

GAO

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NASA

# Issues Surrounding the Transition from the Space Shuttle to the Next Generation of Human Space Flight Systems

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Highlights of [GAO-07-595T](#), a testimony before the Subcommittee on Space, Aeronautics, and Related Sciences, Committee on Commerce, Science and Transportation, U. S. Senate

## Why GAO Did This Study

On January 14, 2004, the President announced a new *Vision* for space exploration that directs the National Aeronautics and Space Administration (NASA) to focus its efforts on returning humans to the moon by 2020 in preparation for future, more ambitious missions.

Implementing the *Vision* will require hundreds of billions of dollars and a sustained commitment from multiple administrations and Congresses. Some of the funding for implementing exploration activities is expected to come from funding freed up after the retirement of the Space Shuttle, scheduled for 2010, and projected termination of U.S. participation in the International Space Station by 2016.

Congress, while supportive of the effort has voiced concern over the potential gap in human space flight. In the NASA Authorization Act of 2005, Congress stated that it is the policy of the United States to have the capability for human access to space on a continuous basis. NASA has made it a priority to minimize the gap to the extent possible.

GAO provides no recommendations in this statement. However, GAO continues to emphasize that given the Nation's fiscal challenges and NASA's past difficulty developing systems within cost, schedule, and performance parameters, it is imperative that the agency adequately manage this transition in a fiscally competent and prudent manner.

[www.gao.gov/cgi-bin/getrpt?GAO-07-595T](http://www.gao.gov/cgi-bin/getrpt?GAO-07-595T).

To view the full product, including the scope and methodology, click on the link above. For more information, contact Allen Li at (202) 512-4841 or [lia@gao.gov](mailto:lia@gao.gov).

March 28, 2007

## NASA

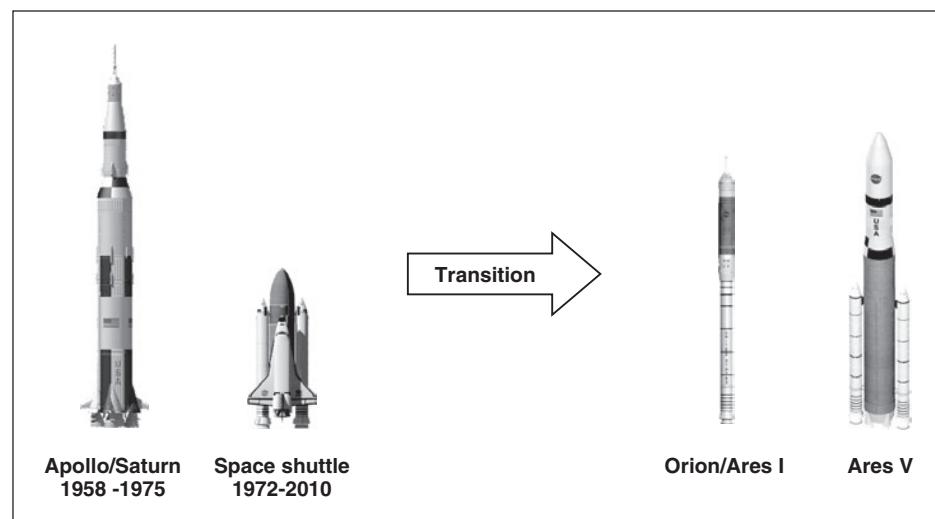
# Issues Surrounding the Transition from the Space Shuttle to the Next Generation of Human Space Flight Systems

## What GAO Found

NASA is in the midst of a transition effort of a magnitude not seen since the end of the Apollo program and the start of the Space Shuttle Program more than 3 decades ago. This transition will include a massive transfer of people, hardware, and infrastructure. Based on ongoing and work completed to-date, we have identified a number of issues that pose unique challenges to NASA as it transitions from the shuttle to the next generation of human space flight systems while at the same time seeking to minimize the time the United States will be without its own means to put humans in space. These issues include: sustaining a viable workforce; effectively managing systems development efforts; managing the supplier base; providing logistical support to the International Space Station; identifying and disposing of property and equipment; ensuring adequate environmental remediation; and transforming its business processes and financial management system.

NASA already has in place many processes, policies, procedures and support systems to carry out this transition. However, successful implementation of the transition will depend on thoughtful execution and effective oversight. How well NASA overcomes some of the challenges we have identified will not only have an effect on NASA's ability to effectively manage the gap in the U.S. human access to space, but will also affect the agency's ability to secure a sound foundation for the President's space exploration policy.

### Moving to the next generation of human space flight vehicles



Source: NASA images; GAO graphic .

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Mr. Chairman and Members of the Subcommittee:

Thank you for inviting me to discuss the challenges faced by the National Aeronautics and Space Administration (NASA) in transitioning from the space shuttle to the next generation of human space flight systems. In 2004, the President established a new exploration policy—*A Renewed Spirit of Discovery: The President's Vision for U.S. Space Exploration (Vision)*—which calls for the retirement of the space shuttle and the development of a new family of exploration systems. NASA's implementation of the *Vision* is expected to cost hundreds of billions of dollars. A NASA effort of this size and scope has not been seen since the end of the Apollo program and the start of the Space Shuttle Program more than 3 decades ago. The transition includes a massive transfer of people, hardware, and infrastructure. Although NASA has in place many processes, policies, procedures, and support systems to carry out this effort, successful transition will depend on thoughtful execution and effective oversight.

The need for NASA to implement the *Vision* in a fiscally prudent and effective manner cannot be overemphasized given the competing fiscal demands facing the federal government and an already troubling funding profile projected for human spaceflight activities. We have issued a number of reports that touch on various aspects of retiring the space shuttle and transitioning its assets and people to exploration activities. These reports have questioned the affordability of the exploration program, NASA's acquisition strategy for the development of new space vehicles, agencywide contract management, and workforce planning for current and future agency needs. We also have an ongoing body of work being performed at the request of the House Committee on Science and Technology regarding effective management of the industrial base, development of the Ares I Crew Launch Vehicle, and the logistical support needed by the International Space Station (ISS). In addition, at the request of the Senate Committee on Homeland Security and Governmental Affairs, Subcommittee on Oversight of Government Management, the Federal Workforce, and the District of Columbia, we are reviewing NASA's ability to attract and retain a skilled workforce. My statement today will focus on the overarching challenges that NASA faces in transitioning from the shuttle to the next generation of human space flight systems and will discuss our prior work on shuttle workforce and development of the Orion Crew Exploration Vehicle, one of the agency's complex programs. I will also discuss areas where we have related ongoing work.

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This testimony is based on work conducted in accordance with generally accepted government auditing standards.

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## Summary

NASA faces numerous challenges as it transitions from the Space Shuttle Program to the next generation of human space flight systems. We have undertaken a body of work over the past 3 years that has highlighted two of these challenges—sustaining the shuttle workforce and developing new systems. Sustaining the shuttle workforce through retirement and ensuring that the workforce is available to support future exploration activities presents an enormous challenge for NASA. In 2005, we reported that NASA has made limited progress toward developing a detailed strategy to retain a critically skilled workforce for shuttle operations. We recommended that the agency begin identifying the shuttle program's future workforce needs. NASA has recognized that shuttle workforce management and critical skills retention will be a major challenge and has taken action to address this issue. In 2006, we reported that NASA's acquisition strategy for the Orion Crew Exploration Vehicle was risky because it committed the government to a long-term contract before establishing a sound business case. We recommended that NASA modify the current Orion Crew Exploration Vehicle acquisition strategy to ensure that the agency does not commit itself to a long-term contractual obligation prior to establishing a sound business case. Although it initially disagreed with our recommendation, NASA subsequently revised its acquisition strategy to address some of the concerns we raised.

We are currently conducting a body of work relating to the transition, including NASA's management of the supplier base, development of the Crew Launch Vehicle, and logistical support of the space station. Our work to date has also identified other issues that NASA will face during the transition, including disposing of property and equipment, completing environmental clean up, managing the overall workforce, and integrating financial information into how NASA does business. Each area contains its own set of unique challenges, but they are all critical to NASA's overall transition effort and will require significant management attention.

## Background

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The President's Vision for Space Exploration for NASA announced in 2004 calls for the retirement of the shuttle upon completion of the ISS and the creation of new vehicles for human space flight that will allow a return to

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the moon by 2020 and voyages to Mars and points beyond. The shuttle manifest currently consists of 16 flights—15 to complete assembly and integration of the ISS and a servicing mission<sup>1</sup> to the Hubble Space Telescope. The first new space vehicles currently are targeted to begin operating no later than 2014—thereby creating a potential gap in U.S. human space flight. Congress has voiced concern over the United States not having continuous access to space. NASA has made it a priority to minimize the gap to the extent possible.

NASA has begun planning for the retirement of the shuttle, scheduled for 2010, by identifying best practices in closing facilities and the transitioning of capabilities. Specifically, NASA has conducted a number of benchmarking studies of previous closures and realignment of large programs, including the Titan IV rocket fly-out, the F/A-18 C/D fighter production close, and the Navy Base Realignment and Closure activities. The benchmarking efforts have highlighted to NASA the importance of having a plan, effective communication, human capital management, and effective program management tools. NASA's benchmarking effort also showed that closing and transitioning facilities, equipment, and people is expensive and time consuming. Among the lessons learned is that, historically, it has taken 3.5 years to close down an installation and another 3 years to complete the transition of the property. NASA's Office of the Inspector General has recently reviewed NASA's plan for the space shuttle transition and recommended, among other improvements, that the two affected space directorates finalize and implement the Human Space Flight Transition Plan.<sup>2</sup>

Development of the Orion crew capsule, Ares I launch vehicle, and other exploration systems needed to implement the *Vision* is dependent on a “go as you can afford to pay” approach, wherein lower-priority efforts will be deferred, descoped, or discontinued to allow NASA to stay within its available budget profile. In recent testimony, the NASA Administrator said that the cost associated with returning the shuttle to flight, continued shuttle operations, and recent budget reductions had the combined effect

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<sup>1</sup> The servicing mission includes installing the Cosmic Origins Spectrograph and Wide Field Camera 3, installing a refurbished Fine Guidance Sensor that replaces one degrading unit of the three already onboard, and an attempt will also be made to repair the Space Telescope Imaging Spectrograph, which stopped working in 2004.

<sup>2</sup> NASA Office of Inspector General. *NASA's Plan for Space Shuttle Transition Could Be Improved by Following Project Management Guidelines*, IG-07-005, (Washington, D.C.: Jan. 29, 2007).

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of increasing the gap by delaying the first manned Orion test flight by 6 months.

In an effort to address the gap in U.S. capability to resupply the space station following retirement of the shuttle, NASA is investing in commercial space transportation services. NASA's expectation is that by acquiring domestic orbital transportation services it will be able to send cargo and, in the future, transport crews to the ISS in a cost-effective manner. NASA refers to this as the Commercial Orbital Transportation Services project. The project is in the early stages of development. Should these commercial services prove to be unreliable or more costly than anticipated, NASA will need to purchase space transportation from its international partners to meet obligations to the ISS until the new Orion spacecraft become operational.

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## NASA Faces Significant Challenges in Retiring the Space Shuttle Program and Transitioning to Exploration Activities

We have undertaken a substantial body of work over the past 3 years that has highlighted the significant challenges that NASA will face as it retires the shuttle and transitions to exploration activities. One key challenge is sustaining the shuttle workforce through the retirement of the shuttle while ensuring that a viable workforce is available to support future activities. Another key challenge will be developing the Orion Crew Exploration Vehicle within cost, schedule, and performance goals. Additionally, our ongoing work has identified a number of other areas that may present challenges during the transition period. Some of these challenges include managing the supplier base to ensure its continued viability, developing the Ares I Crew Launch Vehicle, and completing and supporting the space station.

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### Maintaining a Skilled Workforce

The Space Shuttle Program's workforce is critical to the success of the *Vision*. The shuttle workforce currently consists of approximately 2,000 civil service and 15,000 contractor personnel, including a large number of engineers and scientists. In 2005, we reported that NASA had made limited progress toward developing a detailed strategy for sustaining a critically skilled shuttle workforce to support space shuttle operations. We reported that significant delays in implementing a strategy to sustain the shuttle workforce would likely lead to larger problems, such as funding and failure to meet NASA program schedules. Accordingly, we concluded that timely action to address workforce issues is critical given their potential impact on NASA-wide goals such as closing the gap in human spaceflight.

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When we performed our work several factors hampered the ability of the Space Shuttle Program to develop a detailed long-term strategy for sustaining the critically skilled workforce necessary to support safe space shuttle operations through retirement. For example, at that time, the program's focus was on returning the shuttle to flight, and other efforts such as determining workforce requirements were delayed. In our report, we recommended that NASA begin identifying the Space Shuttle Program's future workforce needs based upon various future scenarios. Scenario planning could better enable NASA to develop strategies for meeting future needs. NASA concurred with our recommendation. It has acknowledged that shuttle workforce management and critical skills retention will be a major challenge for the agency as it progresses toward retirement of the space shuttle and has taken action to address this issue. For example, since we made our recommendation, NASA has developed an agencywide strategic human capital plan and developed workforce analysis tools to assist it in identifying critical skills needs. NASA has also developed a human capital plan specifically for sustaining the shuttle workforce through the retirement and, then transitioning the workforce.

Additionally, in March 2006, the Senate Appropriations Subcommittee on Commerce, Justice, Science, and Related Agencies, and NASA asked the National Academy of Public Administration (NAPA) to assist the agency in planning for the space shuttle's retirement and transition to future exploration activities. In February 2007, a NAPA panel recommended that the Space Shuttle Program adopt a RAND model for projecting a core workforce because of its emphasis on "long-term scheduling projections, quantification of core competencies and proficiencies, and analysis of overlapping mission needs."<sup>3</sup> Under the RAND model, an organization maintains a core capability for any competency that will be needed in the future. According to NAPA, this model is useful where a given expertise is not immediately required, but is likely to be needed in the future—in this case, for the Orion Crew Exploration Vehicle.

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## Developing New Exploration Systems

In July 2006, we reported that NASA's acquisition strategy for the Orion Crew Exploration Vehicle placed the project at risk of significant cost overruns, schedule delays, and performance shortfalls because it committed the government to a long-term contract before establishing a

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<sup>3</sup>NAPA also recommended that NASA adopt scenario planning into its agencywide workforce planning processes and use the results to inform decisionmaking.

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sound business case.<sup>4</sup> Our past work has shown that developing a sound business case—one that matches requirements to available and reasonably expected resources before committing to a new product development effort—reduces risk and increases the likelihood of successful outcomes.<sup>5</sup> For a program to increase its chances of success, high levels of knowledge should be demonstrated before significant commitments are made (i.e., they should be following a knowledge-based approach to product development).

At the time of our report, NASA had yet to develop key elements of a sound business case, including well-defined requirements, mature technology, a preliminary design, and firm cost estimates that would support its plans for making a long-term commitment. Without such knowledge, NASA cannot predict with any confidence how much the program will cost, what technologies will or will not be available to meet performance expectations, and when the vehicle will be ready for use. NASA acknowledged that it would not have these elements in place until the project's Preliminary Design Review scheduled for fiscal year 2008. As a result, we recommended that the NASA Administrator modify the agency's acquisition strategy for the Orion Crew Exploration Vehicle to ensure that the agency does not commit itself, and in turn the federal government, to a long-term contractual obligation prior to establishing a sound business case at the project's Preliminary Design Review.

Although it initially disagreed with our recommendation, NASA subsequently took steps to address some of the concerns we raised. Specifically, NASA modified its acquisition strategy for the Orion project and changed the production and sustainment portions of the contract into options. The agency will decide whether to exercise these options after the project's critical design review in 2009. While these changes are in line with our recommendation and a step in a positive direction, we continue

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<sup>4</sup> GAO, *NASA: Long-Term Commitment to and Investment in Space Exploration Program Requires More Knowledge*, GAO-06-817R (Washington, D.C.: July 17, 2006).

<sup>5</sup> Examples of our best practices reports include GAO, *Best Practices: Using a Knowledge-Based Approach to Improve Weapon Acquisition*, GAO-04-386SP (Washington, D.C.: Jan. 2004); *Space Acquisitions: Committing Prematurely to the Transformational Satellite Program Elevates Risks for Poor Cost, Schedule, and Performance Outcomes*, GAO-04-71R (Washington, D.C.: Dec. 4, 2003); *Best Practices: Capturing Design and Manufacturing Knowledge Early Improves Acquisition Outcomes*, GAO-02-701 (Washington, D.C.: July 15, 2002); and *Best Practices: Better Matching of Needs and Resources Will Lead to Better Weapon System Outcomes*, GAO-01-288 (Washington, D.C.: Mar. 8, 2001).

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to believe NASA's acquisition strategy is risky because it does not fully conform to a knowledge-based acquisition approach. Attempting to close that gap by pushing forward development of the Orion Crew Exploration Vehicle without first obtaining the requisite knowledge at key points could very well result in the production of a system that not only does not meet expectations but ends up costing more and actually increases the gap.

Since we last testified on this subject in September 2006,<sup>6</sup> NASA has successfully completed its first major milestone for the Orion project. It has completed the Systems Requirements Review.<sup>7</sup> This was a major step toward obtaining the information critical for making informed decisions. According to NASA's Orion contracting officer, NASA is also in the process of renegotiating the Orion contract to extend the Initial Operational Capability date of the system to 2014. Further, while this change will increase contract costs, the increase has already been accounted for in the Orion budget because the agency has been planning the change for over a year. In addition, risks associated with schedule, cost, and weight continue to be identified for the Orion project.

As we have previously testified, sound project management and oversight will be key to addressing the risks that remain for the Orion project as it proceeds with its acquisition approach. To help mitigate the risks, we have recommended in the past that NASA have in place markers (i.e., criteria) to assist decision makers in their monitoring of the project at key junctures in the development process. Such markers are needed to provide assurance that projects are proceeding with and decisions are being based upon the appropriate level of knowledge and can help to lessen project risks. NASA has recently issued its updated program and project management requirements for flight systems in response to our recommendation. Changes to the policy,<sup>8</sup> including the incorporation of key decision points throughout the project development life cycle, should

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<sup>6</sup> GAO, *NASA: Sound Management and Oversight Key to Addressing Crew Exploration Vehicle Project Risks*, GAO-06-1127T (Washington, D.C.: Sept. 28, 2006).

<sup>7</sup> According to NASA's Systems Engineering Procedural Requirements (NASA Procedural Requirements NPR 7123.1), the SRR examines the functional and performance requirements defined for the system and the preliminary program or project plan and ensures that the requirements and the selected concept will satisfy the mission.

<sup>8</sup> NASA Procedural Requirements (NPR) 7120.5D establishes the requirements by which NASA will formulate and implement space flight programs and projects. NPR 7120.5D became effective on March 6, 2007, and supersedes the previous version of the document, NPR 7120.5C, for space flight programs and projects.

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provide an avenue for decision makers to reassess project decisions at key points in the development process to ensure that continued investment is appropriate. However, it should be noted that implementation of the policy in a disciplined manner will ensure success, not the existence of the policy itself.

Currently, we are evaluating the development of NASA's latest human-rated launch vehicle—the Ares I Crew Launch Vehicle. When completed, the Ares I vehicle will be capable of delivering the Orion spacecraft to low earth orbit for ISS missions and for exploration missions to the moon. As initially conceived by NASA in the Exploration Systems Architecture Study completed in 2005, the Ares I design would rely on the existing solid rocket boosters and main engines from the space shuttle as major components of its two stages. The current design for the Ares I, however, diverges from the initial design set forth in the architecture study and now includes elements from the Apollo-era Saturn V launch vehicle. Current plans are for Ares I to evolve the solid rocket boosters from the Space Shuttle Program from four segments to five segments and to build a new upper-stage engine based on an original Saturn V design. NASA maintains that these changes are necessary to increase commonality between the Ares I and the planned Ares V cargo launch vehicle and to reduce overall development costs for implementing the Vision. As NASA's design for the Ares I continues to evolve, careful planning and coordination between the Orion and Ares I development teams will be critical to ensuring that current developmental efforts result in hardware that satisfies the future requirements of these systems. Subsequently, any development problems on either of these systems could result in increasing the gap.

Our ongoing work is aimed at assessing whether NASA's acquisition strategy for Ares I reflects the effect of changes to the Ares I design incorporated since the Ares I was first conceived in the Exploration Systems Architecture Study as a shuttle-derived alternative. Also, we are evaluating the extent to which NASA's Ares I acquisition strategy incorporates knowledge-based concepts designed to minimize technical and programmatic risk.

The Orion Crew Exploration Vehicle and the Ares I Crew Launch Vehicle are the first in a series of new systems to be developed in support of exploration activities. NASA's careful management of these projects must preclude historical instances of cost and schedule growth. Indeed, while NASA has had many successes in the exploration of space, such as landing the Pathfinder and Exploration Rovers on Mars, NASA has also experienced its share of unsuccessful missions, unforeseen cost overruns,

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and difficulty bringing a number of projects to completion. For example, NASA has made several attempts to build a second generation of reusable human spaceflight vehicle to replace the space shuttle, such as the National Aero-Space Plane, the X-33 and X-34, and the Space Launch Initiative, that never accomplished its objective of fielding a new reusable space vehicle. We estimate that these unsuccessful development efforts have cost approximately \$4.8 billion since the 1980s. The high cost of these unsuccessful efforts and the potential costs of implementing the *Vision* make it important that NASA achieve success in developing new systems for its new exploration program.

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### Managing the Supplier Base Throughout Retirement and Transition

NASA's plans to retire the shuttle have the potential to greatly impact the supplier base that has been supporting that program for the last several decades, as well as mold the future supplier base needed for its exploration program. Over the next few years, NASA will be making decisions about its supplier base needs, including which suppliers will be required for the remainder of the Space Shuttle Program, which will no longer be required for the program, and which will be needed to support exploration efforts. One concern is that NASA will be unable to sustain suppliers necessary to support the exploration program during the period between the shuttle's retirement and resumption of human space flight. Also of concern is that those suppliers determined by NASA as not needed for the exploration program will prematurely end their services, thus jeopardizing the safe and efficient completion of shuttle activities. In addition, issues such as obsolescence—already being experienced by some shuttle projects—could have an impact on the exploration program given the planned use of heritage hardware for some components of the Constellation projects. In an attempt to address these potential issues, NASA has been developing and implementing plans and processes to manage the transition of its supplier base.

We are in the process of assessing how well NASA is positioning itself to effectively manage its supplier base to ensure both sustainment of the Space Shuttle Program through its scheduled retirement in 2010 and successful transition to planned exploration activities.

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### Providing Logistical Support to the International Space Station

The shuttle is uniquely suited for transporting crew and cargo to and from the ISS. However, with scheduled retirement of the shuttle in 2010, NASA and its international partners will be challenged to fully support ISS operations until 2014, when the new crew exploration vehicle is scheduled to come on line. To fill this gap, NASA plans to rely on its international

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partners and commercial services to provide ISS logistics and crew rotation.

Two recent studies have raised serious concerns about whether future ISS operations can be continuously supported. A 2006 report by the National Research Council noted that the capabilities, schedules, and funding requirements for NASA, international partners, and commercial cargo and crew vehicles were not yet firm enough to give the panel confidence that ISS exploration mission objectives have a high likelihood of being fulfilled.<sup>9</sup> A February 2007 report by the International Space Station Independent Safety Task Force, which was required by the NASA Authorization Act of 2005<sup>10</sup>, noted that the transition from the space shuttle to post-shuttle systems for logistical support to the ISS will require careful planning and phasing of new capabilities. Specifically, care must be taken to ensure adequate logistics and spares are provided to maintain a viable station.<sup>11</sup> The task force report went on to say that if a commitment is made to an emerging logistics delivery capability and the capability does not materialize, then logistical support to the ISS could be lost for some time, seriously decreasing the utility of the space station and possibly resulting in its abandonment.

We are reviewing NASA's plans for meeting ISS logistics and maintenance requirements after the shuttle retires, identifying the main risks to meeting ISS logistics and maintenance requirements, and assessing NASA's plans for addressing the risks.

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## Disposing of Property and Equipment

NASA has not developed a comprehensive cost estimate for transitioning or disposing of Space Shuttle Program facilities and equipment. This poses a financial risk to the agency. As NASA executes the remaining missions needed to complete the assembly of and provide support for the ISS, it will simultaneously begin the process of disposing of shuttle facilities and hardware that the Space Shuttle Program will no longer need, or,

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<sup>9</sup>Review of NASA Plans for the International Space Station, National Research Council, Washington, D.C., 2006.

<sup>10</sup>Pub. L. No. 109-155, §§ 802, 804 (2005).

<sup>11</sup>Final Report of the International Space Station Independent Safety Task Force, February 2007.

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transitioning such facilities and hardware to the other NASA programs.<sup>12</sup> As the ninth largest federal government property holder, NASA owns more than 100,000 acres, as well as over 3,000 buildings and 3,000 other structures totaling over 44 million square feet. Currently, the Space Shuttle Program uses 654 facilities valued in excess of \$5 billion. The Space Shuttle Program also manages equipment dispersed across government and its contractors valued at more than \$12 billion. NASA is in the process of evaluating its Space Shuttle Program facilities and equipment requirements and identifying existing facilities and equipment that will no longer be needed to support shuttle operations. Constellation and other NASA programs will determine whether they need any of the facilities or equipment released by the Space Shuttle Program. According to NASA officials, assessments currently project that only 70 to 80 of the existing facilities are needed to support the development or operation of future exploration systems. In cases where facilities or equipment are no longer required by the Space Shuttle Program, no other use is identified, or it is selected for disposal, it will transition to the resident NASA field center for disposition.

It is worth noting that even before the retirement of the shuttle, over 10 percent of NASA's facilities are underutilized or not utilized at all. One option NASA has is to lease underutilized facilities in exchange for cash and/or in-kind consideration, such as improvement of NASA's facilities or the provision of services to NASA. As directed by the NASA Authorization Act of 2005, we recently reported on NASA's Enhanced Use-Leasing Program.<sup>13</sup> Congress authorized NASA to employ enhanced-use leasing at two demonstration centers. This allowed the agency to retain the proceeds from leasing out underutilized real property and to accept in-kind consideration in lieu of cash for rent. The act allows NASA to deposit the net proceeds (i.e., net of leasing costs) in a no-year capital account to use later for maintenance, capital revitalization, and improvement of the facilities, albeit only at the demonstration centers—Ames Research Center and Kennedy Space Center. However, unlike other agencies with enhanced-use leasing authority, NASA is not authorized to lease back the property during the term of the lease. Furthermore, we found that the

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<sup>12</sup>Facilities refers to real property such as land, buildings and other structures that cannot be readily moved, and equipment refers to personal property that could be transported elsewhere with relative ease.

<sup>13</sup>Pub. L. No. 109-155, § 710 (2005) and GAO, *NASA: Enhanced Use Leasing Program Needs Additional Controls*, GAO-07-306R (Washington, D.C.: Mar. 1, 2007).

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agency does not have adequate controls in place to ensure accountability and transparency and to protect the government. We recommended that the NASA Administrator develop an agencywide enhanced use leasing policy that establishes controls and processes to ensure accountability and protect the government's interests including developing mechanisms to keep the Congress fully informed of the agency's enhanced use leasing activity. NASA concurred with our recommendations. After not receiving additional authority in the NASA Authorization Act of 2005, the agency is again requesting that the Congress extend enhanced use leasing authority to at least six NASA centers. NASA currently has other leasing authorities, but they require the agency to return to the U.S. Treasury any amounts exceeding cost. Further, NASA has indicated that it is preparing a package of legislative and administrative tools to help in the transition from the Space Shuttle Program to the Constellation Program. For example, in addition to requesting authority for increased use of enhanced use leasing, a NASA official informed us that one tool the agency might consider pursuing is the ability to keep the funds within NASA from the sale of facilities and equipment, rather than returning such funds to the Treasury.

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## Completing Environmental Clean Up

NASA does not have a comprehensive estimate of the environmental clean up costs associated with the transition and disposal of Space Shuttle Program facilities and equipment. The agency must comply with federal and state environmental laws and regulations, such as the National Environmental Policy Act of 1969, as amended,<sup>14</sup> the Resource, Conservation, and Recovery Act of 1976, as amended,<sup>15</sup> and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended,<sup>16</sup> in identifying and mitigating the environmental concerns. Although NASA has an approach for identifying environmental risks, in our report on major challenges facing the nation in the 21st century, we pointed out that progress in cleaning up sites frequently does not meet expected time frames and the costs dramatically exceed available funding levels.<sup>17</sup> For example, it cost the Titan IV program approximately \$300 million over six years on cleaning facilities,

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<sup>14</sup> 42 U.S.C. § 4321, et seq.

<sup>15</sup> 42 U.S.C. § 6901, et seq.

<sup>16</sup> 42 U.S.C. § 9601 et seq.

<sup>17</sup> GAO, *21st Century Challenges: Reexamining the Base of the Federal Government*, GAO-05-325SP (Washington, D.C.: February 2005).

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equipment, and tools. At this time, the extent of the Space Shuttle Program's environmental liabilities is not yet fully known. Paying for this liability may require a significant future outflow of funds at the same time that NASA will be facing many other competing demands for its limited dollars, such as development of Orion, Ares I, and other exploration projects.

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### Positioning the Science, Engineering, and Technical Workforce

As it moves away from flying the shuttle, the NASA acknowledges that it must realign where necessary and plan for a workforce that will not be quite as large. NASA projects fewer resources will be required for operating and sustaining hardware, especially during vehicle processing and launch operations. The reduction in reusability of future space systems will also result in less refurbishing. In addition, as new space systems are designed, emphasis will shift to personnel with skills in systems development and engineering, program management and systems integration. Unfortunately, these skills will be in high demand at a time when other federal agencies and the private sector have similar needs.

NASA projects that by fiscal year 2012 the total number of personnel needed to meet its strategic goals will decrease from 18,100 to 17,000. The agency is taking advantage of the flexibilities outlined in the NASA Flexibility Act of 2004<sup>18</sup> to attract highly qualified candidates, however, continued buy-outs and the threat of a reduction in force have created a feeling of instability among the science and engineering workforce. NASA's senior leaders recognize the need for an effective workforce strategy in achieving mission success. NASA has a strategic human capital plan, but more work is needed in workforce planning and deployment. In addition, NASA's transition to full cost accounting in fiscal year 2004 resulted in a number of its centers experiencing less than Full Time Equivalent utilization, a situation referred to by NASA as "uncovered capacity." The Administrator has committed to operating and maintaining 10 centers and transferred work to those centers with identified uncovered capacity.

We are examining whether several federal agencies, including NASA, are taking sufficient steps to address their workforce challenges in a timely and comprehensive manner, while sustaining focus on its mission and programmatic goals. Specifically, we are assessing the extent to which

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<sup>18</sup>Pub. L. No. 108-201.

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NASA's human capital framework is aligned with its strategic mission and programmatic goals; whether NASA is effectively recruiting, developing, and retaining critically skilled staff; and what internal or external challenges NASA faces in achieving its workforce needs. As noted earlier, NAPA recently completed a study that made recommendations to NASA on how to achieve a flexible and scalable workforce by integrating its acquisition and workforce planning processes.

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### Transforming the Way Financial Information Is Used

Since 1990, GAO has designated NASA's contract management as high risk principally because NASA has lacked a modern financial management system that can provide accurate and reliable information on contract spending and has placed little emphasis on product performance, cost controls, and program outcomes.<sup>19</sup> NASA has made progress toward implementing a disciplined project management processes, but it has made only limited progress in certain areas such as reengineering NASA's contractor cost reporting process. As we reported, the current Integrated Enterprise Management Program does not provide the cost information that program managers and cost estimators need to develop credible estimates and compare budgeted and actual cost with the work performed on the contract. NASA plans to spend billions of dollars to develop a number of new capabilities, supporting technologies, and facilities that are critical to enabling space exploration missions. The development of such capabilities will be largely dependent on NASA contractors—on which NASA spends about 85 percent of its annual budget. Because of such a large reliance on contractors to achieve its mission, it is imperative that NASA be able to track costs and the means to integrate financial decisionmaking with scientific and technical leadership by providing decisionmakers accurate information. To its credit, NASA is working to improve business processes and integrating disparate systems in order to improve efficiencies, reduce redundant systems, and improve business information available to the acquisition community and mission support organizations. However, more effort will be needed to make the cultural transformation a reality.

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### Concluding Observations

The Vision for Space Exploration puts NASA on a bold new mission. Implementing the *Vision* over the coming decades will require hundreds of billions of dollars and a sustained commitment from multiple

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<sup>19</sup>GAO, *High-Risk Series: An Update*, GAO-07-310 (Washington, D.C.: Jan. 2007).

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administrations and Congresses over the length of the program. How well NASA overcomes the transition challenges that we and others have identified will not only have an effect on NASA's ability to effectively manage the gap in the U. S. human access to space, but also will affect the agency's ability to secure a sound foundation of support for the President's space exploration policy. Consequently, it is incumbent upon NASA to ensure that these challenges are being addressed in a way that establishes accountability and transparency to the effort.

Mr. Chairman and Members of the Subcommittee, this concludes my prepared statement. I would be happy to answer any questions you may have at this time.

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## GAO Contact and Acknowledgments

For further information regarding this testimony, please contact Allen Li at (202) 512-4841 or [lia@gao.gov](mailto:lia@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this testimony. GAO staff who made key contributions to this testimony include Greg Campbell, Richard Eiserman, Yanina Golburt, James L. Morrison, Jeffrey M. Niblack, Shelby S. Oakley, Jose A. Ramos, Sylvia Schatz, and John Warren.

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