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Space and Science, Committee on  
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# NASA

## Lessons from Ongoing Major Projects Could Improve Future Outcomes

Statement of W. William Russell, Director, Contracting  
and National Security Acquisitions

Accessible Version

# GAO Highlights

Highlights of [GAO-22-105709](#), a testimony before the Subcommittee on Space and Science, Committee on Commerce, Science, and Transportation, U.S. Senate

## Why GAO Did This Study

Acquisition management has been a long-standing challenge at NASA. GAO first designated NASA's acquisition management as a high-risk area in 1990 in view of NASA's history of persistent cost growth and schedule slippage in the majority of its largest systems. While NASA's major projects are complex, specialized, and often groundbreaking, GAO has identified management weaknesses that have exacerbated the inherent technical and engineering risks the projects face.

In 2005, NASA expanded its effort to partner with commercial companies by forming the Commercial Crew and Cargo Program Office. The public-private partnerships established by this program office represented a new way of doing business in the realm of human spaceflight.

This statement reflects GAO's observations on lessons that NASA can apply to its management of its major projects as it seeks to leverage resources between the public and private sector to maximize federal return on program investments.

This statement is based primarily on prior work GAO issued between 2019 and 2021.

## What GAO Recommends

In prior work, GAO made recommendations to improve NASA's acquisition of major projects. NASA generally agreed with those recommendations. As of November 2021, NASA has not fully addressed eight priority recommendations related to monitoring program costs and execution, which were detailed most recently in a report to the NASA Administrator in [June 2021](#).

View [GAO-22-105709](#). For more information, contact W. William Russell at (202) 512-4841 or [RussellW@gao.gov](mailto:RussellW@gao.gov).

February 9, 2022

## NASA

### Lessons from Ongoing Major Projects Could Improve Future Outcomes

#### What GAO Found

The complexity of NASA's major projects means they will always carry inherent risk—but prior GAO work found that management and oversight problems contribute to cost and schedule growth. As NASA works to execute new missions, including those that rely on commercial partners, GAO's past work provides lessons that, if applied, could strengthen NASA's management and improve outcomes of its major projects. For example, NASA could:

**Better manage cost and schedule.** Increases associated with NASA's most costly and complex missions can have cascading effects on the rest of the portfolio. For example, in [April 2013](#), GAO found that cost growth for the now \$10 billion James Webb Space Telescope would have reverberating effects on the NASA acquisition portfolio for years to come.

**Minimize risky decisions.** NASA leadership has approved decisions that compound technical challenges. For example, in [May 2021](#), GAO found that NASA's planned pace to develop a human landing system (illustrated below) was months faster than other spaceflight programs. The initial proposals also included unproven technologies, which adds technical and schedule risk to the program.

#### Artist's Rendition of Artemis Lunar Landing Mission



Source: National Aeronautics and Space Administration. | [GAO-22-105709](#)

**Establish a governance structure.** While it has made some progress, NASA has not yet finished establishing its governance structure to oversee and manage its Artemis effort—a series of missions to return astronauts to the lunar surface. In [December 2019](#), GAO recommended that NASA determine a schedule for integration reviews to help ensure that requirements between mission and program levels are reconciled. NASA held the first review in fall 2021. However, in September 2021, NASA announced a reorganization of its human exploration mission directorate. It is too soon to know how these changes will affect NASA's governance of Artemis missions or programs.

February 9, 2022

Chair Hickenlooper, Ranking Member Lummis, and Members of the Subcommittee:

I am pleased to be here today to discuss NASA's efforts to leverage the commercial sector to accomplish the agency's goals. NASA's major projects are the key enablers for the agency to achieve its vision and its mission. These projects will allow NASA to continue exploring Earth and the solar system, extending human presence beyond low Earth orbit to the lunar surface, and understanding climate change, among other things. In its fiscal year 2022 budget request, NASA requested \$24.8 billion, which included \$6.8 billion for its deep space exploration programs and \$7.9 billion for its science programs. As these projects are complex and specialized, and often push the state of the art in space technology, NASA manages an acquisition portfolio that will always have inherent technical, design, and integration risks.

Acquisition management has been a long-standing challenge at NASA, although we have reported on improvements the agency has made in recent years.<sup>1</sup> We first designated NASA's acquisition management as a high-risk area in 1990 in view of NASA's history of persistent cost growth and schedule slippage in the majority of its major systems. We have identified management weaknesses that have exacerbated the inherent technical and engineering risks faced by NASA's largest projects. NASA has taken steps to improve its management of major projects, but has continued to struggle with major project cost and schedule performance. In our March 2021 High-Risk Update, we found that NASA needs to do more to reduce acquisition risk and demonstrate progress, especially with regard to demonstrating sustained improvement in cost and schedule performance for new, large, complex programs entering the portfolio.<sup>2</sup>

My statement today provides our observations on lessons that NASA can apply to its management of its major projects as it seeks to leverage resources between the public and private sector to maximize federal return on program investments. This statement is based primarily on

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<sup>1</sup>GAO, *High-Risk Series: Dedicated Leadership Needed to Address Limited Progress in Most High-Risk Areas*, [GAO-21-119SP](#) (Washington, D.C.: Mar. 2, 2021).

<sup>2</sup>[GAO-21-119SP](#).

completed work from six GAO reports issued between June 2019 and May 2021.<sup>3</sup> To identify lessons that can be applied to NASA's management of large complex projects, we examined NASA's efforts to address issues identified in our prior work examining the James Webb Space Telescope (JWST), human space flight, and the major projects portfolio, and our March 2021 High-Risk Update.<sup>4</sup> Detailed information on the objectives, scope, and methodologies for that work is included in each of the reports that are cited throughout this statement.

We conducted the work on which this statement is based in accordance with generally accepted government auditing standards. Those standards required 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 provided a reasonable basis for our findings and conclusions based on our audit objectives.

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## Background

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### NASA Acquisition Management

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NASA's mission is to drive advances in science, technology, aeronautics, and space exploration, and contribute to education, innovation, our country's economic vitality, and the stewardship of the Earth. To accomplish this mission, NASA establishes programs and projects that rely on complex instruments and spacecraft.<sup>5</sup> NASA's projects aim to

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<sup>3</sup>GAO-21-119SP; GAO, *NASA: Assessments of Major Projects*, [GAO-21-306](#) (Washington, D.C.: May, 20, 2021); *NASA Lunar Programs: Significant Work Remains, Underscoring Challenges to Achieving Moon Landing in 2024*, [GAO-21-330](#) (Washington, D.C.: May 26, 2021); *NASA Human Space Exploration: Significant Investments in Future Capabilities Require Strengthened Management Oversight*, [GAO-21-105](#) (Washington, D.C.: Dec. 15, 2020); *NASA Lunar Programs: Opportunities Exist to Strengthen Analyses and Plans for Moon Landing*, [GAO-20-68](#) (Washington, D.C.: Dec. 19, 2019); and *NASA Human Space Exploration: Persistent Delays and Cost Growth Reinforce Concerns over Management of Programs*, [GAO-19-377](#) (Washington, D.C.: June 19, 2019).

<sup>4</sup>GAO, *NASA: Lessons from Ongoing Major Projects Can Inform Management of Future Space Telescopes*, [GAO-22-105555](#) (Washington, D.C.: Dec. 1, 2021); [GAO-21-119SP](#); [GAO-21-306](#); [GAO-21-330](#); [GAO-21-105](#); [GAO-20-68](#); [GAO-19-377](#); and *James Webb Space Telescope: Actions Needed to Improve Cost Estimate and Oversight of Test and Integration*, [GAO-13-4](#) (Washington, D.C.: Dec. 3, 2012).

<sup>5</sup>We define major projects as those projects or programs with an estimated life-cycle cost of over \$250 million.

continue exploring Earth and the solar system, extend human presence beyond low Earth orbit to the lunar surface, and understand climate change, among other things. Some of NASA's projects are expected to incorporate new and sophisticated technologies that must operate in harsh, distant environments.

Many of the government's most costly and complex acquisition programs require developing cutting-edge technologies and integrating them into large and complex systems. For 2 decades, we have shown that using effective management practices and processes to assess how far a technology has matured, and how this maturity has been demonstrated are fundamental to evaluating the technology's readiness to be integrated into a system and managed for risk in the federal government's major acquisitions. Our January 2020 Technology Readiness Assessment Guide established a methodology for evaluating technology maturity based on best practices that can be used across the federal government.<sup>6</sup> It is a companion to our Cost Estimating and Assessment Guide and Schedule Assessment Guide.<sup>7</sup> In June 2020, NASA published a Technology Readiness Assessment Best Practices Guide that aligns with GAO's definition of critical technologies.<sup>8</sup>

Since we initially designated NASA's acquisition management as high risk, we made numerous recommendations to reduce acquisition risk. Through these recommendations, we identified multiple areas where NASA should take action to improve the management of its portfolio of major projects. NASA generally agreed with these recommendations, but additional action is needed to fully address them, including some that warrant priority attention by NASA. For example, in December 2019, we recommended that NASA create a life-cycle cost estimate for the Artemis

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<sup>6</sup>GAO, *Technology Readiness Assessment Guide: Best Practices for Evaluating the Readiness of Technology for Use in Acquisition Programs and Projects* [Reissued with revisions on Feb. 11, 2020], [GAO-20-48G](#) (Washington, D.C.: Jan. 7, 2020).

<sup>7</sup>GAO, *GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs*, [GAO-09-3SP](#) (Washington, D.C.: Mar. 2, 2009); and *GAO Schedule Assessment Guide: Best Practices for Project Schedules*, [GAO-16-89G](#) (Washington, D.C.: Dec 22, 2015).

<sup>8</sup>NASA, Office of the Chief Technologist, *Technology Readiness Assessment Best Practices Guide*, SP-20205003605 (June 30, 2020). Technologies are considered critical if they are new or novel, or used in a new or novel way, and needed for a system to meet its operational performance requirements within defined cost and schedule parameters (i.e., cost and schedule targets set at key decision point B or C). Technologies identified as critical may change as programmatic or mission related changes occur, system requirements are revised, or if technologies do not mature as planned.

III mission. NASA concurred with the recommendation and said the agency would create this estimate after establishing cost and schedule baselines for the human landing system program, among other things. As of November 2021, NASA has not fully addressed eight open priority recommendations related to monitoring program costs and execution.

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## NASA Public-Private Partnerships

NASA expanded its effort to contract with commercial companies, especially for its human spaceflight efforts. For example, NASA established the Commercial Crew and Cargo Program Office in 2005 to encourage the growth of the private spaceflight sector in the U.S. According to NASA, the public-private partnerships established by this program office represented a new way of doing business in the realm of human spaceflight.

The Commercial Crew Program has had some success with its commercial partnerships. For example, SpaceX successfully completed a crewed demonstration of its transportation system including launch, in-orbit, docking, and landing operations in May 2020. In November 2020, NASA determined that SpaceX met the agency's standards for human spaceflight, so it certified SpaceX to conduct crewed missions to and from the International Space Station.

NASA has continued to build on this experience to support the Artemis missions to return humans to the lunar surface in 2025. For example, in the September 2020 Artemis plan, NASA highlighted that its efforts to catalyze the U.S space economy through public-private partnerships should make it possible to return to the moon quickly.<sup>9</sup> NASA is moving in this direction because the agency believes that using a commercial service-type approach increases competition, innovation, flexibility, speed, and affordability. For example:

- The Human Landing System (HLS) program is using commercial partnerships to develop and jointly deploy a landing system to transport humans to and from the lunar surface. NASA expects that its commercial partners will heavily leverage NASA technology and expertise throughout the development process, leading to a lunar transportation system that will deliver humans to the lunar surface,

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<sup>9</sup>NASA, *NASA's Lunar Exploration Program Overview*, NP-2020-05-2853-HQ (September 2020).

and develop and demonstrate a more sustainable HLS for subsequent crewed missions.

- Commercial Lunar Payload Services companies are to provide NASA with end-to-end commercial payload delivery services to the surface of the moon. The services include integrating payloads onto a robotic lander, launching the lander, and operating the lander and payloads. The payloads include science instruments and technology demonstrations that will characterize the lunar environment and inform the development of future landers and other exploration systems needed for human lunar surface exploration. Beginning in 2018, NASA awarded firm-fixed-price, multiple-award, indefinite delivery/indefinite quantity contracts to a total of 14 companies to deliver science and technology payloads to the lunar surface.<sup>10</sup>
- The Deep Space Logistics project office manages the Gateway Logistics Services contract, which will be used to buy services to transport cargo, science experiments, and supplies to the Gateway. The Gateway is planned to be an outpost orbiting the moon to facilitate Artemis missions. In March 2020, NASA awarded an initial firm-fixed price, indefinite delivery/indefinite quantity contract to SpaceX, which guarantees the company a minimum of two logistics missions. SpaceX is responsible for building, integrating, and operating the logistics vehicle. Under the contract, NASA may award further task orders to additional logistics service providers.

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## Lessons from NASA Major Acquisition Projects

NASA's major projects will always have inherent technical, design, and integration risks because they are complex, specialized, and often push the state of the art in space technology. But often, our reports find that management and oversight problems—which can include poor planning, optimistic cost estimating, budgeting gaps, lax oversight, and poor contractor performance—are the real drivers behind cost and schedule growth.

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<sup>10</sup>Under a firm-fixed-price contract, the price is not subject to any adjustment on the basis of the contractor's cost experience in performing the contract. Federal Acquisition Regulation (FAR) § 16.202-1. An indefinite delivery/indefinite quantity contract provides for an indefinite quantity, within stated limits, of supplies or services during a fixed period. The government places orders for individual requirements. FAR § 16.504(a).

In recent years, we found that the cost and schedule performance of the agency's major project portfolio have continued to deteriorate.<sup>11</sup> NASA acknowledged recent challenges in cost and schedule growth and is taking steps to identify and address areas contributing to acquisition risk. For example, in our 2021 High-Risk Assessment, we found that NASA had taken steps to improve transparency and monitoring of cost and schedules, but continued to experience challenges.<sup>12</sup>

As NASA works to execute the Artemis missions to include working with private partners, I would like to highlight five lessons from our reviews of NASA's major projects. The extent to which NASA has adopted these practices is mixed. NASA has an opportunity to strengthen its management of major acquisitions by doing so.

**Manage Cost and Schedule Performance for Large Projects to Limit Implications for Entire Portfolio.** While cost and schedule growth can occur on any project, increases associated with NASA's most costly and complex missions can have cascading effects on the rest of the portfolio. For example, in 2013, we found that the JWST cost growth would have reverberating effects on the NASA acquisition portfolio for years to come. The cost growth required the agency to identify \$1.4 billion in additional resources over fiscal years 2012 through 2017, according to Science Mission Directorate officials.<sup>13</sup> As JWST costs continued to grow in subsequent years, they began to affect other projects. For example, in May 2021, we found that for the third year in a row, the President's budget request proposed canceling the Nancy Grace Roman Space Telescope project.<sup>14</sup> According to NASA budget documentation, the agency proposed canceling the project in order to focus on higher priorities including completion of JWST.

**Minimize Risk in Programmatic Decisions to Better Position Programs for Successful Execution.** Through our reviews of NASA's

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<sup>11</sup>[GAO-21-306](#).

<sup>12</sup>[GAO-21-119SP](#).

<sup>13</sup>GAO, *NASA: Assessments of Selected Large-Scale Projects*, [GAO-13-276SP](#) (Washington, D.C.: Apr. 17, 2013).

<sup>14</sup>The Nancy Grace Roman Space Telescope, formerly known as Wide-Field Infrared Survey Telescope, is an observatory designed to perform wide-field imaging and survey of the near-infrared sky to answer questions about the structure and evolution of the universe, and expand our knowledge of planets beyond our solar system.



major projects, we found that NASA leadership approved programmatic decisions that compound technical challenges. These decisions include establishing insufficient cost and schedule reserves, approving cost and schedule baselines that do not follow best practices, pursuing aggressive schedules, and proceeding with immature technologies.<sup>15</sup> For example:

- In April 2021, NASA announced the selection of SpaceX for the contract to develop the Artemis III lunar lander. In May 2021, we found that NASA's planned pace to develop a human landing system was months faster than other spaceflight programs, even though a lander is inherently more complex than those programs because it supports human spaceflight.<sup>16</sup>
- At the time of our May 2021 review, we found that while NASA planned to avoid extensive technology development for its lunar landers by asking the HLS contractors to include mature technologies in their proposed designs, the initial HLS contractor proposals included technologies with relatively low maturity levels.<sup>17</sup> Our analysis of HLS critical technologies data for all three contractors showed that the contractors proposed only four mature technologies out of a total of 11 critical technologies at the time of the base contract award. In addition, NASA noted in its April 2021 source selection statement for the Option A contract, which NASA awarded to SpaceX, that SpaceX had several propulsion sub-systems that would require substantial maturation.<sup>18</sup> The source selection statement also stated that SpaceX's proposal acknowledged the risks introduced due to the complexity of its system, coupled with the level of development and testing activities that must occur with relatively little schedule margin available, and proposed an approach to help mitigate this risk.

Our best practices work has shown that maturing technologies to a technology readiness level 6—which includes demonstrating a

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<sup>15</sup>[GAO-21-330](#); GAO, *NASA: Actions Needed to Improve the Management of Human Spaceflight Programs*, [GAO-19-716T](#) (Washington, D.C.: Sept. 18, 2019); NASA: *Preliminary Observations on the Management of Space Telescopes*, [GAO-18-277T](#) (Washington, D.C.: Dec. 6, 2017); [GAO-13-4](#); and NASA: *Assessments of Selected Large-Scale Projects*, [GAO-09-306SP](#) (Washington, D.C.: Mar. 2, 2009).

<sup>16</sup>[GAO-21-330](#).

<sup>17</sup>[GAO-21-330](#).

<sup>18</sup>We have not yet reviewed the HLS program contract with SpaceX for technology maturity of critical technologies after the resolution of the GAO bid protest and dismissal of Blue Origin's lawsuit by the U.S. Court of Federal Claims.

representative prototype of the technology in a relevant environment that simulates the harsh conditions of space—by preliminary design review can minimize risks for the systems entering product development.<sup>19</sup> Maturing these technologies requires either (1) additional time for development, or (2) NASA and the contractor to make trade-offs to use more mature technologies.

- In May 2021, we found that the Gateway program also increased technical risks due to the decision to launch its Power and Propulsion Element (PPE) and Habitation and Logistics Outpost (HALO) modules on the same vehicle, known as a co-manifest. Because of the increased mass of the co-manifested vehicle, the Gateway now requires PPE to use an even higher-power solar electric propulsion system than originally planned. This system includes technology for the thrusters that is not yet mature. If the thruster development is not mature when needed for integration, the PPE project will not be able to fulfill the current requirements for the Gateway. Due to the significant level of risk involved with the development of a high-powered solar electric propulsion system, PPE's continued pursuit of this plan could create a need for significant design changes later in development. Late design changes would likely increase project cost and schedule and affect other lunar programs and projects, including HALO. We recommended that NASA assess the solar electric propulsion thrusters' technical risks and determine whether a change in plans was needed—such as reduced requirements for PPE or a modification to its schedule.<sup>20</sup> NASA concurred with the recommendation and plans to take steps to address it this year.

**Enhance Contract Management and Oversight to Improve Program Outcomes.** We previously identified shortcomings related to NASA's management and oversight of its human spaceflight contracts. These shortcomings have left NASA ill-positioned to identify early warning signs of impending schedule delays and cost growth, reap the potential benefits of competition, and achieve desired results through contractor incentives. For example:

- In July 2014, we found that NASA allowed high-value modifications to the Space Launch System (SLS) contracts to remain undefinitized for extended periods—in one instance a modification remained

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<sup>19</sup>[GAO-20-48G](#).

<sup>20</sup>[GAO-21-330](#).

undefinitized for 30 months.<sup>21</sup> Agency officials told us that the program was delayed in definitizing contracts, in part, due to resource uncertainty. We previously found that while authorizing contractors to begin work before reaching a final agreement with the government may be necessary under certain circumstances, this can be considered risky because the government may incur unnecessary costs if requirements change before the contract action is definitized.<sup>22</sup> Because lack of agreement on the terms of the modification prolonged NASA's timeframes for definitizing, the establishment of contractor cost and schedule baselines necessary to monitor performance was delayed. This area continues to be of concern. For example, in December 2020, we found that NASA was utilizing undefinitized contract actions and letter contracts for some of its human spaceflight programs.<sup>23</sup>

- In June 2019, we found that NASA's award fee plans for the SLS stages and Orion crew spacecraft contracts provided for hundreds of millions of dollars to incentivize contractor performance, but the programs continued to fall behind schedule and incur cost overruns.<sup>24</sup> Our past work shows that when incentive contracts are properly structured, the contractor has profit motive to keep costs low, deliver a product on time, and make decisions that help ensure the quality of the product. Our prior work also shows, however, that incentives are not always effective tools for achieving desired acquisition outcomes. We found that, in some cases, there are significant disconnects between contractor performance for which the contractor was

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<sup>21</sup>GAO, *Space Launch System: Resources Need to be Matched to Requirements to Decrease Risk and Support Long Term Affordability*, [GAO-14-631](#) (Washington, D.C.: July 23, 2014).

<sup>22</sup>GAO, *Missile Defense: The Warfighter and Decision Makers Would Benefit from Better Communication About the System's Capabilities and Limitations*, [GAO-18-324](#) (Washington, D.C.: May 30, 2018).

<sup>23</sup>[GAO-21-105](#). The FAR describes a letter contract as a written preliminary contractual instrument that authorizes the contractor to begin immediately manufacturing supplies or performing services. FAR § 16.603-1. The FAR states that a letter contract may be used when the government's interests demand that the contractor be given a binding commitment so that work can start immediately and negotiating a definitive contract is not possible in sufficient time to meet the requirement. FAR § 16.603-2(a). At the time of our report, NASA's supplement to the FAR defined an undefinitized contract action as a unilateral or bilateral contract modification, or a delivery/task order in which the final price or estimated cost and fee have not been negotiated and mutually agreed to by NASA and the contractor.

<sup>24</sup>[GAO-19-377](#).

awarded the majority of award fees possible without achieving desired program results.

**Improve Transparency into Costs for Long-term Plans.** A key best practice for development efforts is that requirements need to be matched to resources (for example, time, money, and people) at program start.<sup>25</sup> In the past, we found that NASA programs, including the 2005 Constellation Program, did not have sufficient planned funding to match demanding requirements.<sup>26</sup> Funding gaps can cause programs to delay or delete important activities and thereby increase risks.

- In December 2020, we found that since NASA already awarded long-term Artemis contracts, it must ensure that sufficient programmatic tools are in place to manage these efforts. We previously found that NASA often lacks cost and schedule baselines needed to oversee its programs and that this contributes to poor acquisition performance. Our prior work found that there is a lack of transparency in the long-term costs of these human spaceflight programs.<sup>27</sup> Specifically, the Exploration Ground Systems and SLS programs do not have a cost and schedule baseline that covers activities beyond Artemis I. In addition, the Orion program does not have a baseline beyond Artemis II. As a result, we found that NASA is planning to spend billions of dollars for missions that do not have a cost and schedule baseline against which to assess progress.<sup>28</sup>
- In December 2019, we recommended that NASA create an Artemis III mission cost estimate to help the agency effectively monitor total mission costs and to provide Congress with insight into mission or program affordability when making decisions about each year's budget request.<sup>29</sup> NASA concurred with the recommendation and said the agency would create this estimate after establishing cost and schedule baselines for the HLS program, among other things. NASA plans to establish a baseline for the HLS program in August 2022.

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<sup>25</sup>GAO, *U.S. Launch Enterprise: Acquisition Best Practices Can Benefit Future Efforts*, [GAO-14-776T](#) (Washington, D.C.: July 16, 2014).

<sup>26</sup>GAO, *NASA: Constellation Program Cost and Schedule will Remain Uncertain until a Sound Business Case is Established*, [GAO-09-844](#) (Washington, D.C.: Aug. 26, 2009); and *NASA: Actions Needed to Improve Transparency and Assess Long-term Affordability of Human Exploration Programs*, [GAO-14-385](#) (Washington, D.C.: May 8, 2014).

<sup>27</sup>[GAO-14-385](#).

<sup>28</sup>[GAO-21-105](#).

<sup>29</sup>[GAO-20-68](#).

**Establish Governance Structure to Oversee and Manage Artemis Programs.** NASA needs to continue making progress to establish a solid foundation for Artemis mission management and integration. This is especially necessary since NASA's resources will continue to be strained as it works toward an aggressive goal of returning astronauts to the lunar surface in 2025—with the Artemis III mission—while also supporting its increasing portfolio of other nonlunar major projects. For example:

- In December 2019, we recommended that the Advanced Exploration Systems (AES) division define and determine a schedule for synchronization or integration reviews to help ensure that requirements between mission and program levels are reconciled.<sup>30</sup> We found that, without reconciling these requirements, NASA risked discovery of needed design changes late in the acquisition process, which could result in cost or schedule delays. NASA concurred with this recommendation and took steps to implement it. The AES division held its first integration review, which focused on the Artemis III mission, in September 2021, and plans to hold these reviews roughly on an annual basis.
- In May 2021, we found that NASA had assigned Artemis mission roles and responsibilities to specific divisions, but had not yet finalized the documentation of roles, responsibilities, and authorities. In September 2021, NASA announced a reorganization of its human exploration mission directorate. The reorganization splits the directorate into two, with one directorate focused on space operations and the second on systems development. NASA is still in the process of implementing the reorganization, and it is too soon to know how these changes will affect NASA's governance of Artemis missions or programs.
- In May 2021, we found that the agency had not clearly documented how it determined what key programmatic and technical tools it plans to use to guide mission decision-making. For example, while NASA's program management and systems engineering policy and guidance do not include requirements for missions, the agency plans to apply some practices and tools found in program management and systems engineering policy and guidance to the Artemis III mission—such as creating a mission integrated master schedule—but not other practices and tools, such as holding mission-level key decision point reviews. Without documenting this decision-making process, NASA cannot ensure that it has the appropriate processes in place to track how the missions will achieve objectives and address risks at the

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<sup>30</sup>[GAO-20-68](#).

mission level. We recommended that the AES division document the process used to determine the program and technical management practices and tools that it will apply to the Artemis III and later missions.

NASA concurred with this recommendation. NASA officials said they reviewed the set of products the AES division plans to use to govern the Artemis III mission at its September 2021 integration review. The agency continues to evaluate the structure within its two new mission directorates, including the execution and operation of the Artemis missions. We will continue to assess NASA's implementation of the recommendation.

In summary, NASA continues to pursue ambitious goals through its portfolio of major projects as it expands its efforts to leverage resources between the public and private sector. These efforts have resulted in some notable achievements. For example, since November 2020, SpaceX has launched three of its six planned flights transporting NASA and international partner astronauts to the International Space Station through the Commercial Crew Program. It marked the first time that American astronauts traveled to the station from American soil on a commercially built and operated spacecraft. Using the project management tools and implementing the recommendations that I highlighted today could help to better position future major projects for success. We look forward to continuing to work with NASA and this committee in addressing these issues.

Chair Hickenlooper, Ranking Member Lummis, and Members of the Subcommittee, this completes my prepared statement. I would be pleased to respond to any questions you may have at this time.

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## GAO Staff and Acknowledgements

If you or your staff have any questions about this testimony, please contact W. William Russell, Director, Contracting and National Security Acquisitions at (202) 512-4841 or [russellw@gao.gov](mailto:russellw@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this statement. GAO staff who made key contributions to this statement include Kristin Van Wychen, Assistant Director; Erin Kennedy, Analyst-in-Charge; Lorraine Ettaro; Laura Greifner; Min-Hei (Michelle) Kim; John Ortiz; Hai Tran; Alyssa Weir; and Robin Wilson.

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