft. JPL continued construction on an array of antennas known as the Deep Space Network and also began construction on a 5-story, 85,000 square foot laboratory known as the Flight Electronics Integration Facility that will support spacecraft avionics and electronic hardware fabrication and testing.[15] Glenn is constructing a 64,000 square foot multi-use office building known as the Research Support Building along with a 55,000 square foot Aerospace Communications Facility that will be utilized for radio frequency communications technology research and development. Other significant projects included construction of a 41,000 square foot facility at Ames known as the Biosciences Collaborative Facility that houses laboratories for space biology, astrobiology, and synthetic biology and construction of Goddard's Instrument Development Facility, a 54,200 square foot multi-story laboratory and office facility.

CoF Program Management

NASA's CoF programs are managed by the Facilities and Real Estate Division (FRED) within the Office of Strategic Infrastructure at NASA Headquarters. In accordance with federal and NASA policy, FRED is required to lead the review and prioritization of institutional facility projects proposed under NASA's 5-year construction funding plan based upon business case analyses provided by the Centers.[16] This review includes an evaluation of existing capabilities to minimize or eliminate the creation of excess capacity within the Agency or the private sector. NASA's policy is to construct new facilities only when existing capabilities, including those owned by the Agency and other external entities, cannot be used or modified cost effectively. In addition, NASA requires that construction of new facilities be offset by a greater than equivalent amount of facility disposal, currently at least 125 percent of the new space.[17] FRED and the associated Mission Directorate coordinate the process for facility projects funded from other sources such as programmatic or external funds.

While FRED is responsible for overseeing the progress of CoF projects by monitoring significant design and construction milestones, change orders, cost overruns, and safety concerns, NASA Centers are responsible for executing the approved projects. Centers manage project development and planning, design, construction, activation, and any associated facility demolition. CoF projects are procured through either design-bid-build or design-build approaches. For design-bid-build projects, Centers contract with an architecture-engineering firm to produce a design that is then solicited for a construction bid with the winning contractor building the facility. Design-build projects are performed by a company under a single contract to provide both design and construction. Centers must ensure that CoF projects are constructed in compliance with applicable codes, laws, regulations, and NASA standards. They are also required to report to FRED quarterly on CoF project performance, including on cost, schedule, and any significant issues such as change orders or safety concerns.

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[15] NASA's Deep Space Network consists of three antennas located at Goldstone, California, and near Madrid, Spain, and Canberra, Australia. The network is used to command, track, and monitor spacecraft at many distant planetary locales, as well as to perform science experiments and research. Spacecraft avionics are the electrical systems, driven by software, that control a spacecraft's direction and trajectory during flight.

[16] NASA Procedural Requirements (NPR) 8800.15C, *Real Estate Management Program w/Change 1, February 24, 2015* (October 30, 2014). A business case provides the business need and justification for initiating a project, often presented in terms of a cost–benefit analysis, which may include both financial and non-financial costs and benefits.

[17] NASA Policy Directive 8820.2E, *Design and Construction of Facilities* (July 15, 2019).

CENTER-DRIVEN SELECTION PROCESS FOR COF PROJECTS DOES NOT FULLY UTILIZE BUSINESS CASE ANALYSIS AND LACKS CLEAR GUIDANCE ON THE USE OF FUNDS

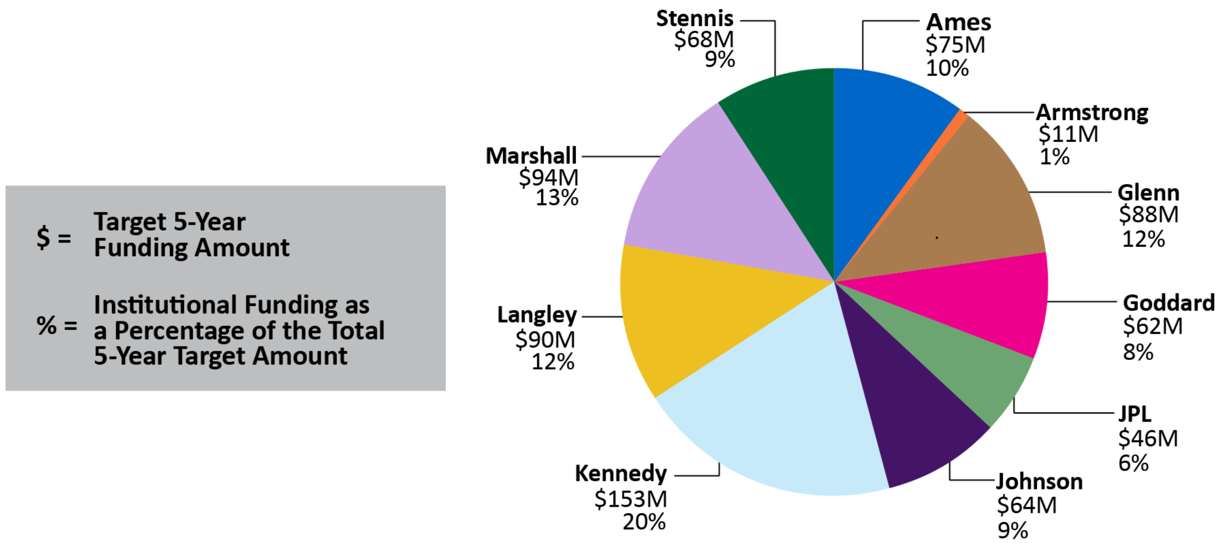
NASA's process for selecting and prioritizing the Agency's discrete CoF replacement and renovation projects—those with costs of more than $10 million—is largely driven by Centers and does not effectively utilize business cases. In addition, Agency guidance does not distinguish between the use of institutional and programmatic CoF funds or require programs to identify facility needs early in the development phase. We also found that NASA lacks an Agency-wide facility master plan that considers consolidation of activities between Centers. As a result, the Agency may not be constructing the highest priority projects to meet future mission needs while diluting institutional funds needed for repairs. Issues surrounding the selection and prioritization of NASA's discrete CoF projects are long-standing and currently under Agency review.

Process for Selecting Replacement and Renovation Projects Is Largely Center Driven

NASA limits every Center to a portion of available institutional funding for replacement and renovation projects over a 5-year period based primarily on the current value of each Center's facilities, regardless of the importance to Agency missions or economic efficiencies. This process differs from the prioritization process the Agency utilizes for repair projects, which employs a risk-based approach to rank projects for selection. Under the replacement and renovation approach, each Center receives a percentage of the overall institutional funds available, and FRED generally approves Centers' desired projects on a first-come, first-funded basis as long as the projects are within the Center's targeted funding levels, consistent with the Center's planning documents, and approved by the Agency's Mission Support Council.[18] According to FRED officials, the targeted funding levels were established in 2011 and have continued without significant change; however, the officials could not fully explain how the funding levels were established or whether they reflect current Agency priorities. Figure 5 shows each Centers' target funding levels for discrete replacement and renovation projects for the current 5-year period (2020 to 2025).

[18] The Center's planning documents include the Future Development Concept illustrating key changes proposed for facilities development and redevelopment, and a Capital Improvement Program Plan listing projects required to implement a Center Master Plan over a 20-year period. NASA's Mission Support Council serves as the Agency's senior decision-making body for mission support activities such as facilities, workforce, and information technology.

Figure 5: Target 5-Year Funding for Institutional Replacement and Renovation Projects (2020 to 2025)



Source: NASA OIG presentation of Agency data.

This process has generally resulted in Centers with the highest replacement values receiving a bigger portion of available institutional funds regardless of what may be in the best interest of the Agency. For example, Kennedy, which receives the largest amount of institutional funds, has plans for a $75 million expansion to the Center's new headquarters building starting in 2024. However, we question whether the Center's case for the expansion—to provide for additional swing space to facilitate moves and have additional space for contractors on-site—is a critical need for the Agency at this time particularly given the backlog of repair projects. On the other hand, a Center like Armstrong could consolidate many dispersed activities at its Center into one, more energy efficient building with significant downstream cost savings to NASA. However, because Armstrong is only allocated approximately $11 million over the current 5-year period, that type of project would be cost prohibitive.

Process Does Not Fully Utilize Business Cases

NASA's process to allocate institutional funds for discrete replacement and renovation projects also does not fully utilize business cases and the required cost-benefit analyses as part of the approval process. Office of Management and Budget (OMB) Circular A-94 requires all federal agencies to conduct cost-benefit analyses to justify projects submitted as part of the annual budgeting process.[19] This requirement includes all of NASA's CoF repair and replacement projects that cost over $1 million. To meet this OMB policy, NASA guidance requires the utilization of business cases to perform the analyses and stipulates that the business cases should justify and prioritize the most cost-effective CoF projects to meet Agency mission needs. However, because the Agency limits institutional CoF funds based on Centers' targeted 5-year funding levels, the decisions on which CoF projects to fund are not always driven by business case analyses which are supposed to determine the most cost-effective means to meet an Agency need.

[19] OMB Circular A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* (December 21, 2020, updated annually).

We also found the assumptions, such as the scope of the projects, used in the Agency's business cases did not consistently match with the actual scope of the approved projects. For example, Ames's $47 million Biosciences Collaborative Facility had significant scope changes from the assumptions used in the cost-benefit analysis. Specifically, the cost-benefit analysis assumed the facility would be 60,000 square feet; however, because of budget constraints Ames reduced the size, changed the purpose of the laboratory, and was only able to design and build a 41,000 square foot facility. Similarly, Langley's $110.6 million Measurement Systems Laboratory had significant scope changes from what was initially agreed to be built. According to the business case, the proposed laboratory was 115,000 square feet with three stories; however, the final building has 175,000 square feet with five stories. According to a Center official, the increased scope resulted from General Services Administration recommendations to add additional common, office, and conference space.[20] This resulted in the project cost increasing by about $17 million from the original estimate in the business case. Because the Agency does not utilize business cases as part of its justification and approval process for new construction projects, these scope changes were not identified when the projects were initially approved or after the changes were made.

Lastly, NASA only requires energy savings projects costing more than $10 million to submit the standard business cases that are required for other discrete construction projects.[21] For energy savings projects costing less than $10 million, NASA requires Centers to utilize a form to request funds; however, the form only requires consideration of total cost savings per year as part of a simple payback period analysis and does not require other costs such as operations and maintenance as part of the life-cycle cost analysis.[22] For example, JPL built a $4.9 million, approximately 1 megawatt solar plant on top of a Center parking garage. According to the request form, the simple payback period was 21 years, but if operations and maintenance costs had been considered as part of this estimate, the payback period would have been 23 years or about $17,000 less per year in savings than originally estimated. If the assumptions NASA uses in the cost-benefit analyses do not consider all costs or proposed scopes are significantly different from the actual projects, the analyses are less accurate and could result in poor decisions on which projects to fund.

Guidance Does Not Distinguish Between the Use of Institutional and Programmatic Funds

NASA guidance does not distinguish how institutional versus programmatic funding should be used, nor does the Agency have a cost sharing mechanism (building a facility from multiple program's funding sources) for technical facilities projects that have multiple users. Although NASA policy does not define how institutional and programmatic funding should be used for construction of facilities, the Agency does define the two types of funding in its annual budget requests to Congress. As previously noted, institutional CoF projects should include facility planning and design, discrete projects (costs more than $10 million), minor revitalization and construction (costs between $1 million and $10 million), demolition of facilities, and energy savings investments. Programmatic CoF projects are Mission

[20] Langley contracted with the General Services Administration to support developing the design for the Measurement Systems Laboratory.

[21] Energy saving projects implement energy conservation measures and install renewable energy facilities such as solar plants.

[22] Energy savings projects are justified when energy cost savings over a period of time are greater than what it costs to implement the project. A payback period is the amount of time needed to recover these initial investment outlays. Evaluating projects using the simple payback period analysis does not consider the time value of money or operations and maintenance costs, nor does it assess the risk involved with each project.

Directorate-funded discrete or minor projects for construction of specialized capabilities as required for testing and development that directly support specific NASA missions. However, in practice the only real distinction between institutional and programmatic construction projects is the source of the funding. As a result, Centers often use funds more traditionally used to support institutional capabilities to instead fund highly technical projects like the Biosciences Collaborative Facility, Aerospace Communications Facility, Measurement Systems Laboratory, and Flight Dynamics Research Facility constructed at Ames, Glenn, and Langley (described below). While Center personnel stated they wanted to maintain or improve their current capabilities in these disciplines, Mission Directorates were unwilling to fund the projects or stated it was too difficult to determine cost sharing arrangements for construction of new technical facilities intended for multiple users. In addition, we found that the Biosciences Collaborative Facility, Aerospace Communications Facility, and Measurement Systems Laboratory resulted in the expansion of facilities rather than merely consolidation, as intended. While NASA policy requires that construction of new facilities be offset by a greater than equivalent amount of facility disposal (currently at least 125 percent of the new space), the guidance does not require the disposal to come from facilities with space similar to what is being built.[23] Therefore, the Agency often increases the amount of technical laboratory space, which is more expensive to maintain, by demolishing non-technical administrative facilities such as warehouses, trailers, and storage sheds without a clear mission requirement for the additional technical space.

Biosciences Collaborative Facility

Biosciences Collaborative Facility at Ames

Source: NASA.

In 2020, Ames finished constructing the Biosciences Collaborative Facility—a 41,000 square foot science laboratory with supporting office space—to revitalize and consolidate the Center's biological research capabilities. Most of the laboratories that moved into the new facility were already primarily housed in a single facility. According to Ames officials, the $47 million facility was funded with CoF institutional funds because the Center wanted a new facility to attract research talent and the Agency's Science Mission Directorate was not willing to provide programmatic CoF funds for the project. Science Mission Directorate officials stated that although they agreed the new facility met legitimate mission requirements and the old facility needed renovation, they were unwilling to fund the project because the existing laboratories met mission requirements and they identified higher priorities to fund. In addition, Ames planning documentation stated that the facility would consolidate Center-wide laboratories and biological research into one space. However, the Center never planned to demolish the vacated laboratories because most of them are part of an overall facility that contains other necessary capabilities. Instead, Ames plans to demolish other non-technical buildings, a conference building, and a warehouse to offset the square footage of the new facility. Currently, Ames does not have an identified use for the vacated laboratories and

[23] NASA Policy Directive 8820.2E.

repurposing the space will likely require additional funding not planned for as part of this project. By constructing the Biosciences Collaborative Facility and not demolishing the vacated laboratories, Ames increased the overall amount of available laboratory space at the Center without identifying new users.

Aerospace Communications Facility

Aerospace Communications Facility at Glenn

Source: NASA.

In 2020, Glenn began construction on the Aerospace Communications Facility, a 55,000 square foot communications laboratory with supporting office and conference space. According to Glenn officials, the $43.6 million facility was funded in 2019 with institutional rather than programmatic funds because the Center wanted to improve its capability to conduct communications research and the Mission Directorates were not willing to fund the construction project. Officials from the Aeronautics Research, Human Exploration and Operations, and Science Mission Directorates said they were not significantly involved with the facility's development and were unwilling to commit programmatic funds to the project because they had higher mission priorities. In addition, funding for the facility did not include approximately $12 million for new antennas necessary to conduct the communications research, and as of March 2021 the source for this additional funding is still in question. Moreover, Center planning documentation states that the new facility would be offset by the demolition of over 70,000 square feet of existing buildings, but we found that Glenn only included 43,733 square feet of similar laboratory space and 26,474 square feet from conferencing and utility support buildings that will be demolished. As a result, instead of consolidating the research laboratories at the Center, the project will expand the amount of laboratory space by more than 11,000 square feet.

Measurement Systems Laboratory and Flight Dynamics Research Facility

Measurement Systems Laboratory at Langley

Source: NASA/W.M. Jordan Company.

In September 2021, Langley plans to finish constructing the Measurement Systems Laboratory—a 175,000 square foot laboratory with supporting office space—to serve as the primary research and development facility for branches of the Research and Engineering Directorates at the Center. According to Langley officials, the $110.6 million facility was funded with institutional funds because consolidating the research and engineering functions into one facility was a high Center priority, but Mission Directorates were not willing to fund its construction. Human Exploration and Operations and Science Mission Directorate officials stated that although they agreed the facility met legitimate mission requirements, they were unwilling to commit programmatic CoF funds for the new project because their mission requirements were already being met by other facilities and they had higher priorities. We also found that the project did not reduce the amount of laboratory space at the Center as the planning documentation claimed. Specifically, the Center planned to demolish buildings that totaled more than 304,000 square feet. However, of that amount only 174,476 square feet were from facilities with similar laboratory and research space. The other facilities demolished were dilapidated administrative support buildings and trailers.

Langley is also in the process of constructing its Flight Dynamics Research Facility, a 20-foot vertical wind tunnel that will replace two existing vertical wind tunnels:

- *20-foot vertical wind tunnel* used primarily for aeronautics research and testing at ground level for aircraft, parachute, and ordinance stability simulations.
- *12-foot pressurized wind tunnel* used primarily for aircraft and spacecraft to conduct static and dynamic tests at subsonic conditions.

According to Langley officials, the $51 million facility was funded in 2020 with institutional rather than programmatic funds because the Center wanted to retain its ability to conduct aeronautics research testing and the Aeronautics Research Mission Directorate was not willing to fund the construction project. Officials further stated the two existing wind tunnels the new facility would replace are over 75 years old and suffer from saltwater flooding during storm events due to the tunnels' proximity to the Back River, a condition that hampers their ability to adequately support current and future missions. Aeronautics Research Mission Directorate officials stated that although they agreed the aeronautics research and testing conducted in the existing wind tunnels is important, they were unwilling to commit programmatic CoF funds for the new facility because they had higher priorities. In addition, the new facility will only be able to conduct testing at ground level pressures, limiting its usefulness in testing for space exploration vehicles that will encounter different atmospheric pressures. Requirements for the new facility were primarily developed by the Center's Aeronautics Division, and Human Exploration and Operations Mission Directorate officials advised they did not support the development of space exploration requirements for the facility.

Agency Guidance Does Not Require Programs to Identify Facility Needs

Agency guidance does not require Mission Directorates to identify facility requirements for their programs early in the development process or as mission goals change. Specifically, the Agency's space flight programs are not required to identify facility needs during various reviews and when establishing budgets during their development and implementation phases.[24] In addition, research and technology programs have the option as to whether they want to identify needed facilities during their development and implementation phases.[25] While each Mission Directorate identifies facility requirements slightly differently, all make annual requests to their programs to identify future mission requirements and determine which priorities to fund. The Human Exploration and Operations Mission Directorate funds more construction projects than the other directorates—usually in support of its crewed and uncrewed rocket launch programs—but does not typically fund related research facilities such as the Human Health and Performance Laboratory which instead was funded by Johnson's

[24] NPR 7120.5E, *NASA Space Flight Program and Project Management Requirements (Updated w/Change 18)* (August 14, 2012).

[25] NPR 7120.8A, *NASA Research and Technology Program and Project Management Requirements* (September 14, 2018).

institutional Center budget.[26] The Science Mission Directorate funds a variety of construction projects, including research and test facilities and NASA's supercomputing facility at Ames. The Aeronautics Research Mission Directorate largely funds construction projects at Armstrong where most of NASA's aircraft are located as well as some wind tunnel projects. By funding these program-specific construction projects, Mission Directorates have identified these facilities as critical to support their activities.

According to Center personnel, the current facilities construction process does not require programs to identify facility needs during the development and implementation phases, increasing the risk that facility requirements will not be identified until later in the development process when they can be more costly to address. As noted previously, we could not identify a direct mission link to the construction of several new facilities we reviewed and the construction process has often led to the expansion rather than consolidation of Center capabilities without considering whether they are located at the most strategic locations. FRED officials said they are considering updating NASA guidance to require Mission Directorates to identify facility requirements early during the development phase and be more involved in the overall identification of Agency facility requirements.

Lack of Agency-Wide Facility Master Plan Is a Long-Standing Issue that Inhibits Coordinated Planning

We found that individual Centers continue to focus on maintaining or improving their existing capabilities without the benefit of an integrated Agency-wide facility master plan that considers consolidation of activities between Centers. We identified similar issues in 2011 when we reported that the Agency needs a more comprehensive Agency-wide facility master plan that would enable NASA to make better strategic decisions regarding its real property assets, especially decisions that involve trade-offs between Centers.[27] In the absence of an integrated Agency-wide facility master plan, NASA has relied primarily on Center-based planning to anticipate the Agency's infrastructure needs, making it difficult to coordinate and address such needs across the Agency.

In 2016, NASA assessed the health of mission support activities and operations across the Agency and found several of the same issues we have identified.[28] Specifically, the assessment found that the Agency lacks a consistent, integrated, direct mapping of facilities to mission needs and stated that Mission Directorates are critical in defining facility requirements and need to be more involved in the facility prioritization process. Additionally, the assessment found that NASA lacks strategic guidance to integrate facility planning and is rolling-up individual Center plans into an Agency-wide master plan without meaningful integration. As a result, NASA has been working to update its master planning process and is currently developing new guidance for the CoF program, including making changes to how discrete replacement and renovation projects are prioritized and approved. These efforts are ongoing, and the Agency does not have an expected completion date.

[26] The Human Health and Performance Laboratory supports applied research to mitigate the risks to human health and performance in space.

[27] NASA OIG, *NASA's Infrastructure and Facilities: An Assessment of the Agency's Real Property Master Planning* (IG-12-008, December 19, 2011).

[28] NASA, *Business Services Assessment—Facilities Deep Dive Recommendations* (September 1, 2016).

Prioritization of Construction Projects Dilutes Funds That Could Be Used for Needed Repairs

NASA's Center-driven process for prioritizing and funding CoF projects has resulted in infrastructure that has, at times, been built using the "build it and they will come" mantra and dilutes funds that could be used for other needed repairs. As we reported in 2013, NASA's culture has been one of decentralized facilities management with Centers competing for work from the Agency's major programs rather than identifying ahead of time what capabilities are required to meet Agency mission needs, alternative ways to address the needs, or the most efficient way to do so.[29] These factors have contributed to a tendency for NASA Centers to build up capabilities with little regard for whether they exist elsewhere at the Agency and to maintain the associated facilities to better position themselves to compete for work. This in turn provides incentives for the Centers to maintain or grow their infrastructure capabilities by building or preserving facilities that duplicate capabilities available elsewhere in the Agency or that lack an identified mission use. Our previous work identified numerous specialized facilities such as test stands, thermal vacuum chambers, and wind tunnels spread across the Agency that were not fully utilized or for which Agency managers could not identify a future mission use, often because similar facilities were being used at other NASA locations to meet those needs.

Centers' use of institutional CoF funds to build specialized facilities for testing and development also dilutes the funds available for making critical repairs and supporting other more traditional institutional requirements. FRED and Center officials we spoke with indicated that finding funding to support repair projects continues to be a significant problem with NASA officials identifying $262 million in critical repair projects that could not be performed prior to FY 2022 due to limited institutional funding, including the following:

- *Ames*: Repair Unitary Plan Wind Tunnel auxiliary cooling water pipe and restore cooling capabilities, $7.6 million.
- *Armstrong*: Repair chilling and hot water piping in the Center headquarters building, $8.7 million.
- *Johnson*: Replace heating, ventilation, and air conditioning systems at the White Sands Test Facility, $13 million.
- *Langley*: Repair the Center steam plant and replace pumps in the Center's cooling tower, $22.2 million.
- *Marshall*: Replace water system in the Engineering and Development Laboratory and replace siding on the Multipurpose High Bay Facility, $11.2 million.
- *Stennis*: Repair pumping station's sewage conveyance and treatment systems and refurbish the High-Pressure Gas Facility, $22.9 million.

Allowing Centers to use institutional CoF funds to construct new specialized testing and development facilities, which in our judgement should be funded by the Mission Directorates with programmatic CoF funds, will continue to limit the Agency's ability to make these and many other critical repairs to existing facilities.

[29] NASA OIG, *NASA's Efforts to Reduce Unneeded Infrastructure and Facilities* (IG-13-008, February 12, 2013).

CoF Projects Have Not Met Cost and Schedule Goals While Oversight Remains Lax

CoF projects we reviewed had significant cost overruns and have taken longer to complete than initially planned.[30] Costs increased primarily because requirements were not fully developed by the Agency before construction began, requirements were not fully understood by contractors, and contract prices were higher than originally estimated. Delays occurred because projects faced postponed start times, changing requirements, poor workmanship and rework issues, disagreements between NASA and contractors over contract requirements, and work stoppages. NASA also did not provide effective oversight to determine whether the Agency's portfolio of CoF projects were meeting cost, schedule, and performance goals. Increased costs and delays diminished NASA's CoF resources and hindered the Agency's ability to modernize its infrastructure into fewer, more sustainable and affordable facilities.

CoF Projects Have Not Consistently Met Cost and Schedule Estimates

Of the 20 CoF projects we reviewed, 6 incurred significant cost overruns and 16 took or will take longer to complete than initially planned. Table 1 details the 6 projects we reviewed at Glenn, Kennedy, and Langley that were significantly over budget as of June 2021, their status, original budget estimates, final or current costs, and the amounts over budget. Cost increases ranged from $2.2 million for upgrades to the In-Space Propulsion Exhaust System at Glenn to $36.6 million to repair and modify the VAB for SLS at Kennedy. According to Center personnel, costs increased for two of these projects because of changing requirements while contract prices for four others were either higher than originally estimated or resulted from disagreements between NASA and the contractor.

Table 1: Selected CoF Projects Over Budget as of June 2021 (Dollars in Millions)

Project Title	Center	Status	Original Budget	Final or Current Cost	Amount Over Budget
Aerospace Communications Facility	Glenn	Under Construction	$35.6	$43.6	**$8.0**
Upgrades to the In-Space Propulsion Exhaust System	Glenn	Under Construction	3.1	5.3	**2.2**
Research Support Building	Glenn	Under Construction	35.3	40.6	**5.3**
Repair and Modify the VAB for SLS	Kennedy	Completed	133.0	169.6	**36.6**
Computational Research Facility	Langley	Completed	26.0	28.6	**2.6**
Measurement Systems Laboratory	Langley	Under Construction	94.7	110.6	**15.9**

Source: NASA OIG presentation of Agency data

Note: Budget data is from June 2021.

[30] For the purpose of this report, we considered cost and schedule overruns greater than 10 percent to be significant.

Table 2 details the 16 projects that were behind schedule at Ames, Glenn, Goddard, JPL, Johnson Kennedy, Langley, and Marshall as of June 2021, their status, original schedule estimates, final or current schedules, and the amounts over schedule. Delays ranged from 3 months for the Human Health and Performance Laboratory at Johnson to 3 years and 3 months for upgrades to the In-Space Propulsion Exhaust System at Glenn. According to Center personnel, delays were driven by three primary reasons: (1) appropriations from Congress did not occur at the beginning of a fiscal year because of temporary continuing resolutions and new projects were postponed until funds were appropriated; (2) the procurement process took longer than anticipated, which delayed the start of the projects; or (3) the projects took longer than originally estimated due to changing requirements, workmanship and rework issues, disagreements between NASA and the contractor, and work stoppages due to the government shutdown during FY 2019 and the COVID-19 pandemic. In addition, these delays often impacted demolition projects linked to the construction projects, resulting in reductions to the cost savings that typically occur from new, more energy efficient buildings.

Table 2: Selected CoF Projects Over Schedule as of June 2021

Project Title	Center	Status	Original Schedule Estimate	Final or Current Schedule	Amount Over Schedule
Biosciences Collaborative Facility	Ames	Completed	2 yrs.	3 yrs. 2 mos.	**1 yr. 2 mos.**
Unitary Plan Wind Tunnel Compressor Rotor Blades	Ames	Under Construction	2 yrs. 3 mos.	4 yrs. 3 mos.	**2 yrs.**
Aerospace Communications Facility	Glenn	Under Construction	2 yrs. 6 mos.	3 yrs.	**6 mos.**
Research Support Building	Glenn	Under Construction	1 yr. 6 mos.	3 yrs. 2 mos.	**1 yr. 8 mos.**
Upgrades to the In-Space Propulsion Exhaust System	Glenn	Under Construction	1 yr. 3 mos.	4 yrs. 6 mos.	**3 yr. 3 mos.**
Instrument Development Facility	Goddard	Completed	1 yr. 8 mos.	2 yrs. 6 mos.	**10 mos.**
Solar Photovoltaic System on Parking Structure	JPL	Completed	1 yr. 3 mos.	3 yrs. 8 mos.	**2 yrs. 5 mos.**
Human Health and Performance Laboratory	Johnson	Completed	1 yr. 11 mos.	2 yrs. 2 mos.	**3 mos.**
Central Campus Solar Plant	Kennedy	Completed	1 yr. 6 mos.	3 yrs. 10 mos.	**2 yrs. 4 mos.**
Kennedy Headquarters Building	Kennedy	Completed	2 yrs. 1 mo.	5 yrs. 1 mo.	**3 yrs.**
Safety and Reliability Upgrades Phase 3	Kennedy	Under Construction	1 yr. 3 mos.	2 yrs. 11 mos.	**1 yr. 8 mos.**
Repair and Modify the VAB for SLS	Kennedy	Completed	3 yrs. 7 mos.	5 yrs.	**1 yr. 5 mos.**
Computational Research Facility	Langley	Completed	1 yr. 9 mos.	2 yrs. 8 mos.	**11 mos.**
Measurement Systems Laboratory	Langley	Under Construction	2 yrs. 3 mos.	5 yrs. 3 mos.	**3 yrs.**
Replacement Office Building 4221	Marshall	Completed	1 yr. 7 mos.	3 yrs. 7 mos.	**2 yrs.**
Steam Distribution Replacement	Marshall	Under Construction	2 yrs.	4 yrs. 5 mos.	**2 yrs. 5 mos.**

Source: NASA OIG presentation of Agency data.

Note: Schedule data is from June 2021.

Repairs and Modifications to the VAB for SLS Cost More and Took Longer than Planned

The cost of a 2012 project to repair and modify Kennedy's VAB for SLS increased from an original estimate of $133 million to $169.6 million (a $36.6 million or 28 percent increase) while its schedule increased from 3 years and 7 months to 5 years by the time the project was completed in October 2017. Kennedy conducted the project to remove platforms that supported the Space Shuttle and replace them with new platforms to support the SLS. The project included demolition and replacement of the existing platforms in the VAB's High Bay 3 and associated facility systems, as well as replacing a control system for the facility's 175-ton crane and supporting utility systems located in adjacent facilities. According to Kennedy personnel, because repairs and modifications to the VAB had to be completed in time to support SLS launches in 2017, some of the requirements were not fully defined when the project began and as those requirements matured, designs and work performed had to be modified. Among the change orders, floors and door thresholds in High Bay 3 were reinforced to support the crawler-transporter and the increased weight of the SLS, the VAB fire suppression water supply system was replaced, power and communications systems were revitalized, and an additional elevator system was installed to mitigate the risk of an outage on the other single elevator system.[31] These modifications led to contract changes that resulted in the project's increased cost and delays.

Measurement Systems Laboratory Overran Cost and Schedule Estimates

The Measurement Systems Laboratory at Langley was originally estimated to cost $94.7 million and scheduled to take 2 years and 3 months to construct; however, the project is projected to cost $110.6 million (a $15.9 million or nearly 17 percent increase) and take 5 years and 3 months to complete. Langley plans to finish constructing the facility in September 2021 to serve as the primary research and development facility for branches of the Center's Research and Engineering Directorates. According to Langley personnel, costs increased because contractor bids were greater than projected estimates. In addition, the project was delayed because it received funding later than anticipated; the procurement process took longer than planned due to bids that were higher than originally estimated; and the construction contractor had to rework facility systems such as the heating, ventilation, and air conditioning system due to special requirements for the facility's clean rooms.[32] The facility's completion was also delayed by access issues that resulted from the COVID-19 pandemic.[33]

[31] The crawler-transporter is a large tracked machine weighing approximately 6.6 million pounds (the weight of about 1,000 pickup trucks) that will carry the mobile launcher ground structure with the Orion Multi-Purpose Crew Vehicle atop the SLS rocket from the VAB to Launch Pad 39B for the launch of Artemis I. In March 2020, we issued a report on NASA's Development of Its Mobile Launchers. NASA OIG, *Audit of NASA's Development of Its Mobile Launchers* (IG-20-013, March 17, 2020).

[32] CoF projects typically plan to receive funding in October of each fiscal year. However, funding can be delayed due to continuing resolutions—temporary funding enacted by Congress for the federal government to continue operations for a limited period of time—which in turn delays the start of some projects.

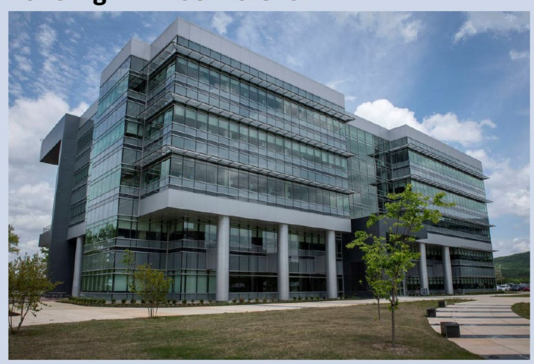
[33] Langley officials expect the contractor to claim additional expenses of at least $1.5 million from COVID-19-related delays and some minor disagreements over requirements.

Kennedy Headquarters Building Significantly Delayed and Affected by Disputes with the Contractor

Kennedy planned to begin construction on its Headquarters Building in August 2014 expecting the project to take 2 years and 1 month to complete; however, the building was not completed until September 2019, 3 years later than expected. This project replaced Kennedy's original Headquarters Building, which was more than 50 years old, with a 189,000 square foot facility of mostly energy efficient office and meeting space. According to Kennedy personnel, the Center and contractor disagreed about the project's technical requirements and other related issues. As a result, the contractor has filed appeals totaling approximately $30 million, which are currently in litigation.

Delays and Cost Increases for Building 4221 Delayed Demolition of an Associated Building

Building 4221 at Marshall



Source: NASA.

Marshall began construction in 2016 on Building 4221, a 149,394 square foot office facility designed to replace the 110,000 square foot Building 4201. The project was originally scheduled to take 1 year and 7 months to construct; however, the building took 3 years and 7 months to complete. According to Marshall personnel, the project was delayed because it received funding later than anticipated; the procurement process took longer than planned because the bids were higher than originally estimated; and the construction contractor experienced issues with subcontractors and had to perform rework on heating, ventilation, and air conditioning systems, which delayed the project and increased costs. In addition, the project included $3 million in funding to demolish Building 4201, but as cost overruns with the construction project increased, the Center used almost all the funds designated for the demolition project to complete construction of Building 4221. As a result, the demolition of Building 4201 has been delayed by more than 4 years with a tentative demolition date now in FY 2021 and cost the Agency an additional $1.9 million in operations and maintenance expenses.

NASA Is Not Providing Effective Oversight of the CoF Program

NASA has not provided effective oversight of the CoF program to determine whether the Agency's portfolio of CoF projects successfully met cost, schedule, and performance goals. We found that after FRED approved and funded a project, the office had limited visibility into its outcome and did not determine if projects delivered what was promised or were completed on schedule.

NASA policy requires FRED to measure and verify CoF program results through annual assessments, quarterly reports, project-level documentation reviews, and project management tools such as Earned Value Management.[34] FRED officials stated that their office has failed to consistently keep up with the oversight requirements because of a lack of office resources. FRED employs 4 civil servants to oversee roughly 100 CoF projects at any given time. They advised that when this guidance was first approved in 2014, the Agency never fully implemented the assessment requirements. For example, FRED officials stated the Agency conducted several annual assessments on specific projects, but never completed a holistic assessment of NASA's construction activities and did not continue even selective assessments after 2018 because of the lack of funding.

Additionally, the current oversight guidance does not clearly align with Agency facility goals. For example, FRED is not tracking whether facilities linked with construction projects are demolished on schedule and at the estimated cost even though the Agency has a goal to eliminate obsolete and unneeded facilities. In addition, FRED is not effectively tracking basic cost, schedule, and performance metrics and comparing them to original estimates for large construction projects. In our judgement, aligning FRED oversight activities with the Agency's overall CoF goals will better utilize resources and provide a greater benefit to senior management about future construction activities. Without effective oversight, NASA is missing opportunities to address facility construction issues in a timely manner and adjust policy to respond to future infrastructure challenges.

Additional Costs and Delays Limit CoF Resources and Hinder the Agency's Ability to Renew Its Aging Infrastructure

Cost overruns and schedule delays further limit NASA's CoF resources and hinder its ability to modernize infrastructure into fewer, more sustainable facilities that reduce overall maintenance costs. As previously stated, the Agency's infrastructure is old with more than 75 percent of its facilities beyond their original design life, presenting considerable risks to overall mission success. According to FRED officials, NASA often has limited CoF funds to address this challenge. Specifically, the Agency's CoF budget has been declining in both total dollars and percentage of NASA's budget over the past decade. For example, in FY 2010 the CoF budget was $389 million, or 2.1 percent of the Agency's total budget, while 10 years later in FY 2020 the CoF budget had decreased to approximately $358 million, or 1.6 percent of the total budget. When construction inflation costs are factored in, the purchasing power of FY 2020's CoF budget is approximately 40 percent less than in FY 2010.

[34] NPR 8820.2G, *Facility Project Requirements* (June 5, 2014). Earned Value Management is designed to objectively measure and assess a project's performance and progress by comparing the estimated value of a completed task—how much the task will cost to complete—at a specific point in time in the project's schedule with the actual cost.

Against this backdrop of declining budgets, inefficiencies in the management of CoF projects further hinders NASA from accomplishing its facility modernization goals. For example, NASA's facility revitalization rate, which measures how often a facility is completely revitalized, has increased from 98 years in FY 2016 to 111 years in FY 2020. While the Agency's facility condition index rating has moderately improved over the last 5 years, increasing from a 3.71 in 2016 to 3.77 in 2020, the Agency still fell short of its goal of a 4.0 rating by 2020. In addition, NASA's annual deferred maintenance costs continue to rise each year. For example, since FY 2015 annual deferred maintenance costs increased from $2.3 billion to $2.7 billion at an average rate of 3.4 percent per year despite Agency goals aimed at reducing the growth in such costs. NASA also is likely to not achieve a targeted 25 percent reduction in facility gross square footage by 2038 despite ongoing demolition projects. Lastly, NASA's current facility replacement value continues to increase annually despite the Agency's stretch goal—a target set above what is expected to be accomplished—of a 10 percent reduction by 2020. Effective management of CoF projects is crucial to ensure that projects are completed on time and within budget.

Other Matters of Interest

NASA's CoF projects faced additional challenges since 2020 due to the COVID-19 pandemic. In March 2020, the Agency implemented its emergency response plan that closed installations across the country except to protect critical infrastructure and ongoing missions. Consequently, NASA was forced to scale back work on construction projects, resulting in increased costs and schedule delays. As of February 2021, 101 CoF projects reported nearly $10.9 million in contractor requests for equitable adjustment (REA) related to the pandemic from which the Agency paid $2.2 million after negotiations.[35] In addition, facility closures delayed project schedules by 5 months on average. Table 3 provides details by Center of the number of CoF projects impacted by COVID-19 closures; their average delay; and submitted and resolved REAs.

Table 3: Projects Impacted by the COVID-19 Pandemic

Center	Number of Projects Impacted	Average Delay	Submitted REA	Resolved REA
Ames	6	8 months	$40,000	$30,000
Armstrong	5	5 months	40,000	0
Glenn	10	7 months	4,160,000	930,000
Goddard	11	10 months	320,000	110,000
JPL	12	5 months	0	0
Johnson	10	3 months	210,000	30,000
Kennedy	19	2 months	480,000	120,000
Langley	6	5 months	4,030,000	30,000
Marshall	11	3 months	240,000	0
Stennis	11	3 months	1,330,000	950,000
Total	**101**	**5 months**	**$10,850,000**	**$2,200,000**

Source: NASA OIG presentation of Agency data as of February 2021.

[35] According to Federal Acquisition Regulation Subpart 43.2, *Change Orders,* REAs are a type of proposal submitted by contractors in response to a unilateral contract change order. A contractor may submit a REA to the government for payment when unforeseen or unintended changes occur within the contract causing an increase in contract costs such as government modification of the contract, differing site conditions, defective or late-delivered government property, or issuance of a stop work order.

CONCLUSION

The majority of NASA's infrastructure is more than 50 years old and is facing significant and expensive deferred maintenance. Over the past decade, the Agency's CoF program has worked to address these issues by constructing new facilities and repairing other failing infrastructure. In recent years, the Agency has been utilizing CoF funds to revitalize both institutional and programmatic facilities and supporting infrastructure with a significant amount of those funds spent revitalizing infrastructure to support the Artemis program.

Given the long-standing challenges NASA faces with its infrastructure, proper management of the Agency's CoF funds is crucial to ensure that the right facilities are built in the right locations and that they are justified, prioritized, and funded in accordance with the Agency's overarching policies and goals. However, NASA's process for selecting and prioritizing the Agency's CoF projects is largely driven by Centers rather than Agency-wide strategic planning and does not effectively utilize due diligence resources such as business cases. NASA Centers, in turn, used a large amount of institutional funds to construct specialized testing and development facilities that at times did not have a clear and compelling case or Agency mission need to justify their construction. Many of these projects also resulted in the expansion of facilities rather than consolidation, as intended by NASA strategic objectives. Consequently, the Agency may continue its practice of not funding the highest priority projects. That coupled with the Centers' use of institutional funds to build specialized facilities will continue to dilute the funds available for critical repairs and supporting other more traditional institutional requirements.

It is also crucial that CoF projects are completed on time and within budget to the degree possible. Many of the CoF projects we reviewed had significant cost overruns and took much longer to complete than initially planned. While many of the overruns and delays occurred because of issues between the Centers and their contractors, the Agency's FRED has limited visibility into the outcomes of projects, which lessens its ability to determine if projects are delivering what was promised or mitigate issues and adjust policy to respond to challenges. Delays, increased costs, and other issues diminish NASA's limited resources and prevent the Agency from accomplishing its goals.

Lastly, NASA's CoF projects have faced challenges since March 2020 due to the COVID-19 pandemic. Equally important, the pandemic may shift needs for Agency office buildings and other facilities given that large portions of the NASA workforce may continue to work from home post-pandemic. Going forward, NASA's decisions about its needs will have an impact on the CoF program and the facilities and infrastructure required in the future.

Recommendations, Management's Response, and Our Evaluation

To ensure NASA's CoF projects are supported by Agency needs and deliver what was promised within cost, schedule, and performance goals, we recommended NASA's Assistant Administrator for Strategic Infrastructure:

1. Develop and institute an Agency-wide process to prioritize and fund institutional and programmatic CoF projects that align with Agency-level missions and require business case analyses to be completed and considered as part of the process prior to the projects' approval.
2. Revise NASA Procedural Requirements 8820.2G to:
    a. Define and establish parameters for the use of institutional and programmatic CoF funds and establish a cost-sharing method for facilities that will have more than one user.
    b. Require energy savings projects to consider life-cycle costs as part of their cost-benefit analyses.
    c. Include requirements to reduce and consolidate the Agency's footprint that consider the demolition of like facilities when possible for discrete construction projects.
3. In coordination with the Mission Directorates, institute a process to ensure facility requirements are identified and funding sources are specified during a program's development and implementation phases.
4. Reexamine policies regarding oversight of the CoF program to identify alternative approaches to more effectively oversee the program.

We provided a draft of this report to NASA management who concurred or partially concurred with our recommendations and described planned actions to address them. We consider the proposed actions for recommendations 1, 2b, 2c, 3, and 4 responsive and will close the recommendations upon completion and verification of the actions. For recommendation 2a, NASA plans to define the use of institutional and programmatic CoF funds in policy and stated that the Strategic Infrastructure Board will consider cost-sharing opportunities but did not indicate that cost-sharing methods will be defined in policy. In our view, establishing cost-sharing methods in policy will require the Agency to consider cost-sharing options for all facilities that will have more than one user. Therefore, this recommendation will remain unresolved pending further discussions with Agency management.

Management's comments are reproduced in Appendix B. Technical comments provided by management and revisions to address them have been incorporated as appropriate.

Major contributors to this report include Tekla Colón, Mission Support Director; Mike Brant, Project Manager; Gene Bauer; Andy McGuire; Barbara Moody; Troy Zigler; and Lauren Suls.

If you have questions or wish to comment on the quality or usefulness of this report, contact Laurence Hawkins, Audit Operations and Quality Assurance Director, at 202-358-1543 or laurence.b.hawkins@nasa.gov.

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Paul K. Martin
Inspector General

Appendix A: Scope and Methodology

We performed this audit from April 2020 through July 2021 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. The scope of this audit included NASA's process for selecting and funding CoF projects as well as CoF projects' cost, schedule, and performance results.

To evaluate the Agency's CoF project selection and approval process, we interviewed Agency officials from FRED, the Mission Directorates, and eight Centers.[36] We reviewed federal and Agency guidance and selected a judgmental sample of 20 CoF projects to review justification documents such as budgets, business cases, cost estimates, and requirements. We selected projects based on dollar value, location, and type of construction project. The guidance and documents we reviewed included, but were not limited to, the following:

- OMB Circular A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* (December 21, 2020, updated annually)
- NASA Policy Directive 8820.2E, *Design and Construction of Facilities* (July 15, 2019)
- NASA Procedural Requirements 8820.2G, *Facility Project Requirements* (June 5, 2014)
- NASA Business Case Guide for Real Property and Facilities Projects Investments (April 20, 2006)
- NASA Form 1509, *Facility Project-Brief Project Document*
- NASA Form 1510, *Facility Project Cost Estimate*
- ECONPACK Economic Analysis Reports, *Business Cases*

To evaluate CoF projects' cost, schedule, and performance results, we reviewed Agency guidance and select projects' contracts, cost and schedule data, and project management plans. We also reviewed CoF assessments and reports developed by the Centers for submission to FRED. Finally, we interviewed Agency officials from FRED and the Centers.

Assessment of Data Reliability

We relied upon budget and cost data from NASA's financial system and obtained construction planning documents from FRED's data management system TRIRIGA as part of performing this audit. We assessed the reliability of computer processed data by (1) performing electronic testing, (2) reviewing existing information about the data and system that produced them, and (3) interviewing Agency officials knowledgeable about the data. We determined that the data were sufficiently reliable for the purposes of this report.

[36] The eight Centers were Ames, Glenn, Goddard, Johnson, JPL, Kennedy, Langley, and Marshall.

Review of Internal Controls

We assessed internal controls and compliance with laws and regulations to determine whether NASA is effectively managing its facility construction efforts. Control weaknesses are identified and discussed in this report. Our recommendations, if implemented, will improve those identified weaknesses.

Prior Coverage

During the last 10 years, the NASA Office of Inspector General and Government Accountability Office have issued seven reports of significant relevance to the subject of this report. Unrestricted reports can be accessed at https://oig.nasa.gov/audits/auditReports.html and https://www.gao.gov/.

NASA Office of Inspector General

Construction of Test Stands 4693 and 4697 at Marshall Space Flight Center (IG-17-021, May 17, 2017)

NASA's Decision Process for Conducting Space Launch System Core Stage Testing at Stennis (IG-14-009, January 8, 2014)

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

NASA's Infrastructure and Facilities: An Assessment of the Agency's Real Property Master Planning (IG-12-008, December 19, 2011)

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

Government Accountability Office

Federal Real Property: Measuring Actual Office Space Costs Would Provide More Accurate Information (GAO-20-130, December 10, 2019)

Federal Buildings: Agencies Focus on Space Utilization As They Reduce Office and Warehouse Space (GAO-18-304, March 8, 2018)

APPENDIX B: MANAGEMENT'S COMMENTS

National Aeronautics and
Space Administration

Mary W. Jackson NASA Headquarters
Washington, DC 20546-0001

September 2, 2021

Reply to Attn of: Office of Strategic Infrastructure

TO: Assistant Inspector General for Audits

FROM: Assistant Administrator for Strategic Infrastructure

SUBJECT: Agency Response to OIG Draft Report, "NASA's Construction of Facilities" (A-20-005-00)

The National Aeronautics and Space Administration (NASA) appreciates the opportunity to review and comment on the Office of Inspector General (OIG) draft report entitled, "NASA's Construction of Facilities (CoF)" (A-20-005-00), dated July 28, 2021.

In the draft report, the OIG makes four recommendations addressed to the Assistant Administrator for Strategic Infrastructure to ensure NASA's CoF projects are supported by Agency needs and deliver what was promised within cost, schedule, and performance goals.

Specifically, the OIG recommends the following:

Recommendation 1: Develop and institute an Agency-wide process to prioritize and fund institutional and programmatic CoF projects that align with Agency-level missions and require business case analyses to be completed and considered as part of the process prior to the projects' approval.

Management's Response: NASA partially concurs with the recommendation. See distinct answers for Institutional and Programmatic CoF.

Institutional CoF projects: NASA concurs with the recommendation to develop and institute an Agency-wide process to prioritize and fund institutional CoF projects. NASA will utilize the Agency Master Plan (AMP), which currently is under development, to respond to this recommendation. The AMP will ensure an Agency-level prioritization of renewal CoF projects, including programmatic CoF that stems from the requirements identified by the Mission Directorates, and the institutional infrastructure. This will reverse the current "bottoms up" trend of CoF proposals from the Centers and focus more on a top-down approach where the AMP will guide the Centers on what to include in their Center Master Plans relating to institutional and programmatic needs. NASA will continue to prioritize its CoF Repair program using its risk-based prioritization approach for repair projects that are not part of NASA's Renewal program.

NASA is currently implementing a phased plan to transform all mission support services to an enterprise operating model, while maintaining mission focus, improving efficiency, ensuring local authority, and valuing the workforce. The Office of Strategic Infrastructure (OSI) has established the Strategic Infrastructure Board (SIB), which will ensure stakeholder engagement as OSI assesses and manages enterprise risks, develops improved strategies, and determines requirements to enable the successful support of the Agency's mission across the enterprise. The SIB will oversee all NASA-owned and/or -controlled facilities and structures, including in-grant leases. The SIB authority encompasses multiple functions, including the approval of business cases for proposed actions that may divest of–or establish new or enhanced capability for–Agency institutional, cross functional, and technical capability assets and infrastructure not previously approved in the AMP or Capability Portfolio Management annual plans. Thus, going forward, the SIB will review programmatic CoF projects that meet the requirements above.

Programmatic CoF: NASA partially concurs with the recommendation to develop and institute and an Agency-wide process to prioritize and fund programmatic CoF projects. Mission Directorate programs already have in-depth prioritization processes, and any programmatic projects will be provided to OSI as part of the master planning process and annual budget formulation process. OSI will ensure that any Mission Directorate project is consistent with the AMP and consistent with Center roles and responsibilities.

In response to the OIG report's comment that NASA policy does not distinguish between the use of institutional and programmatic CoF funding, NASA plans to update NASA Procedural Requirements 8820.2G to include the definitions that distinguish these types of projects.

Estimated Completion Date: December 30, 2022.

Recommendation 2: Revise NASA Procedural Requirements (NPR) 8820.2G to:

a. Define and establish parameters for the use of institutional and programmatic CoF funds and establish a cost-sharing method for facilities that will have more than one user.

b. Require energy savings projects to consider life-cycle costs as part of their cost-benefit analyses.

c. Include requirements to reduce and consolidate the Agency's footprint that consider the demolition of like facilities when possible for discrete construction projects.

Management's Response: NASA concurs with this recommendation. NASA will:

a. Develop a process for evaluating large investment renewal projects as part of the AMP; the SIB will consider opportunities for cost-sharing institutional and programmatic CoF projects.

b. Update NPR 8820.2 to require energy savings projects to consider life-cycle costs as part of their cost-benefit analyses.
c. Update NPR 8820.2 to include requirements to reduce and consolidate the Agency's footprint that consider the demolition of like facilities when possible for construction projects.

Estimated Completion Date: January 31, 2022.

Recommendation 3: In coordination with the Mission Directorates, institute a process to ensure facility requirements are identified and funding sources are specified during a program's development and implementation phases.

Management's Response: NASA concurs with this recommendation.

OSI representatives will participate in the Mission Directorate Program Management Councils to ensure that the Mission Directorates fully understand and provide consideration for institutional responsibilities during a program's development and implementation phase.

There is an existing requirement in NPR 7120.5E for projects to develop initial infrastructure requirements and plans, including the supporting resources in the pre-formulation phase with updates as needed for subsequent life-cycle phases. This requirement has been updated in NPR 7120.5F to point to NPR 8820.2, *Facility Project Requirements*, which contains a requirement to develop a Business Case Analysis, as well as the process for securing funding approval for facility projects, and this is included in the projects' life-cycle cost baselines.

Estimated Completion Date: December 30, 2022.

Recommendation 4: Reexamine policies regarding oversight of the CoF program to identify alternative approaches to more effectively oversee the program.

Management's Response: NASA concurs with this recommendation.

NASA will augment the current monthly CoF Project Reviews with Quarterly Program Reviews, thereby enabling a more effective top-down examination of the overall CoF program. These reviews will include both institutional and Programmatic CoF activities. The monthly and quarterly reviews will provide insight and oversight regarding program/project cost and schedule as well as accountability of demolition offsets.

Also, under the transformation described in the Management's Response to OIG Recommendation 1 above, the OSI Facilities and Real Estate Division (FRED) will be reorganized and augmented with a Design, Construction and Demolition (DCD) Branch. The DCD Branch is charged with the responsibility for the insight and oversight of all ongoing CoF projects.

Within DCD, FRED has implemented a new role of the Executive Project Manager (EPM). The new EPM position will provide expertise and oversight to Center project management teams on select mission-critical discrete CoF projects. They will assist in monitoring projects for early-risk identification, cross-discipline dependencies, and schedule delays. This improvement will ensure early mitigation of potential claims and support remediation or solving problems. The new Executive Project Management role is being aligned and codified in policy through the current update of NPR 8820.G.

Estimated Completion Date: December 30, 2022.

We have reviewed the draft report for information that should not be publicly released. As a result of this review, we have identified some information that should not be publicly released. We note that the mention of the Kennedy Space Center Headquarters on pages 20 and 21 of the report covers sensitive information about a contractor claim that has not been resolved. NASA recommends redacting this section as it could have a negative impact on claim negotiations or settlement. We also request that the section titled "Other Matters of Interest" should be redacted from the public document as this includes sensitive information related to Requests for Equitable Adjustments (REAs) and could affect the outcome of ongoing NASA negotiations with contractors or incite future REAs.

Once again, thank you for the opportunity to review and comment on the subject draft report. If you have any questions or require additional information regarding this response, please contact Rick Marrs at (202) 358-0941.

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Burton R. Summerfield

Appendix C: Report Distribution

National Aeronautics and Space Administration

Administrator
Deputy Administrator
Associate Administrator
Chief of Staff
Associate Administrator for Mission Support Directorate
Assistant Administrator for Strategic Infrastructure
Director, Ames Research Center
Director, Armstrong Flight Research Center
Director, Glenn Research Center
Director, Goddard Space Flight Center
Director, Jet Propulsion Laboratory
Director, Johnson Space Center
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Office of Management and Budget
- Deputy Associate Director, Energy and Space Programs Division

Government Accountability Office
- Director, Contracting and National Security Acquisitions

Congressional Committees and Subcommittees, Chairman and Ranking Member

Senate Committee on Appropriations
- Subcommittee on Commerce, Justice, Science, and Related Agencies

Senate Committee on Commerce, Science, and Transportation
- Subcommittee on Aviation and Space

Senate Committee on Homeland Security and Governmental Affairs

House Committee on Appropriations
- Subcommittee on Commerce, Justice, Science, and Related Agencies

House Committee on Oversight and Reform
- Subcommittee on Government Operations

House Committee on Science, Space, and Technology
- Subcommittee on Investigations and Oversight
- Subcommittee on Space and Aeronautics

(Assignment No. A-20-005-00)