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NASA

Major Management Challenges and Program Risks

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Chairman Gehman and Members of the Columbia Accident Investigation Board:

Thank you for inviting me to discuss the challenges and risks facing the National Aeronautics and Space Administration (NASA). You asked that we provide information concerning NASA, particularly the management of the Space Shuttle Program. We recognize the complexity and difficulty in establishing not only the cause of the Columbia accident, but also in understanding the agency's environment in which management decisions are made. We believe our body of work can help the Board in this area.

Since its inception, NASA has undertaken numerous programs that have greatly advanced scientific and technological knowledge. As you are aware, NASA's activities span a broad range of complex and technical endeavors. But the agency is at a critical juncture, and major management improvements are needed. In January of this year, we identified four challenges facing NASA.[1]

- Strengthening strategic human capital management.
- Improving contract management.
- Controlling International Space Station costs.
- Reducing space launch costs.

Weak contract management and financial controls pose risks across the agency. Therefore, we have placed this area on our high-risk list.

Results in Brief

In summary, these challenges affect NASA's ability to effectively run its largest programs. NASA's ultimate challenge will be in tackling the root problems impeding those programs. This will require (1) instituting a results-oriented culture that fosters knowledge sharing and empowers its workforce to accomplish programmatic goals; (2) ensuring that the agency adheres to management controls to prevent cost overruns and scheduling problems; (3) transforming the financial management organization so it better supports NASA's core mission; and (4) sustaining commitment to change.

[1]See U.S. General Accounting Office, *Major Management Challenges and Program Risks: National Aeronautics and Space Administration*, GAO-03-114 (Washington, D.C.: January 2003).

Strengthening Strategic Human Capital Management

An agency's most important organizational asset is its people—they define the agency's culture, drive its performance, and embody its knowledge base. Leading public organizations worldwide have found that strategic human capital management must be the centerpiece of any serious change management initiative. However, NASA, like many federal agencies, is facing substantial challenges in attracting and retaining a highly skilled workforce, thus putting the agency's missions at risk. While NASA is taking comprehensive steps to address this problem across all mission areas, implementing a strategic approach to marshal, manage, and maintain human capital has been a significant challenge.

In January 2001, we reported that NASA's shuttle workforce had declined significantly to the point of reducing NASA's ability to safely support the shuttle program.[2] Many key areas were not sufficiently staffed by qualified workers, and the remaining workforce showed signs of overwork and fatigue. Recognizing the need to revitalize the shuttle program's workforce, NASA discontinued its downsizing plans in December 1999 and initiated efforts to hire new staff. In September 2001, we testified that NASA was hiring approximately 200 full-time equivalent staff and that it had focused more attention on human capital in its annual performance plan by outlining an overall strategy to attract and retain skilled workers.[3] However, considerable challenges remain, including the training of new staff and addressing the potential loss of key personnel through retirement.

As we reported in January 2003, these challenges have not been mitigated, and work climate indicators, such as forfeited leave and absences from training courses continue to reflect high levels of job stress. In addition, staffing shortages in many key skill areas of the shuttle program remain a problem, despite the recent hires. These areas include subsystems engineering, flight software engineering, electrical engineering, environmental control, and shuttle resources management. NASA's hiring posture for fiscal year 2003 has been to target areas where skill imbalances still exist in the shuttle program.

[2]See U.S. General Accounting Office, *Major Management Challenges and Program Risks: National Aeronautics and Space Administration*, GAO-01-258 (Washington, D.C.: January 2001).

[3]See U.S. General Accounting Office, *Space Shuttle Safety: Update on NASA's Progress in Revitalizing the Shuttle Workforce and Making Safety Upgrades* GAO-01-1122T (Washington, D.C.: Sept. 6, 2001).

NASA believes that similar workforce problems affect the entire agency and that, as a result, its ability to perform future missions and manage its programs may be at risk. Currently, the average age of NASA's workforce is over 45, and 15 percent of NASA's science and engineering employees are eligible to retire; within 5 years, about 25 percent will be retirement eligible. At the same time, the agency is finding it difficult to hire people with science, engineering, and information technology skills—fields critical to NASA's missions. Within the science and engineering workforce, the over-60 population currently outnumbers the under-30 population nearly 3 to 1. As the pool of scientists and engineers shrinks, competition for these workers intensifies. The agency also faces the loss of significant procurement expertise through 2007, according to NASA's Inspector General.[4] Coupled with these concerns, NASA has limited capability for personnel tracking and planning, particularly on an agencywide or programwide basis. Furthermore, NASA acknowledges that it needs to complete and submit to the Office of Management and Budget (OMB) a transformation workforce restructuring plan, which it notes that, in conjunction with its strategic human capital plan, will be critical to ensuring that skill gaps or deficiencies do not exist in mission- critical occupations.[5]

NASA is taking steps to address its workforce challenges. For example:

- NASA is developing an agencywide integrated workforce planning and analysis system that aims to track the distribution of NASA's workforce across programs, capture critical competencies and skills, determine management and leadership depth, and facilitate gap analyses. NASA has completed a pilot of an interim competency management system to facilitate analyses of gaps in skills and competencies. NASA plans to implement the interim system agencywide in 2003 and integrate it with the new comprehensive workforce planning and analysis system in 2005. The new system should foster better management of the existing workforce and enable better strategic decisions about future workforce needs.
- NASA has developed a strategic human capital plan, which identifies human capital goals, problems, improvement initiatives, and intended

[4]See National Aeronautics and Space Administration, *Audit Report: Procurement Workforce Planning*, IG-01-041 (Washington, D.C.: September 2001).

[5]As stated in President's Management Agenda Action Plans for the National Aeronautics And Space Administration, (Washington, D.C.: May 9, 2002). This document is an agreement between NASA and OMB on NASA's plans for addressing the governmentwide initiatives in The President's Management Agenda.

outcomes and incorporates strategies and metrics to support the goals.[6] The plan has been approved by OMB and the Office of Personnel Management (OPM). According to NASA, the plan is based on OMB's scorecard of human capital standards and OPM's scorecard of supporting human capital dimensions, as well as our own model, which we published in March 2002.[7]

- NASA has renewed its attention to hiring applicants just out of college and intends to pursue this even more aggressively in coming years. The agency is undertaking a number of initiatives and activities aimed at acquiring and retaining critically needed skills, such as using the new Federal Career Intern Program to hire recent science and engineering graduates, supplementing the workforce with nonpermanent civil servants where it makes sense, and implementing a program to repay student loans to attract and retain employees in critical positions.
- Finally, NASA has included an objective in its most recently updated strategic plan[8] and fiscal year 2004 performance plan[9] to implement an integrated agencywide approach to human capital management. The plans state that this approach will attract and maintain a workforce that represents America's diversity and will include the competencies that NASA needs to deliver the sustained levels of high performance that the agency's challenging mission requires.

The 108th Congress is currently considering a series of legislative proposals developed by NASA to provide it with further flexibilities and authorities for attracting, retaining, developing, and reshaping a skilled workforce. These include a scholarship-for-service program; a streamlined hiring authority for certain scientific positions; larger and more flexible recruitment, relocation, and retention bonuses; noncompetitive conversions of term employees to permanent status; a more flexible critical pay authority; a more flexible limited-term appointment authority for the senior executive service; and greater flexibility in determining annual leave accrual rate for new hires.

[6]NASA has also developed a companion strategic human capital implementation plan that contains detailed action plans for the improvement initiatives.

[7]See U.S. General Accounting Office, *A Model of Strategic Human Capital Management*, GAO-02-373SP (Washington, D.C.: Mar. 15, 2002).

[8]See National Aeronautics and Space Administration, *2003 Strategic Plan* (Washington, D.C.: 2003).

[9]NASA's fiscal year 2004 performance plan is integrated with its fiscal year 2004 budget request.

We continue to monitor NASA's progress in resolving its human capital problems, including how well its human capital initiatives and reforms and any new and existing flexibilities and authorities are helping to strategically manage and reshape its workforce.

Correcting Weaknesses in Contract Management

Much of NASA's success depends on the success of its contractors—who received more than 85 percent, or $13.3 billion, of NASA's funds in fiscal year 2002. However, since 1990, we have identified NASA's contract management function as an area at high risk because of its ineffective systems and processes for overseeing contractor activities. Specifically, NASA has lacked accurate and reliable information on contract spending and has placed little emphasis on end results, product performance, and cost control. NASA has addressed many of these acquisition-related weaknesses, but key tasks remain, including completing the design and implementation of a new integrated financial management system.

Since 1990, our reports and testimonies have repeatedly demonstrated just how debilitating these weaknesses in contract management and oversight have been. For example, our July 2002 report on the International Space Station found that NASA did not effectively control costs or technical and scheduling risks, provide adequate oversight review, or effectively coordinate efforts with its partners. In other examples, we found that NASA lacked effective systems and processes for overseeing contractor activities and did not emphasize controlling costs.

Center-level accounting systems and nonstandard cost-reporting capabilities have weakened NASA's ability to ensure that contracts are being efficiently and effectively implemented and that budgets are executed as planned. The agency's financial management environment is comprised of decentralized, nonintegrated systems with policies, procedures, and practices unique to each of its field centers. For the most part, data formats are not standardized, automated systems are not interfaced, and on-line financial information is not readily available to program managers. NASA's lack of a fully integrated financial management system also hurts its ability to collect, maintain, and report the full cost of its projects and programs. For example, in March 2002, we testified that NASA was unable to provide us with detailed support for amounts that it reported to the Congress as obligated against space station and related

shuttle program cost limits,[10] as required by the National Aeronautics and Space Administration Authorization Act of 2000.[11]

In recent years, NASA made progress in addressing its contract management challenges. For example:

- In July 1998, we reported that NASA was developing systems to provide oversight and information needed to improve contract management and that it had made progress in evaluating its field centers' procurement activities on the basis of international quality standards and its own procurement surveys. In January 1999, we reported that NASA was implementing its new system for measuring procurement-related activities and had made progress in evaluating procurement functions in its field centers.
- NASA has also made progress reducing its use of undefinitized contract actions (UCA)[12]—that is, unnegotiated, or uncosted, contract changes. In 2000, we reported that NASA's frequent use of undefinitized contract changes could result in contract cost overruns and cost growth in the International Space Station program. In March 2003, NASA's Office of Inspector General reported that NASA had significantly reduced both the number and dollar amount of undefinitized contract actions since we highlighted UCAs as one reason for designating NASA's contract management as a major management challenge.
- NASA has also recognized the urgency of implementing a fully integrated financial management system. We recently reported that NASA has estimated the life-cycle cost of this effort through 2008 to be $861 million.[13], [14] While this is NASA's third attempt at implementing a new financial management system (NASA's first two efforts covered 12 years

[10]See U.S. General Accounting Office, *National Aeronautics and Space Administration: Leadership and Systems Needed to Effect Financial Management Improvements*, GAO-02-551T (Washington, D.C.: Mar. 20, 2002).

[11]Section 202 of P.L. 106-391.

[12]An undefinitized contract action means a unilateral or bilateral contract modification or 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. 48 C.F.R. 1843.7001.

[13]See U.S. General Accounting Office, *Business Modernization: Improvements Needed in Management of NASA's Integrated Financial Management Program*, GAO-03-507 (Washington, D.C.: Apr. 30, 2003).

[14]For this estimate, NASA has defined life-cycle costs to include implementation efforts through fiscal year 2008 and major upgrades, plus operation and support costs for each system module for the first 2 years after the module goes live.

and cost $180 million), this effort is expected to produce an integrated, NASA-wide financial management system through the acquisition and incremental implementation of commercial software packages and related hardware and software components.[15] The core financial management module, which NASA considers to be the backbone of the Integrated Financial Management Program, is currently operating at 6 of NASA's 10 centers[16] and is expected to be fully operational in June 2003. According to NASA's business case analysis for the system, the core financial module will provide NASA's financial and program managers with timely, consistent, and reliable cost and performance information for management decisions.

While NASA has made noteworthy progress in strengthening its contract oversight, much work remains. As NASA moves ahead in acquiring and implementing its new financial management system, NASA needs to ensure that its systems and processes provide the right data to oversee its programs and contractors—specifically, data to allow comparisons of actual costs to estimates, provide an early warning of cost overruns or other related difficulties, and monitor contract performance and make program requirement trade-off decisions. In addition, NASA must employ proven best practices, including (1) aligning its selection of commercial components of the system with a NASA-wide blueprint, or "enterprise architecture;" (2) analyzing and understanding the dependencies among the commercial components before acquiring and implementing them; (3) following an event-driven system acquisition strategy; (4) employing effective acquisition management processes, such as those governing requirements management, risk management, and test management; (5) ensuring that legacy system data are accurate to avoid loading and perpetuating data errors in the new system; and (6) proactively positioning NASA for the business process changes embedded in the new system, for example, by providing adequate formal and on-the-job training.

However, as we reported in April 2003, the core financial module is not being designed to accommodate much of the information needed by

[15]The system is to consist of nine modules: core financial management, resume management, travel management, position description management, human resource management, payroll, budget formulation, contract administration, and asset management.

[16]NASA is comprised of its headquarters offices, nine centers located throughout the country, and the Jet Propulsion Laboratory. The Jet Propulsion Laboratory is operated by the California Institute of Technology, but for the purpose of this testimony, we treat the Jet Propulsion Laboratory as a center.

program managers and cost estimators.[17] For example, to adequately oversee NASA's largest contracts, program managers need reliable contract cost data—both budgeted and actual—and the ability to integrate these data with contract schedule information to monitor progress on the contract. However, because program managers were not involved in defining system requirements or reengineering business processes, the core financial module is not being designed to integrate cost and schedule data needed by program managers. In addition, because NASA has embedded in the core financial module the same accounting code structure that it uses in its legacy reporting system, the core financial module is not being implemented to capture cost information at the same level of detail that it has received from NASA's contractors. Finally, because NASA has done little to reengineer its acquisition management processes to ensure that its contractors consistently provide the cost and performance information needed, the core financial module does not provide cost estimators with the detailed cost data needed to prepare credible cost estimates.

Because more work is needed to demonstrate substantial progress in resolving the root causes of NASA's contract management weaknesses, our 2003 Performance and Accountability Series continued to report contract management as a major management challenge for NASA and a high-risk area. We are continuing to monitor NASA's progress in addressing contract management weaknesses. In response to a request from the Senate Commerce, Science, and Transportation Committee and the House Science Committee, we continue to assess the extent to which NASA's financial management system acquisition is in accordance with effective system acquisition practices and is designed to support NASA's decision-making needs and external reporting requirements.

Controlling International Space Station Costs

The International Space Station represents an important effort to foster international cooperation in scientific research and space exploration. It is also considered one of the most challenging engineering feats ever attempted. The estimated cost of the space station has mushroomed, and expected completion has been pushed out several years. NASA is taking action to keep costs in check, but its success in this area still faces considerable challenges. In the meantime, NASA has had to make

[17]See GAO-03-507.

substantial cuts in the program, negatively impacting its credibility with the Congress, international partners, and the scientific community.

The grounding of the shuttle fleet following the Columbia accident has had a significant impact on the continued assembly and operation of the International Space Station. The shuttle is the primary vehicle for transferring crew and equipment to and from the station and is used to periodically reboost the station into a higher orbit. Although on-orbit assembly of the station has stopped, NASA must continue to address the challenges of developing and sustaining the station and conducting scientific experiments until shuttle flights resume. While controlling cost and schedule and retaining proper workforce levels have been difficult in the past, the shuttle grounding will likely exacerbate these challenges. Because the return-to-flight date for the shuttle fleet is unknown at this time and manifest changes are likely, the final cost and schedule impact on the station is undefined at this time.

NASA has had difficulty predicting and controlling costs and scheduling for the space station since the program's inception in 1984. In September 1997, we reported that the cost and schedule performance of its prime development contractor, which showed signs of deterioration in 1996, had continued to worsen and that the program's financial reserves for contingencies had all but evaporated. In our January 2001 Performance and Accountability Series, we reported that the prime contract was initially expected to cost over $5.2 billion and that the assembly of the station was expected to be completed in June 2002. But by October 2000, the prime contractor's cost had grown to about $9 billion—$986 million of which was for cost overruns—and the current estimate is about $11 billion. Because of on-going negotiations with the international partners and uncertainty associated with the shuttle's return to flight, the station's final configuration and assembly date cannot be determined at this time. NASA's Office of Inspector General also reported cost overruns in a February 2000 audit report, and based on recommendations in that report, NASA agreed to take several actions, including discussing the prime contractor's cost performance at regularly scheduled meetings and preparing monthly reports to senior management on the overrun status. However, in July 2002, we reported continued cost growth due to an inadequate definition of requirements, changes in program content, schedule delays, and inadequate program oversight.[18] While NASA's

[18]See U.S. General Accounting Office, *Space Station: Actions Under Way to Manage Cost, but Significant Challenges Remain*, GAO-02-735 (Washington, D.C.: July 17, 2002).

controls should have alerted management to the growing cost problem and the need for action, they were largely ignored because NASA focused on fiscal year budget management rather than on total program cost management.

NASA is instituting a number of management and cost-estimating reforms, but significant challenges threaten their successful implementation. First, NASA's new life-cycle cost estimate for the program—which is based on a three-person crew instead of a seven-person crew, as originally planned—will now have to be revised because of changes to the program's baseline. The lack of an adequate financial management system for collecting space station cost data only exacerbates this challenge. Second, NASA must still determine how research can be maximized with only a limited crew. Last, NASA has yet to reach agreement with its international partners on an acceptable on-orbit configuration and sharing of research facilities and costs. As a result, the capacity and capabilities of the space station, the scope of research that can be accomplished, and the partners' share of operating costs are unknown at this time.

Ongoing cost and schedule weaknesses have profoundly affected the utility of the space station—with substantial cutbacks in construction, the number of crew members, and scientific research. As a part of the space station's restructuring, further work and funding for the habitation module and crew return vehicle have been deferred, which led to the on-orbit crew being reduced from seven to three members, limiting the crewmember hours that can be devoted to research. Additionally, the number of facilities available for research has been cut from 27 to 20. NASA's international partners and the scientific community are not satisfied with these and other reductions in capabilities and have raised concerns about the viability of the space station science program.

Reducing Space Launch Costs

In our earlier identification of costs to build the International Space Station, we identified space shuttle launch costs as being a substantial cost component—almost $50 billion.[19] NASA recognized the need to reduce such costs as it considered alternatives to the space shuttle. Indeed, a key goal of the agency's earlier effort to develop a reusable launch vehicle was to reduce launch costs from $10,000 per pound on the Space Shuttle to

[19]U.S. General Accounting Office, *International Space Station: U.S. Life-Cycle Funding Requirements*, GAO/NSIAD-98-147 (Washington, D.C.: May 22, 1998).

$1,000 through the use of such a vehicle. As we testified in June 2001, NASA's X-33 program—an attempt to develop and demonstrate advanced technologies needed for future reusable launch vehicles—ended when the agency chose not to fund continued development of the demonstrator vehicle in February 2001.[20]

Subsequently, until November 2002, NASA was pursuing its Space Launch Initiative (SLI)—a 5-year, $4.8 billion program to build a new generation of space vehicles to replace its aging space shuttle fleet. SLI was part of NASA's broader Integrated Space Transportation Plan, which involves operating the space shuttle program through 2020 as successive generations of space transportation vehicles are developed and deployed, beginning around 2011. The primary goals for SLI were to reduce the risk of crew loss as well as substantially lower the cost of space transportation so that more funds could be made available for scientific research, technology development, and exploration activities. Currently, NASA spends nearly one-third of its budget on space transportation.

In September 2002, we reported that SLI was a considerably complex and challenging endeavor for NASA—from both a technical and business standpoint.[21] For example, SLI would require NASA to develop and advance new technologies for the new vehicle, including (1) new airframe technologies that will include robust, low-cost, low-maintenance structure, tanks, and thermal protection systems, using advanced ceramic and metallic composite materials, and (2) new propulsion technologies, including main propulsion systems, orbital maneuvering systems, main engines, and propellant management. The program would also require NASA to carefully coordinate and communicate with industry and government partners in order to reach agreements on the basic capabilities of the new vehicle, the designs or architectures that should be pursued, the sharing of development costs, and individual partner responsibilities. Last, the SLI project would require careful oversight, especially in view of past difficulties NASA has had in developing the technologies for reusable launch vehicles to replace the space shuttle. These efforts did not achieve their goals primarily because NASA did not

[20]U.S. General Accounting Office, *Space Transportation: Critical Areas NASA Needs to Address in Managing Its Reusable Launch Vehicle Program*, GAO-01-826T (Washington, D.C.: June 20, 2001).

[21]See U.S. General Accounting Office, *Space Transportation: Challenges Facing NASA's Space Launch Initiative*, GAO-02-1020 (Washington, D.C.: Sept. 17, 2002).

develop realistic requirements and, thus, cost estimates, timely acquisition and risk management plans, or adequate and realistic performance goals.

Most importantly, however, we reported that NASA was incurring a high level of risk in pursuing its plans to select potential designs for the new vehicle without first making other critical decisions, including defining the Department of Defense's (DOD) role in the program; determining the final configuration of the International Space Station; and identifying the overall direction of NASA's Integrated Space Transportation Plan. At the time, indications were that NASA and DOD differed on program priorities and requirements; NASA had yet to reach agreement with its international partners on issues that could dramatically impact SLI requirements, such as how many crew members would operate the station.

NASA agreed with our findings and, in October 2002, postponed its systems requirements review for SLI so that it could focus on defining DOD's role, determine the future requirements of the International Space Station, and firm up the agency's future space transportation needs. In November 2002, the administration submitted to the Congress an amendment to NASA's fiscal year 2003 budget request to implement a new Integrated Space Transportation Plan. The new plan makes investments to extend the space shuttle's operational life for continued safe operations and refocuses the SLI program on developing an orbital space plane—which provides a crew transfer capability to and from the space station—and next-generation launch technology. The Integrated Space Transportation Plan is an integral part of our ongoing work assessing NASA's plans to assure flight safety through space shuttle modernization through 2020.

As NASA proceeds with its revised plans, it will still be important for NASA to implement management controls that can effectively predict what the total costs of the program will be and minimize risks. These include cost estimates, controls designed to provide early warnings of cost and schedule overruns, and risk mitigation plans. With such controls in place, NASA would be better positioned to provide its managers and the Congress with the information needed to ensure that the program is on track and able to meet expectations.

Better Mechanisms Needed for Sharing Lessons Learned

In addition to taking actions to address its management challenges, NASA uses various mechanisms to communicate lessons garnered from past programs and projects. In 1995, NASA established the Lessons Learned Information System (LLIS), a Web-based lessons database that managers are required to review on an ongoing basis. NASA uses several mechanisms to capture and communicate lessons learned—including training, program reviews, and periodic revisions to agency policies and guidelines—but LLIS is the principal source for sharing lessons agencywide. In January 2002, we reported that NASA had recognized the importance of learning from the past to ensure future mission success and had implemented mechanisms to capture and share lessons learned.[22] However, spacecraft failures persist, and there is no assurance that lessons are being applied toward future mission success. We reported that insufficient risk assessment and planning, poor team communications, inadequate review process, and inadequate system engineering were often cited as major contributors to mishaps. (See table 1.)

[22]See U.S. General Accounting Office, *NASA: Better Mechanisms Needed for Sharing Lessons Learned*, GAO-02-195 (Washington, D.C.: January 2002).

Table 1: Persistent Reasons for Spacecraft Failures

	Cost and schedule constraints	Insufficient risk assessment and planning	Underestimation of complexity and technology maturity	Insufficient testing	Poor team communication	Inattention to quality and safety	Inadequate review process	Design errors	Inadequate system engineering	Inadequate or under trained staff
Major program reviews										
Broad Area Review	•		•		•	•	•	•	•	•
Lockheed Martin Independent Assessment Team		•			•	•	•		•	•
Major mishap reviews										
Wide-Field Infrared Explorer	•			•	•		•	•	•	
Mars Climate Orbiter		•		•	•	•	•	•	•	•
Mars Polar Lander		•			•		•	•	•	•
Lewis	•	•	•	•	•		•		•	
Solar and Heliospheric Observatory		•	•		•		•		•	•
Mars Observer	•	•	•	•				•	•	•
Delta Clipper-Experimental		•		•			•	•		•
Challenger	•	•		•	•	•	•	•		•

Source: RAND, used with permission.

At that time, we also reported on a survey we conducted of NASA's program and project managers. The survey revealed that lessons are not routinely identified, collected, or shared by programs and project managers. The survey found that less than one-quarter of the respondents reported that they had submitted lessons to LLIS; almost one-third did not even know whether they had submitted lessons. In addition, most respondents could not identify helpful lessons for their program or project.

Furthermore, many respondents indicated that they were dissatisfied with NASA's lessons learned processes and systems. Managers also identified challenges or cultural barriers to the sharing of lessons learned, such as the lack of time to capture or submit lessons and a perception of intolerance for mistakes. They further offered suggestions for areas of

improvement, including enhancements to LLIS and implementing mentoring and "storytelling," or after-action reviews, as additional mechanisms for lessons learning.

While NASA' s current knowledge management efforts should lead to some improvement in the sharing of agency lessons and knowledge, they lack ingredients that have been shown to be critical to the success of knowledge management at leading organizations. Cultural resistance to sharing knowledge and the lack of strong support from agency leaders often make it difficult to implement an effective lessons-learning and knowledge-sharing environment. We found that successful industry and government organizations had overcome barriers by making a strong management commitment to knowledge sharing, developing a well-defined business plan for implementing knowledge management, providing incentives to encourage knowledge sharing, and building technology systems to facilitate easier access to information. The application of these principles could increase opportunities for NASA to perform its basic mission of exploring space more effectively.

To fulfill its vision, NASA is taking on a major transformation aimed at becoming more integrated and results-oriented, and at reducing risks while working more economically and efficiently. However, to successfully implement its human capital, financial management, and other reforms, NASA will need sustained commitment from senior leaders. Given the high stakes involved, it is critical that NASA's leadership provide direction, oversight, and sustained attention to ensure that reforms stay on track. NASA's Administrator, who comes to the position with a strong management background and expertise in financial management, has made a personal commitment to change the way NASA does business and has appointed a chief operating officer to provide sustained management attention to strategic planning, organizational alignment, human capital strategy, performance management, and other elements necessary for transformation success. The challenge ahead for NASA will be to achieve the same level of commitment from managers at NASA centers so that NASA can effectively use existing and new authorities to manage its people strategically and quickly implement the tools needed to strengthen management and oversight.

Objectives, Scope, and Methodology

This testimony was drawn from the most recent[23] in a series of GAO reports first issued in 1999 as well as additional reports that summarize numerous individual GAO reviews that identify important management, oversight, and workforce issues facing NASA. The purpose of the series is to help sustain congressional attention and an agency focus on continuing to make progress in addressing these issues. The individual reviews were conducted in accordance with generally accepted government auditing standards.

Chairman Gehman, this concludes my statement. I will be happy to answer any questions you or members of the board may have.

Contacts and Acknowledgments
For further information regarding this testimony, please contact Allen Li at (202) 512-4841. Individuals making key contributions to this testimony included Jerry Herley, Shirley Johnson, Charles Malphurs, and Karen Sloan.

[23] GAO-03-114.