National Aeronautics and Space Administration

Fiscal Year 2006 Performance and Accountability Report

NASA's Performance and Accountability Report

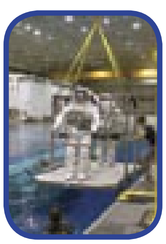
This is the National Aeronautics and Space Administration's (NASA) Fiscal Year 2006 (FY 2006) Performance and Accountability Report. It is a detailed account of NASA's performance in achieving the long-term Strategic Goals, multi-year Outcomes, and Annual Performance Goals for the Agency's programs, management, and budget. This Report includes detailed performance information and financial statements, as well as management challenges and NASA's plans and efforts to overcome them.

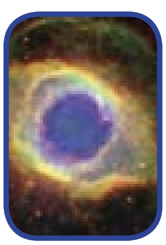
NASA's FY 2006 Performance and Accountability Report meets relevant U.S. government reporting requirements (including the *Government Performance and Results Act of 1993*, the *Chief Financial Officers Act of 1990*, and the *Federal Financial Management Improvement Act of 1996*). This Report also tells the American people how NASA is doing.

Part 1—Management Discussion & Analysis. Part 1 highlights NASA's overall performance, including financial and management activities. Part 1 also describes NASA's organization, performance assessment and rating processes, and management control systems.

Part 2—Detailed Performance Data. Part 2 provides detailed information on NASA's progress toward achieving specific milestones and goals as defined in the Agency's Strategic Plan and, in further detail, in the FY 2006 Performance Plan Update. Part 2 also includes the Agency's Performance Improvement Plan, which details the actions that NASA is taking to achieve all measures the Agency did not meet in FY 2006.

Part 3—Financials. Part 3 includes the Agency's financial statements, audit results by independent accountants in accordance with government auditing standards, and responses to audit findings.





Appendices—The Appendices include required Inspector General follow-up audits (Appendix A), an FY 2005 Performance Improvement Update (Appendix B), a list of OMB Program Assessment Rating Tool (PART) recommendations for FY 2005 (Appendix C), and detailed source information (Appendix D).

A PDF version of this Performance and Accountability Report is available at *http://www.nasa.gov/about/budget/index.html*. Please send questions and comments to *hq-par@mail.nasa.gov*.

Cover: A Delta II rocket stands ready at Vandenberg Air Force Base, California, to launch the CALIPSO and Cloudsat satellites. The two satellites, which launched on April 28, 2006, gather information about clouds, ice crystals, aerosols, and a range of related subjects. (NASA/B. Ingalls)

Message from the Administrator

November 15, 2006

Fiscal Year 2006 was a very good year for NASA. We made significant progress in implementing the goals articulated in NASA's Strategic Plan to carry out our mission of space exploration, scientific discovery, and aeronautics research. With the NASA Authorization Act of 2005, Congress affirmed the Vision for Space Exploration and the course that President Bush set for us to advance our Nation's economic, scientific, and security interests. We have much remaining yet to accomplish, but we are making steady progress in achieving our goals.

Robotic and human spaceflight are the most technically challenging endeavors we can undertake as a Nation. Completion of the International Space Station (ISS), retirement of the Space Shuttle, and transitioning to new exploration systems will be NASA's greatest challenges over the next several years, and we are moving forward to achieve all three goals. In August 2006, we re-started assembly of the ISS, and we plan to complete construction by 2010 and then retire the Space Shuttle. Following the Exploration Systems Architecture Study completed in 2005, this year we awarded a contract to design and develop the Orion Crew Exploration Vehicle that will return our astronauts to the Moon and eventually carry them to Mars and other destinations. NASA also signed Space Act Agreements to demonstrate commercial crew and cargo transportation services to the ISS, and we refined our designs for the Ares I Crew Launch Vehicle and Ares V heavy-lift Cargo Launch Vehicle to save money in life-cycle costs. In the coming months, NASA will enter into development contracts for the upper stage of the Ares I Crew Launch Vehicle, and we are partnering with the U.S. Air Force in developing the RS-68 engine for the Ares V Cargo Launch Vehicle.

We are fostering a work environment throughout NASA in which engineers and technicians feel free to address problems that may affect the safety of the crew and mission. We have completed three successful Shuttle flights to the ISS since the Space Shuttle *Columbia* accident, and we are on track to complete all planned Shuttle flights by 2010, including a servicing mission to the Hubble Space Telescope in 2008.

NASA continues to be a world leader in space and Earth sciences. In 2006, the Nobel Prize for Physics was awarded to Dr. John Mather, the first NASA employee to be awarded this honor. This year, we launched the New Horizons mission to Pluto, the Cloudsat and CALIPSO satellites to monitor global climate change, the STEREO mission to view the effects of solar activity on the Earth, and two additional heliophysics satellites—TWINS–A and SOLAR–B. Today, robotic rovers and satellites explore Mars searching for evidence of life. Scientists working with NASA's astronomy and astrophysics missions search for planets—and possibly life—around other stars and try to unlock the mysteries of the way the universe began and may ultimately end.

In FY 2006, we restructured our aeronautics research program to ensure that it will support long-term, cutting-edge research aligned to our national priorities for the benefit of the broad aeronautics community in academia, industry, and other government agencies. This restructuring reflects NASA's commitment to restoring and maintaining core aeronautics capabilities within the Centers.

These initiatives are part of NASA's objective of creating ten healthy Centers, with each actively contributing to all NASA missions. In FY 2006, we also began tackling the problem of our "uncovered capacity" workforce, those employees who are not assigned directly to specific programs. At the beginning of FY 2006, NASA had approximately 3,000 uncovered positions, but by the end of the fiscal year, the estimate was reduced to approximately 300 positions.

We have many challenges ahead of us. In submitting this Report of our achievements and challenges in FY 2006, NASA accepts the responsibility of reporting performance and financial data accurately and reliably with the same vigor as we conduct our scientific research. For FY 2006, I can provide reasonable assurance that the performance data in this Report are complete and reliable. Performance data limitations are documented explicitly.

In accordance with the Federal Financial Management Improvement Act (FFMIA), NASA's Integrated Financial Management System Core Financial Module (IFMSCFM) produces financial and budget reports. However, because of unresolved data conversion issues, the system is unable to provide reliable and timely information for managing current operations and safeguarding assets. Therefore, NASA's IFMSCFM does not comply fully with the requirements of the FFMIA, and the independent auditors were unable to render an opinion on our FY 2006 financial statements. Instead, they issued a disclaimer of opinion. Therefore, I cannot provide reasonable assurance that the financial data in this Report are complete and reliable. We will continue to focus on bringing NASA's financial management system into compliance.

NASA continues to improve the Agency's internal control environment, compliance with established requirements and standards, and heightened stewardship of the resources and assets entrusted to the Agency. In FY 2006, NASA resolved two of four material weaknesses reported in FY 2005. This year, we report two continuing material weaknesses and one new material weakness in internal control. With the exception of these three material weaknesses, I submit a qualified Statement of Assurance that reasonable controls are in place to achieve the Agency's programmatic, institutional, and financial management objectives. Internal control initiatives and corrective action plans for closing material weaknesses are discussed in detail within the Systems, Controls, & Legal Compliance chapter, Part 1, of this Report.

We have a lot of work ahead of us, but we are making solid progress. Therefore, it is my pleasure to submit NASA's FY 2006 Performance and Accountability Report.

Michael D. Griffin
Administrator

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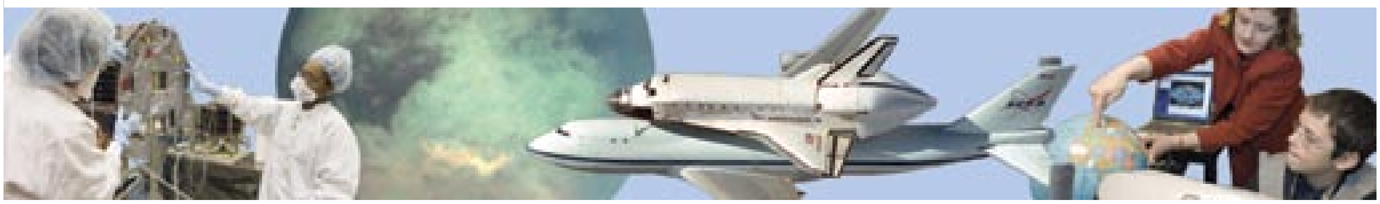
Part 1: Management Discussion & Analysis

Previous page: A fish-eye-view lens curves the fixed service structure toward Space Shuttle *Atlantis* as it blasts off Launch Pad 39B, propelled by columns of fire from the solid rocket boosters. At the lower left is the White Room that, when extended, gave the mission crew access to the Shuttle. After lift-off, *Atlantis* headed for rendezvous with the International Space Station (ISS) on mission STS-115. Mission STS-115 was the 116th Space Shuttle flight, the 27th flight for *Atlantis*, and the 19th flight to the ISS. (NASA)

Above: A crew transport vehicle, a modified "people mover" used at airports, approaches Shuttle *Discovery* after the orbiter was cleared for crew departure at the conclusion of STS-121. The crew exits the Shuttle into a crew hatch access vehicle and, after a brief medical examination, transfers into the crew transportation vehicle. The landing was the 32nd for *Discovery*. (NASA)

Mission, Vision, Values, & Organization



NASA's Mission Is on Track

Congress enacted the *National Aeronautics and Space Act of 1958* to provide for research into problems of flight within and outside Earth's atmosphere and to ensure that the United States conducts activities in space devoted to peaceful purposes for the benefit of humankind. Nearly 50 years later, NASA is continuing the American traditions of pioneering, exploration, and expanding the realm of what is possible by using NASA's unique competencies in science and engineering to fulfill the Agency's purpose and achieve NASA's Mission:

To pioneer the future in space exploration, scientific discovery, and aeronautics research.

Making Progress

On January 14, 2004, President George W. Bush announced *A Renewed Spirit of Discovery: The President's Vision for U.S. Space Exploration*, which Congress endorsed in the *NASA Authorization Act of 2005*. This directive commits the Nation to a journey of exploring the solar system, returning astronauts to the Moon in the next decade, then venturing to Mars and beyond. In issuing it, the President challenged NASA to establish innovative programs to enhance understanding of the planets in this solar system and around other stars, to ask new questions, and to answer questions that are as old as humankind.

To achieve this directive, NASA established six Strategic Goals:

Strategic Goal 1: Fly the Shuttle as safely as possible until its retirement, not later than 2010.

Strategic Goal 2: Complete the International Space Station in a manner consistent with NASA's International partner commitments and the needs of human exploration.

Strategic Goal 3: Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.

Strategic Goal 4: Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.

Strategic Goal 5: Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.

Strategic Goal 6: Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.

NASA's Values

The Agency's four shared core values support NASA's commitment to technical excellence and express the ethics that guide the Agency's behavior. These values are the underpinnings of NASA's spirit and resolve.

- **Safety:** NASA's constant attention to safety is the cornerstone upon which NASA builds mission success. NASA employees are committed, individually and as a team, to protecting the safety and health of the public, NASA team members, and the assets that the Nation entrusts to the Agency.
- **Teamwork:** NASA's most powerful tool for achieving mission success is the Agency's highly skilled, multi-disciplinary workforce. NASA's success is built on high-performing teams that are committed to continuous learning, trust, and openness to innovation and new ideas.
- **Integrity:** NASA is committed to maintaining an environment of trust built upon honesty, ethical behavior, respect, and candor. Building trust through ethical conduct as individuals and as an organization is a necessary component of mission success.
- **Mission Success:** NASA's purpose is to carry out space exploration, scientific discovery, and aeronautics research on behalf of the Nation. Every NASA employee believes that mission success is the natural consequence of an uncompromising commitment to technical excellence, safety, teamwork, and integrity.

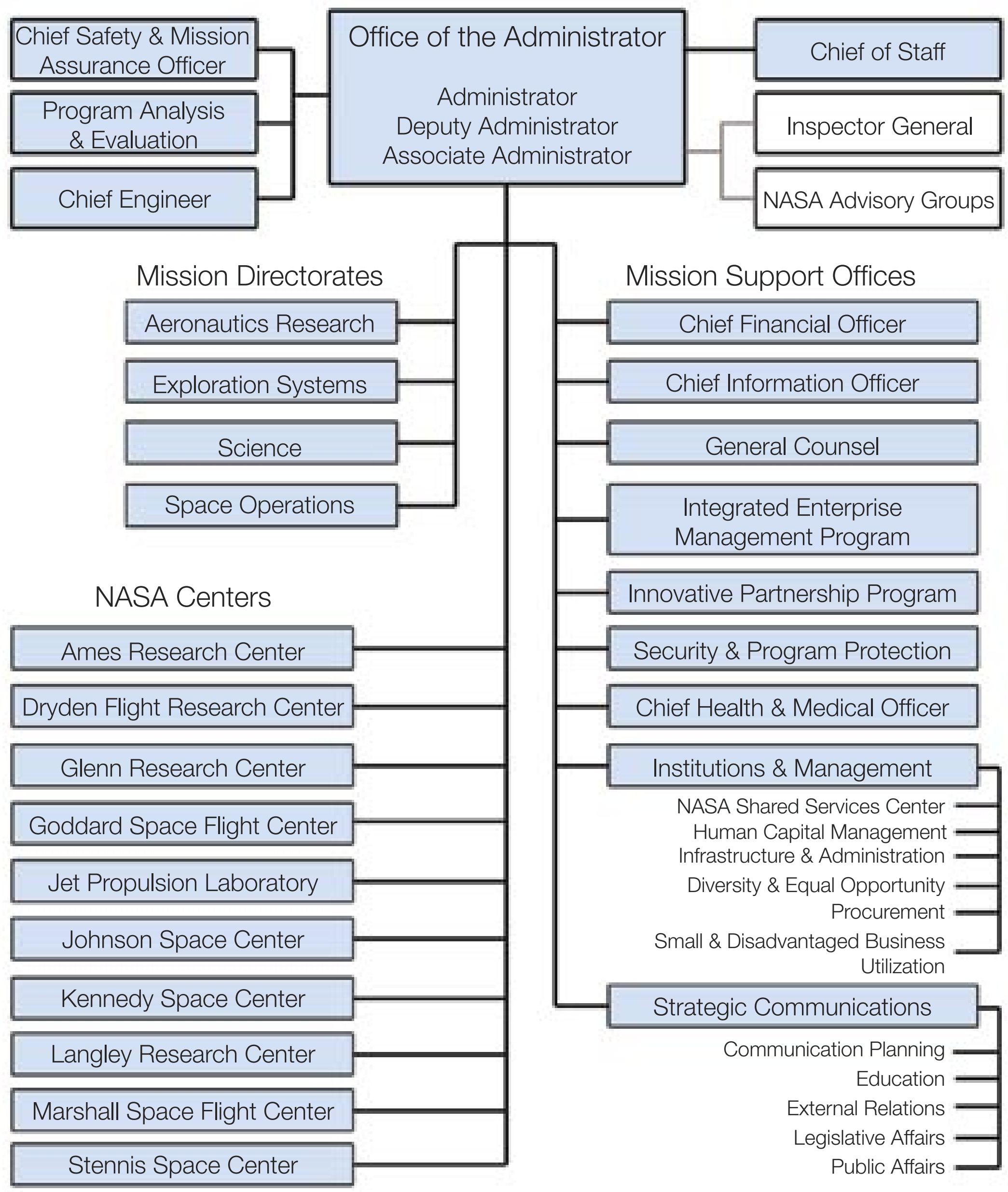
NASA's Organization

NASA is comprised of NASA Headquarters in Washington, D.C., nine Centers located around the country, and the Jet Propulsion Laboratory, a Federally Funded Research and Development Center operated under a contract with the California Institute of Technology. In addition, NASA partners with academia, the private sector, state and local governments, other federal agencies, and a number of international organizations to create an extended NASA family of civil servants, allied partners, and stakeholders. Together, this skilled, diverse group of scientists, engineers, managers, and support personnel share the Mission, Vision, and Values that are NASA.

NASA Headquarters

To achieve NASA's Mission and the Vision for Space Exploration, NASA Headquarters is organized into four Mission Directorates:

- The **Aeronautics Research Mission Directorate** conducts fundamental research in aeronautical disciplines and develops capabilities, tools, and technologies that will enhance significantly aircraft performance, environmental compatibility, and safety, as well as the capacity, flexibility, and safety of the future air transportation system.
- The **Science Mission Directorate** conducts the scientific exploration of Earth, the Sun, the rest of the solar system, and the universe. Large, strategic missions are complemented by smaller, Principal Investigator-led missions, including ground-, air-, and space-based observatories, deep-space automated spacecraft, and planetary orbiters, landers, and surface rovers. This Directorate also develops increasingly refined instrumentation, spacecraft, and robotic techniques in pursuit of NASA's science goals.
- The **Exploration Systems Mission Directorate** develops systems and supports research and technology development to enable sustained and affordable human and robotic space exploration. This Directorate will develop the robotic precursor missions, human transportation elements, and life support systems for the near-term goal of lunar exploration.
- The **Space Operations Mission Directorate** directs spaceflight operations, space launches, and space communications and manages the operation of integrated systems in low Earth orbit and beyond, including the International Space Station. This Directorate also is laying the foundation for future missions to the Moon and Mars by using the International Space Station as an orbital outpost where astronauts can gather vital information that will enable safer and more capable systems for human explorers.



Functional support for NASA initiatives comes from the Agency's Mission Support Offices. These offices focus on reducing risks to missions by implementing efficient management operations Agency-wide: adopting standard business and management tools to improve the effectiveness of cross-Agency operations; implementing innovative practices in human capital management that encourage increased teamwork, Agency-wide perspectives, and capability development; and reducing long-term operations costs by decreasing environmental liability costs.

Building Healthy NASA Centers

All NASA Centers support the Agency's space exploration objectives, scientific initiatives, and aeronautics research in addition to fulfilling their traditional responsibilities. Each Center is sized and staffed to meet its unique needs and to ensure that the skills and abilities of every employee are used fully. Each Center pursues ways to conserve resources and improve processes and procedures in ways that serve the Center's needs while contributing to achieving NASA's Mission. And, all Centers must undertake initiatives to demonstrate the attributes of strong, healthy, productive Centers identified by NASA's Strategic Management Council:

- Clear, stable, and enduring roles and responsibilities;
- Clear program/project management leadership roles;
- Major in-house, durable spaceflight responsibility;
- Skilled, flexible, blended workforce with sufficient depth and breadth to meet NASA's challenges;
- Technically competent and value-centered leadership;
- Capable and effectively utilized infrastructure; and
- Strong stakeholder support.

Measuring NASA's Performance

Establishing Government Performance and Results Act (GPRA) Performance Measures

In February, NASA issued the *2006* NASA Strategic Plan reflecting the Agency's focus on achieving the Vision for Space Exploration through six Strategic Goals. At the same time, NASA updated the Agency's FY 2006 Performance Plan to include multi-year and annual performance metrics that NASA is pursuing in support of the new Strategic Goals.

The resulting FY 2006 Performance Plan Update also demonstrated the latest efforts toward improving the Agency's performance measurement process. NASA reduced the number of multi-year Outcomes from 78 to 37 and, by eliminating redundancies, cut the number of Annual Performance Goals (APGs) from 210 to 165. NASA also began revising the Agency's multi-year Outcomes and APGs to make them more measurable and traceable over given periods of performance and to ensure that they provide relevant and useful performance information to NASA's decision-makers, the White House, Congress, and other stakeholders.

NASA, like all research and development agencies, faces challenges in measuring and reporting annual performance progress against long-term Strategic Goals. NASA's space exploration, science, and aeronautics focus often yields unpredictable discoveries or technological breakthroughs that can enhance or impede progress in the short-term and impact the Agency's long-term goals. In fact, NASA may appear to take a step back in performance progress one year only to make greater progress the following year. NASA will continue to work toward improved performance measurements and reports in subsequent years should show increasing improvement.

Rating NASA's Performance

NASA managers calculate annually Outcome and APG performance ratings based on a number of factors, including internal and external assessments. Internally, program managers, analysts from the Office of Program Analysis and Evaluation, and review committees monitor and analyze each program's adherence to budgets, schedules, and key milestones. External advisors, like the NASA Advisory Council, the National Research Council, and the Aerospace Safety Advisory Panel, assess program content and direction. Also, experts from the science community, coordinated by the Science Mission Directorate, review NASA's progress toward meeting performance metrics under Strategic Goal 3 (Sub-goals 3A through 3D). After weighing the input from all these reviews, NASA program managers determine a program's progress toward achieving its multi-year and annual performance metrics.

In FY 2006, as part of NASA's commitment to improving the Agency's performance measurement and evaluation system, NASA analysts created PARWeb to simplify the process of collecting performance data. PARWeb provides a centralized, Web-based location for all performance ratings, narrative descriptions of performance progress and challenges, explanations of performance shortfalls, and source data to support assigned ratings. PARWeb also lays the foundation for improving NASA's ability to track historical trends for multi-year Outcomes and APGs.

NASA rates performance as follows:

Multi-year Outcome Rating Scale

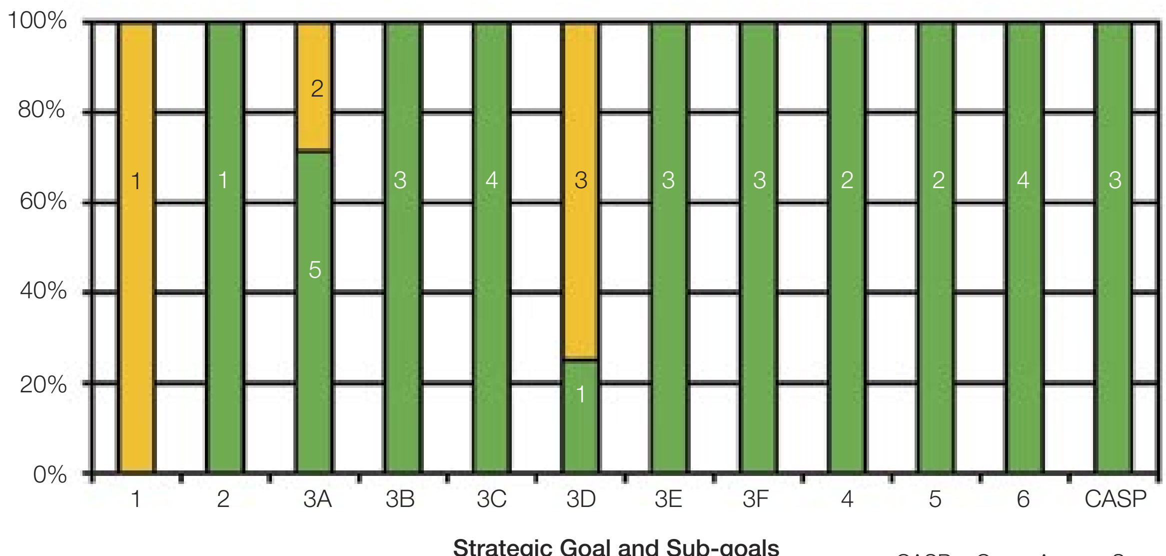
Green	NASA achieved most APGs under this Outcome and is on-track to achieve or exceed this Outcome.
Yellow	NASA made significant progress toward this Outcome, however, the Agency may not achieve this Outcome as stated.
Red	NASA failed to achieve most of the APGs under this Outcome and does not expect to achieve this Outcome as stated.
White	This Outcome was canceled by management directive or is no longer applicable based on management changes to the APGs.

APG Rating Scale

Green	NASA achieved this APG.
Yellow	NASA failed to achieve this APG, but made significant progress and anticipates achieving it during the next fiscal year.
Red	NASA failed to achieve this APG, and does not anticipate completing it within the next fiscal year.
White	This APG was canceled by management directive, and NASA is no longer pursuing activities relevant to this APG.

In FY 2006, NASA achieved 84 percent of the Agency's 37 multi-year Outcomes, as shown in the Figure 1. NASA also achieved 70 percent of the Agency's 165 APGs. NASA rated 12 percent of the Agency's APGs Yellow and 18 percent either Red or White. In previous years, NASA rated performance that exceeded expectations and measures Blue; however, NASA discontinued this rating as of FY 2006. (See Figure 2 for a summary of NASA's APG ratings for FY 2006.)

Figure 1: Summary of NASA's FY 2006 Multi-year Outcome Ratings



CASP = Cross-Agency Support Programs

Figure 2: Summary of NASA's FY 2006 APG Ratings

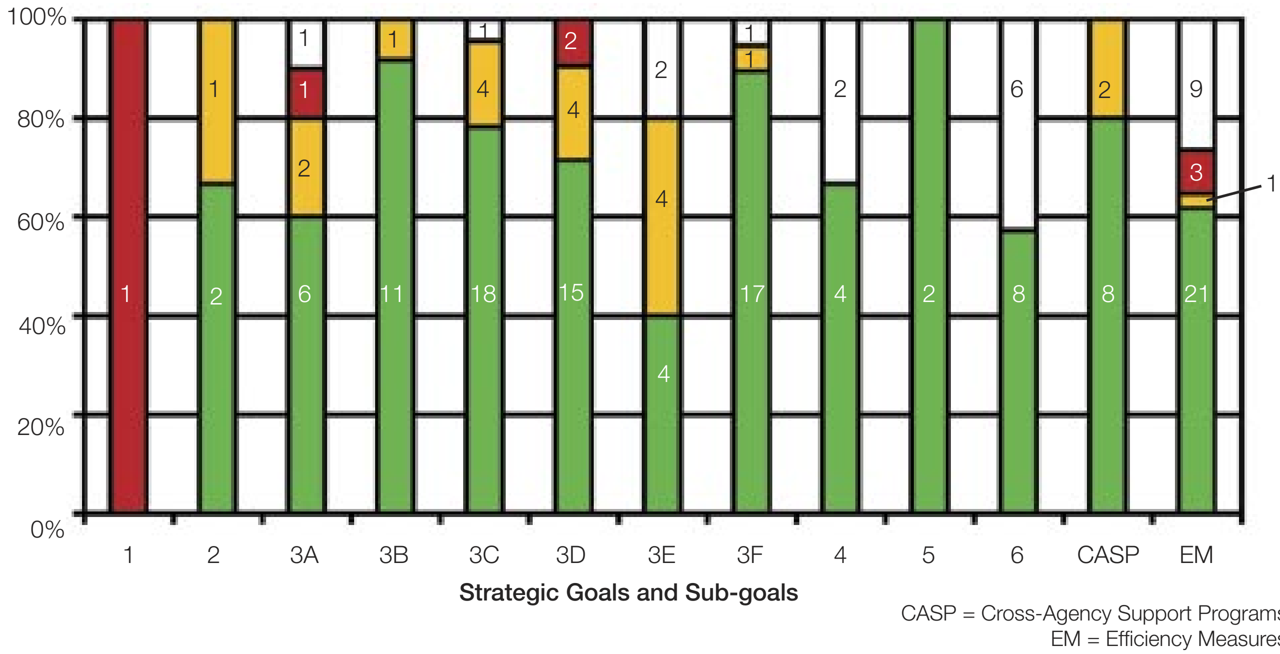
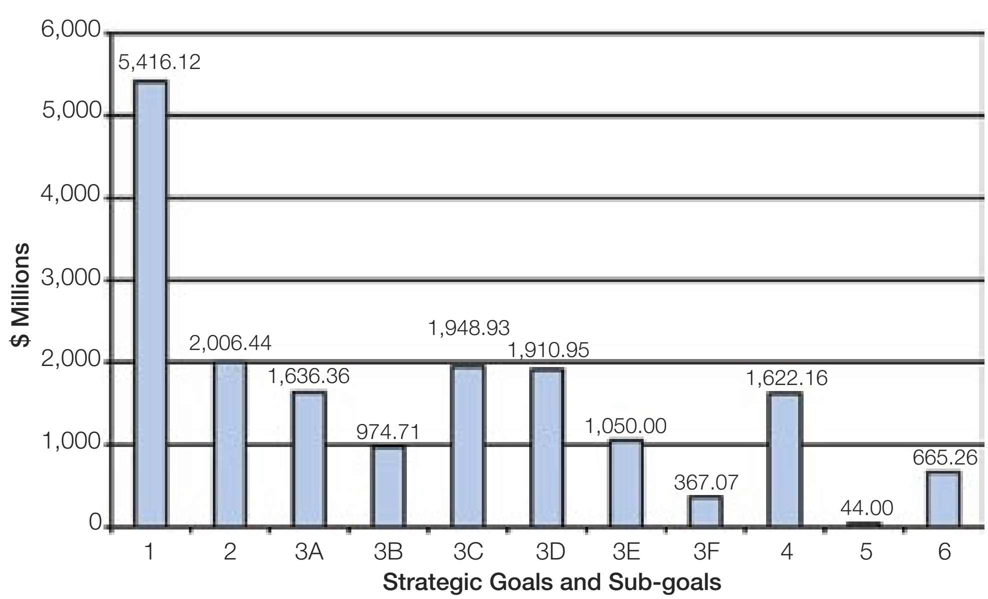


Figure 3 shows an estimate of NASA's FY 2006 cost of performance for each Strategic Goal and Sub-goal. NASA's financial structure is not based on the Strategic Goals; it is based on lines of business that reflect the costs associated with the Agency's Mission Directorate and Mission Support programs. To derive the cost of performance, NASA analysts reviewed and assigned each Agency program to a Strategic Goal (or Sub-goal, when appropriate), then estimated the expenditure based on each program's percentage of the business line reflected in that Strategic Goal (or Sub-goal, when appropriate). This method does not allow NASA to estimate cost of performance by multi-year Outcomes or APGs. However, NASA is making progress in aligning the Agency's budget and financial structure with performance, and the Agency plans to report cost of performance by multi-year Outcomes as soon as possible.

The numbers provided below, and in Part 2, are derived from the FY 2006 Statement of Net Cost included in Part 3: Financials.

Figure 3: FY 2006 Cost of Performance for NASA's Strategic Goals and Sub-goals



The "scorecard" below shows NASA's FY 2006 progress toward achieving the Agency's 37 multi-year Outcomes. Detailed information about FY 2006 performance, including ratings for APGs, rating trends, and NASA's Performance Improvement Plan, are included in Part 2: Detailed Performance Data.

	FY 2006 NASA Performance Metrics	FY 2006 Rating
Strategic Goal 1: Fly the Shuttle as safely as possible until its retirement, not later than 2010.		
1.1	Assure the safety and integrity of the Space Shuttle workforce, systems and processes, while flying the manifest.	Yellow
Strategic Goal 2: Complete the International Space Station in a manner consistent with NASA's International Partner commitments and the needs of human exploration.		
2.1	By 2010, complete assembly of the U.S. On-orbit segment; launch International Partner elements and sparing items required to be launched by the Shuttle; and provide on-orbit resources for research to support U.S. human space exploration.	Green
Strategic Goal 3: Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.		
Sub-goal 3A: Study Earth from space to advance scientific understanding and meet societal needs.		
3A.1	Progress in understanding and improving predictive capability for changes in the ozone layer, climate forcing, and air quality associated with changes in atmospheric composition.	Green
3A.2	Progress in enabling improved predictive capability for weather and extreme weather events.	Green
3A.3	Progress in quantifying global land cover change and terrestrial and marine productivity, and in improving carbon cycle and ecosystem models.	Green
3A.4	Progress in quantifying the key reservoirs and fluxes in the global water cycle and in improving models of water cycle change and fresh water availability.	Yellow
3A.5	Progress in understanding the role of oceans, atmosphere, and ice in the climate system and in improving predictive capability for its future evolution.	Yellow
3A.6	Progress in characterizing and understanding Earth surface changes and variability of Earth's gravitational and magnetic fields.	Green
3A.7	Progress in expanding and accelerating the realization of societal benefits from Earth system science.	Green
Sub-goal 3B: Understand the Sun and its effects on Earth and the solar system.		
3B.1	Progress in understanding the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium.	Green
3B.2	Progress in understanding how human society, technological systems, and the habitability of planets are affected by solar variability and planetary magnetic fields.	Green
3B.3	Progress in developing the capability to predict the extreme and dynamic conditions in space in order to maximize the safety and productivity of human and robotic explorers.	Green
Sub-goal 3C: Advance scientific knowledge of the solar system, search for evidence of life, and prepare for human exploration.		
3C.1	Progress in learning how the Sun's family of planets and minor bodies originated and evolved.	Green
3C.2	Progress in understanding the processes that determine the history and future of habitability in the solar system, including the origin and evolution of Earth's biosphere and the character and extent of prebiotic chemistry on Mars and other worlds.	Green
3C.3	Progress in identifying and investigating past or present habitable environments on Mars and other worlds, and determining if there is or ever has been life elsewhere in the solar system.	Green
3C.4	Progress in exploring the space environment to discover potential hazards to humans and to search for resources that would enable human presence.	Green
Sub-goal 3D: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.		
3D.1	Progress in understanding the origin and destiny of the universe, phenomena near black holes, and the nature of gravity.	Green

	FY 2006 NASA Performance Metrics	FY 2006 Rating
3D.2	Progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects recognized in the present universe.	Yellow
3D.3	Progress in understanding how individual stars form and how those processes ultimately affect the formation of planetary systems.	Yellow
3D.4	Progress in creating a census of extra-solar planets and measuring their properties.	Yellow
Sub-goal 3E: Advance knowledge in the fundamental disciplines of aeronautics, and develop technologies for safer aircraft and higher capacity airspace systems.		
3E.1	By 2016, identify and develop tools, methods, and technologies for improving overall aircraft safety of new and legacy vehicles operating in the Next Generation Air Transportation System (projected for the year 2025).	Green
3E.2	By 2016, develop and demonstrate future concepts, capabilities, and technologies that will enable major increases in air traffic management effectiveness, flexibility, and efficiency, while maintaining safety, to meet capacity and mobility requirements of the Next Generation Air Transportation System.	Green
3E.3	By 2016, develop multidisciplinary design, analysis, and optimization capabilities for use in trade studies of new technologies, enabling better quantification of vehicle performance in all flight regimes and within a variety of transportation system architectures.	Green
Sub-goal 3F: Understand the effects of the space environment on human performance, and test new technologies and countermeasures for long-duration human space exploration.		
3F.1	By 2008, develop and test candidate countermeasures to ensure the health of humans traveling in space.	Green
3F.2	By 2010, identify and test technologies to reduce total mission resource requirements for life support systems.	Green
3F.3	By 2010, develop reliable spacecraft technologies for advanced environmental monitoring and control and fire safety.	Green
Strategic Goal 4: Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.		
4.1	No later than 2014, and as early as 2010, transport three crewmembers to the International Space Station and return them safely to Earth, demonstrating an operational capability to support human exploration missions.	Green
4.2	No later than 2014, and as early as 2010, develop and deploy a new space suit to support exploration, that will be used in the initial operating capability of the Crew Exploration Vehicle.	Green
Strategic Goal 5: Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.		
5.1	Develop and demonstrate a means for NASA to purchase launch services from emerging launch providers.	Green
5.2	By 2010, demonstrate one or more commercial space services for ISS cargo and/or crew transport.	Green
Strategic Goal 6: Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.		
6.1	By 2008, launch a Lunar Reconnaissance Orbiter (LRO) that will provide information about potential human exploration sites.	Green
6.2	By 2012, develop and test technologies for in-situ resource utilization, power generation, and autonomous systems that reduce consumables launched from Earth and moderate mission risk.	Green
6.3	By 2010, identify and conduct long-term research necessary to develop nuclear technologies essential to support human-robotic lunar missions and that are extensible to exploration of Mars.	Green
6.4	Implement the space communications and navigation architecture responsive to Science and Exploration mission requirements.	Green
Cross-Agency Support Programs		
Education		
ED-1	Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals through a portfolio of programs.	Green

FY 2006 NASA Performance Metrics		FY 2006 Rating
Advanced Business Systems (Integrated Enterprise Management Program)		
IEM-2	Increase efficiency by implementing new business systems and reengineering Agency business processes.	Green
Innovative Partnerships Program		
IPP-1	Promote and develop innovative technology partnerships among NASA, U.S. industry, and other sectors for the benefit of Agency programs and projects.	Green

Program Assessment Rating Tool (PART)

OMB developed the PART in 2002 to assess federal agency programs and projects and to identify their strengths and weaknesses. OMB evaluates NASA's programs through PART in a three-year cycle, assessing approximately one-third of the Agency's budget areas, or Themes, each year. In FY 2006, OMB assessed three Themes:

- Solar System Exploration received an "Effective" rating (the highest rating possible) for setting ambitious goals, achieving results, and being well managed and efficient;
- Constellation Systems received an "Adequate" rating for a major program management deficiency related to Agency-wide problems with integrating NASA's new systems for financial and administrative management and due to the relative newness of the program and the limited baselines for comparison and evaluation; and
- The Integrated Enterprise Management Program received a "Moderately Effective" rating for setting ambitious goals. However, the program still needs to revise some of the accountability processes to ensure consistent program effectiveness.

NASA tracks and implements a series of follow-on actions designed to improve program performance based on current and past PART assessments. Part 2: Detailed Performance Data includes detailed PART ratings by program assessment areas. Appendix C contains NASA's follow-up actions to Themes reviewed in FY 2005. OMB's recommendations for the FY 2006 assessments were not available for inclusion in the FY 2006 Performance and Accountability Report.

President's Management Agenda (PMA)

While GPRA and PART focus on Agency and program performance, the President's Management Agenda (PMA) commits the Executive Branch of the federal government to a series of reforms to improve efficiencies and effectiveness in the management of federal programs. PMA focuses on individual agency performance in six government-wide management areas: Human Capital, Competitive Sourcing, Improving Financial Performance, E-Government, Budget and Performance Integration, and Real Property Asset Management. OMB oversees the PMA efforts, negotiates performance goals with each agency, and rates agency performance quarterly. The PMA scores from each agency are rolled up into an Executive Branch Management Scorecard that tracks government-wide status and progress in all PMA focus areas.

The table below shows NASA's PMA status and progress for FY 2006 and the three previous fiscal years.

NASA's PMA Scorecard				
	FY 2006	FY 2005	FY 2004	FY 2003
Human Capital				
Status	Green	Green	Green	Yellow
Progress	Green	Yellow	Green	Green
Competitive Sourcing				
Status	Green	Green	Yellow	Red
Progress	Green	Green	Green	Green
Improving Financial Performance				
Status	Red	Red	Red	Red
Progress	Yellow	Red	Red	Green
E-Government				
Status	Red	Yellow	Green	Red
Progress	Red	Yellow	Green	Green
Budget and Performance Integration				
Status	Green	Green	Green	Yellow
Progress	Green	Yellow	Green	Green
Real Property Asset Management				
Status	Green	Yellow	Red	n/a
Progress	Yellow	Green	Yellow	n/a

Major Program Annual Reports

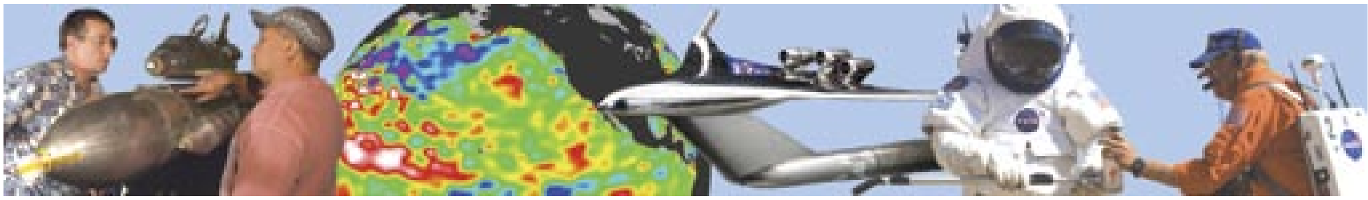
The *NASA Authorization Act of 2005* mandates that NASA submit Major Program Annual Reports with the Agency's fiscal year budget request. Each Major Program Annual Reports begins with a baseline report for every new major program or project, the program or project's purpose, key technical parameters to fulfill that purpose, key milestones, lifecycle cost commitment, estimated development costs, and risks to the program or project.

In FY 2006, as part of the FY 2007 Budget Estimates, NASA provided baseline reports for the following programs and projects:

- Integrated Enterprise Management Program: Core Financial project, including the follow-on SAP Version Update effort to improve the Agency's SAP Core Financial software;
- Science Mission Directorate: Dawn, the Gamma-ray Large Area Space Telescope (GLAST), Herschel, Hubble Space Telescope Servicing Mission 4, Kepler, Mars Phoenix, the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparation Project, Solar Dynamics Observatory (SDO), and the Solar Terrestrial Relations Observatory (STEREO); and
- Space Operations Mission Directorate: International Space Station.

NASA will monitor identified baseline cost and key milestones to assure that each program/project does not exceed the estimated cost by 15 percent and/or does not miss a key milestone by more than six months. If either of these thresholds is exceeded, NASA will update Congress with the reasons and the impacts of the cost growth or the schedule delay.

Performance Overview



Progress Toward Achieving NASA's Strategic Goals

A Guide to Performance Overviews

The following Performance Overviews describe NASA's Strategic Goals and Sub-goals. The discussions include performance achievement highlights and challenges in FY 2006.

Introduction and Reaping Benefits

The introduction provides a general overview of the Strategic Goal or Sub-goal and explains NASA's rationale for pursuing each. The benefits section discusses how each Strategic Goal or Sub-goal serves the public, the Nation, the Vision for Space Exploration, and NASA's Mission.

In the upper right corner is a box displaying the cost of performance for the Strategic Goal or Sub-goal and the responsible Mission Directorate. (Note: The cost of performance is an estimate based on NASA's FY 2006 Statement of Net Cost included in Part 3: Financials. This estimate does not include cost obligations deferred to subsequent fiscal years. A description of how NASA obtains the cost of performance is included in Measuring NASA's Performance.)

Highlighting Achievements

This section highlights the top performance successes during the fiscal year. It also identifies management issues, such as reorganizations, that enabled the Agency to achieve these successes.

Confronting Challenges

This section highlights the major challenges NASA faced during FY 2006 and plans to mitigate or overcome the challenges.

Moving Forward

This section describes activities planned for the next few years that will contribute to the successful achievement of each Strategic Goal or Sub-goal. It also addresses the obstacles that NASA may have to overcome in the near future to achieve the Vision.

Strategic Goal 1: Fly the Shuttle as safely as possible until its retirement, not later than 2010.

Cost of Performance (in millions)
$5,416.12
Responsible Mission Directorate
Space Operations

The Space Shuttle has supported NASA's Mission for over 25 years, carrying crews and cargo to low Earth orbit, performing repair, recovery, and maintenance missions on orbiting satellites, providing a platform for conducting science experiments, and supporting construction of the International Space Station (ISS). NASA will retire the Shuttle fleet by 2010. Until then, the Agency will demonstrate NASA's most critical value—safety—by promoting engineering excellence, maintaining realistic flight schedules, and fostering internal forums where mission risks and benefits can be discussed and analyzed freely.

Reaping Benefits

The Shuttle is recognized around the world as a symbol of America's space program and the Nation's commitment to space exploration. NASA's Space Shuttle Program, and the Shuttle itself, have inspired generations of schoolchildren to pursue dreams and careers in science, technology, engineering, and mathematics. The Space Shuttle Program also provides direct benefits to the Nation by advancing national security and economic interests in space and spurring technology development in critical areas such as navigation, computing, materials, and communications. Furthermore, due to its heavy-lift capacity, the Shuttle is the only vehicle capable of completing assembly of the ISS in a manner consistent with NASA's international partnership commitments and exploration research needs. The remaining Shuttle flights will be dedicated to ISS construction and a Hubble Space Telescope service mission.

A primary public benefit of retiring the Shuttle is to redirect resources toward new programs, such as the Orion Crew Exploration Vehicle and the Ares launch vehicles, needed to carry out the Vision. NASA will use the knowledge and assets developed over nearly three decades of Shuttle operations to build a new generation of vehicles designed for missions beyond low Earth orbit. When NASA retires the Shuttle, the Agency will direct Shuttle personnel, assets, and knowledge toward the development and support of new hardware and technologies necessary to achieve the Vision. For the American public, this means continuity in our access to space and sustained U.S. leadership in technology development and civilian space exploration.

Highlighting Achievements

The most significant activities in FY 2006 for Strategic Goal 1 were the successful flights of STS-121 and STS-115:

- NASA celebrated Independence Day 2006 by launching Shuttle *Discovery* (STS-121), the first launch NASA ever conducted on the July 4 holiday. The second of two test flights (which include STS-114 in July 2005), STS-121 validated the improvements NASA made to the Shuttle system since the loss of *Columbia* in 2003. During the mission, *Discovery* crewmembers conducted a series of hardware and procedural tests and delivered several tons of supplies to the ISS. The mission also delivered Flight Engineer Thomas Reiter to the ISS, returning the ISS crew size to three members.

United Space Alliance technician Erin Schlichenmaier uses a flashlight to inspect tile repair on *Discovery*'s underside in November 2005. In preparation for STS-121, technicians replaced older Shuttle tiles around the main landing gear doors, external tank doors, and nose landing gear doors with a new type of tile called BRI-18. The new tiles are more impact resistant than previous designs. Technicians also developed a new procedure to ensure that gap fillers, which fill the tiny gaps between tiles, do not protrude and pose a hazard during the Shuttle's re-entry into Earth's atmosphere. During the STS-114 mission in 2005, a crewmember conducted a spacewalk to remove a protruding piece of gap filler spotted on *Discovery*'s underside. (NASA)

- *Atlantis* (STS-115) launched on September 9, marked a return to sustained Shuttle operations, placing NASA on track to complete assembly of the ISS by Shuttle retirement in 2010. *Atlantis* delivered to the ISS the P3/P4 truss, which will provide a quarter of the power, data, and communications services needed to operate the completed ISS. During the mission, *Atlantis* crewmembers conducted spacewalks—the most complex ever conducted—to attach the truss and the Solar Alpha Rotary Joint, a wagon wheel-shaped joint that allows the solar arrays attached to the truss to turn toward the Sun.

Confronting Challenges

The Space Shuttle Program faces two main challenges. First, NASA must maintain the skilled workforce and critical assets needed to safely complete the Shuttle manifest. Second, NASA must manage the process of identifying, transitioning, and dispositioning the resources that support the Shuttle in anticipation of the Shuttle's retirement.

The Shuttle transition and phase-out effort will be complex and challenging, especially since it will happen at the same time as the Shuttle is set to carry out the most complicated sequence of flights ever attempted. Over the next four years, the Shuttle will carry tons of hardware to the ISS, where astronauts and cosmonauts will conduct nearly 80 spacewalks to assemble, check out, and maintain the orbiting facility. NASA also plans to conduct a fifth servicing mission to the Hubble Space Telescope to repair critical subsystems and improve Hubble's astronomical instruments.

The Space Shuttle Program occupies 640 facilities and uses over 900,000 pieces of equipment. The total equipment value is over $12 billion, located in hundreds of government and contractor facilities across the United States. The total facilities value is approximately $5.7 billion, which accounts for approximately one-fourth of the value of the Agency's total facility inventory. NASA currently has more than 1,500 active suppliers and 3,000 to 4,000 qualified suppliers located throughout the country. Retiring these assets and facilities or transitioning them to new human exploration efforts is a formidable challenge. NASA must leverage strategically the existing human spaceflight workforce, hardware, and infrastructure to ensure safe Shuttle missions while simultaneously preparing to meet future needs. NASA uses a number of working groups and control boards to monitor and control the transition process, including the Transition Control Board, the Joint Integration Control Board, and the Headquarters Transition Working Group. The Space Shuttle Program manager executes risk management responsibilities through the commit-to-flight process, the Shuttle Engineering Review Board, and Regular Program Requirements Control Board. These boards and processes are designed to manage and reduce the risks associated with both flying the Shuttle and transitioning from Shuttle to other exploration vehicles.

In March 2006, NASA engineers tested a three-percent-size model of the Space Shuttle at Ames Research Center's Unitary Wind Tunnel Complex to help decide whether they should remove the Shuttle's protuberance air load (PAL) ramps from the external tank for the STS-121 launch. During the launch of STS-114 in July 2005, a large piece of insulation foam fell from the PAL ramp area. The results of the wind tunnel tests indicated that the Shuttle team could remove the PAL ramps, leaving in place the smaller ice–frost ramps, and proceed with the launch as planned. (NASA)

Moving Forward

NASA plans to assemble the ISS using the minimum number of Shuttle flights necessary to complete assembly and ensure a safe transition to new capabilities. The Agency also will conduct a fifth servicing mission to the Hubble Space Telescope. At the same time, NASA will phase out the Shuttle and ensure a smooth transition of the workforce and critical assets to new requirements.

Strategic Goal 2: Complete the International Space Station in a manner consistent with NASA's International Partner commitments and the needs of human exploration.

Cost of Performance (in millions)
$2,006.44
Responsible Mission Directorate
Space Operations

Built and operated using state of the art science and technology, the International Space Station (ISS) is a vital part of NASA's program of exploration. The ISS provides an environment for developing, testing, and validating the next generation of technologies and processes needed to support the Nation's exploration program and achievement of the Vision for Space Exploration.

Reaping Benefits

The ISS is a testbed for exploration technologies and processes. Its equipment and location provide a one-of-a-kind platform for Earth observations, microgravity research, and investigations of the long-term effects of the space environment on human beings. The ISS also enables research in fundamental physics and biology, materials sciences, and medicine. Crewmembers test processes for repairing equipment in microgravity, conducting spacewalks, and keeping systems operational over long periods of time—capabilities critical to future missions.

When completed, the ISS will be the largest crewed spacecraft ever built. Many nations provide the resources and technologies that keep the ISS flying, and these international partnerships have increased cooperation and goodwill among participating nations.

Highlighting Achievements

On November 2, 2005, Expedition 12 Commander William McArthur and Flight Engineer Valery Tokarev, both of whom had been aboard the ISS since October 10, 2005, celebrated five years of continuous human presence in low Earth orbit aboard the ISS. Throughout their stay, the Expedition 12 crew focused primarily on ISS operations and maintenance tasks. They also conducted individual experiments, adding to the more than 4,000 hours of research time conducted by past expeditions. Projects in FY 2006 included the following:

- As part of Education Payload Operations, the crew videotaped themselves conducting activities in the near-weightless environment of the ISS to demonstrate science, technology, engineering, mathematics, and geography principles to grade-school students.
- In February 2006, McArthur and Tokarev released into orbit an old Russian Orlan spacesuit outfitted with a special radio transmitter and other gear as part of a Russian experiment called SuitSat. The spacesuit flew free from the ISS like a satellite in orbit for several weeks of scientific research and communications tracking by amateur radio operators.
- McArthur conducted experiments for the Protein Crystal Growth Monitoring by Digital Holographic Microscope, or PromISS, using the Microgravity Science Glovebox. This

Astronaut Jeffrey Williams, Expedition 13 NASA science officer, checks the Beacon/Beacon Tester for the Synchronized Position Hold, Engage, Reorient, Experimental Satellites (SPHERES) on August 19, 2006. SPHERES, which uses robotic mini-satellites, tests the basics of formation flight and autonomous docking that should be useful in future multiple spacecraft formation flying. The first satellite arrived at the ISS by Progress spacecraft in April 2006, and STS-121 delivered the second, blue satellite. A third, yellow satellite will launch on STS-116. Although the SPHERES satellites have been tested on Earth, 2006 marks the first tests in space. (NASA) experiment used a holographic microscope to study how the near-weightless environment aboard the ISS affects protein crystal growth to help scientists better understand the role of proteins in diseases.

- The STS-121 mission in July 2006 delivered the oxygen generation system rack, which is part of the regenerative environmental control and life support system. This rack eventually will allow the ISS to accommodate six crewmembers and will help NASA develop and validate life support technology for use during long-duration human space missions. Shuttle astronauts Michael Fossum and Piers Sellers repaired the ISS's mobile transporter rail car, which allows the remote manipulator arm, or Canadarm-2, to move along the ISS's truss elements, extending the arm's reach so that it can aid future ISS construction. During another extravehicular activity, the two astronauts attached a spare pump module that helps transport liquid ammonia through the ISS's cooling system. STS-121 also delivered Flight Engineer Thomas Reiter, returning the ISS crew complement to three members.

On September 12, 2006, STS-115 astronauts Joseph Tanner (left) and Heidemarie Stefanyshyn-Piper conduct the first of three spacewalks to attach the P3/P4 truss to the International Space Station. (NASA)

- In September, STS-115 crewmembers attached the newly delivered P3/P4 truss, doubling the ISS's power and capability. The P3/P4 truss includes the new Solar Alpha Rotary Joint. This joint, combined with the gimbal assemblies on the solar arrays, allows the massive solar arrays to remain pointed toward the Sun as the ISS orbits. These and other additions to be delivered on future missions prepare the ISS to receive new modules, including International Partner modules, and to accommodate larger crews.

Confronting Challenges

The important role that the Space Shuttle plays in the construction and maintenance of the ISS means that the successful completion of ISS assembly is dependent on the Space Shuttle Program. Each Shuttle mission is critical to the completion of ISS. NASA developed Shuttle schedules and manifests to assure that each Shuttle flight is maximized. The Space Operations Mission Directorate also is seeking alternate transportation options for crew and cargo to relieve the burden placed on the Shuttle.

NASA enjoys the benefits of partnerships with the other nations contributing to the ISS. These partnerships enhance the Agency's ability to achieve NASA's Strategic Goals while also benefiting partner nations. However, international space agency partnerships do not exist in a vacuum, and there are multiple risks involved in these partnerships. NASA's ability to maintain international partnerships even as world conditions and international relationships change is important to the success of the ISS.

Moving Forward

The resumption of Shuttle flights will allow NASA to complete construction of the ISS, increase the crewmember size, and demonstrate the advanced capabilities of the regenerative environmental control and life support system. The return to planned ISS activities also helps NASA achieve on schedule important research milestones for human health and life support. The *NASA Authorization Act of 2005* designated the ISS as a National Laboratory. NASA currently is developing the plan required by Congress that will describe the implementation of National Laboratory status for the ISS.

Goal 3: Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.

Strategic Goal 3 encompasses all basic research programs that enable, and are enabled by, NASA's exploration activities. To ensure a balanced focus that addresses and achieves all objectives of the Vision for Space Exploration and NASA's Mission, the Agency established six Sub-goals supporting Goal 3:

- Sub-goal 3A: Study Earth from space to advance scientific understanding and meet societal needs.
- Sub-goal 3B: Understand the Sun and its effects on Earth and the solar system.
- Sub-goal 3C: Advance scientific knowledge of the solar system, search for evidence of life, and prepare for human exploration.
- Sub-goal 3D: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.
- Sub-goal 3E: Advance knowledge in the fundamental disciplines of aeronautics, and develop technologies for safer aircraft and higher capacity airspace systems.
- Sub-goal 3F: Understand the effects of the space environment on human performance, and test new technologies and countermeasures for long-duration human space exploration.

All four Mission Directorates contribute to these Sub-goals.

Highlighting Achievements

NASA made excellent progress toward achieving Strategic Goal 3 during FY 2006. The Science Mission Directorate, which manages work under Sub-goals 3A through 3D, celebrated many achievements, including the successful completion of several missions: Stardust, which returned samples from comet Wild 2; Gravity Probe–B (GPB), which tested Einstein's theory of general relativity; and the Topography Experiment for Ocean Circulation (TOPEX)/Poseidon mission, which revolutionized the way scientists study Earth's oceans. In July, NASA returned the International Space Station crew size to three members and the Shuttle returned to regular operations in September, increasing flight research opportunities in human health and performance and fundamental physics and biology. The Aeronautics Research Mission Directorate conducted a major reorganization that aligned its programs with NASA's new priorities. Exploration Systems, Science, and Space Operations also streamlined their organizations to strengthen and enhance programmatic coordination, direction, and accountability.

Confronting Challenges

Achieving Sub-goals 3A through 3F will demand that NASA confront unique challenges specific to each Sub-goal. However, NASA also faces some over-arching challenges that impinge on more than one Sub-goal. For example, the Science Mission Directorate must predict technology development and mission implementation life-cycle costs that are key to estimating budget needs across the life of a project. This challenge is apparent in large, flagship missions, as well as in medium and small missions. The Science Mission Directorate also is challenged by the need to maximize the science return for each mission while maintaining an acceptable level of implementation risk and meeting cost and schedule objectives.

The challenge of maximizing science while maintaining cost and schedule objectives is exacerbated by the need to develop one-of-a-kind spacecraft that require cutting-edge technologies and engineering processes. Because NASA and Agency partners are doing something for the first time, costs are rarely fully predictable. A key obstacle in achieving program success is being able to mature the required technologies early enough in the life of the mission to keep the life-cycle costs reasonable and predictable. If NASA and Agency partners take too long to tackle the technology challenges, schedule delays will occur later in the mission when delays are even more costly.

The Agency constantly strives to do a better job of predicting accurately total lifecycle costs. In order to do this, NASA aims to have enough reserves, while conserving resources, at mission confirmation. In addition, the

Science Mission Directorate is conducting studies to analyze best practices from selected past missions in the small, medium, and large mission cost categories.

Another challenge confronting NASA's Science missions is the future availability and cost of launch services. As retirement looms for medium-class expendable launch vehicles like the Delta II, expendable launch vehicles are evolving toward larger, more expensive launchers like the Delta 4 and Atlas 5. These larger launchers provide advantages in lift capabilities for larger payloads, but are more expensive per pound of payload for small- and medium-sized payloads, since NASA would be paying for unneeded lift capabilities.

In addition, technical issues associated with available expendable launch vehicles have led to launch delays and additional costs for several missions. To address the challenge, NASA has undertaken a study to consider options the Agency might pursue to strengthen the launch vehicle portfolio, including using alternate launch providers.

The following discussions of each Sub-goal include background, highlights, and challenges specific to that Sub-goal.

Sub-goal 3A: Study Earth from space to advance scientific understanding and meet societal needs.

Cost of Performance (in millions)
$1,636.36
Responsible Mission Directorate
Science

Earth is a dynamic system. Its land, oceans, atmosphere, climate, and gravitational fields are changing constantly. Some of these changes, especially short-duration and localized phenomena like hurricanes and earthquakes, are big and can pose hazards to humans around the world. Other changes, like climate variability, take longer to have an effect and are revealed through long-term, intensive research. NASA's Earth Science Division helps researchers better understand the causes and consequences of these changes through data gathered by Earth-observing satellites, aircraft, and balloons. Using advanced computer systems, program scientists analyze and model the data into useful Earth science information and distribute it to end users around the world.

NASA's Earth Science Division partners with other government agencies, academia, non-profit organizations, industry, and international organizations to share data and analyses that will help researchers better understand and predict the effects of Earth system events, changes, and interactions. Improved understanding and predictive ability enables end users, especially policy makers, to ameliorate harmful impacts of events and changes to the Earth system.

Reaping Benefits

NASA's Earth Science Division is central to three Presidential initiatives that serve the public:

- The Climate Change Research Initiative, established in 2001 to study global climate change and to provide a forum for public debate and decision-making about how the United States monitors and responds to climate change;
- The Global Earth Observation System of Systems, a multinational effort to coordinate existing and new Earth observation hardware and software to supply free data and information for the benefit of humanity and the environment; and
- The U.S. Ocean Action Plan, released in 2004 as part of an Administration effort to ensure that benefits derived from oceans and other bodies of water will be available to future generations.

To support these initiatives, NASA and the Agency's partners conduct vital research that helps the Nation manage environmental and agricultural resources and prepare for natural disasters. In the course of conducting this research, NASA applies the resulting data and knowledge with the Agency's operational partners to improve their decision making in societal need areas such as public health, aviation, water management, air quality, and energy.

The Earth Science Program also helps NASA achieve the Agency's other Strategic Goals and Mission:

- Earth observing satellites provide meteorological information used by the National Oceanic and Atmospheric Administration (NOAA) and the Department of Defense in providing weather forecasts that help NASA plan launches and landings. At the end of August 2006, satellites indicated that Tropical Storm Ernesto would make landfall in Florida, giving NASA time to review the launch of Space Shuttle *Atlantis* and postpone it until early September.
- The Earth Science Division develops instruments for Earth observation that, with modification, can help NASA explore other planets. For example, instruments that study chemicals in Earth's atmosphere can be adapted to study the atmospheres of planets throughout the solar system.

Highlighting Achievements

Using data from the first-ever gravity survey by the twin Gravity Recovery and Climate Experiment (GRACE) satellites, scientists concluded this year that the mass of the Antarctic ice sheet has decreased significantly since 2002, providing further evidence that observed warming in polar regions is affecting ice mass. The loss, mostly from the West Antarctic ice sheet, was enough to raise sea levels around the world by about 0.05 inches. This loss primarily is a result of increased flow of some major outlet glaciers, which drain the ice sheet, in response to the melting of floating ice shelves where these outlet glaciers meet the sea. Historically, these ice shelves have buttressed the ice and slowed its discharge.

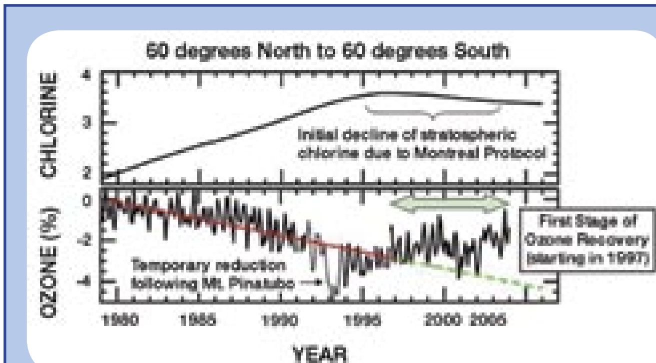
In the past, scientists had difficulty measuring Antarctica's ice sheet because of its size and complexity. They combined various measuring techniques, but the results suffered from a lack of data in critical regions. GRACE overcomes these difficulties by tracking minute changes in Earth's gravity field resulting from regional changes in the distribution of mass. In addition, NASA's Ice, Cloud, Elevation, and Land Satellite (ICESat) provides detailed information on the spatial structure and magnitude of ice sheet growth and shrinkage, providing important insight into the nature of ice changes. Together, the two missions constitute a powerful capability for understanding how ice sheets contribute to rising sea levels.

This photo shows the calving front, or break-off point into the ocean, of the Helheim Glacier, located in southeast Greenland. This glacier, which shows high calving activity associated with faster glacier flow, is now one of the fastest moving glaciers in the world. (NASA)

At the other end of the globe, ICESat, GRACE, and other missions show that ice loss has increased in the last few years, as compared to estimates made in the 1990s obtained from satellite radar altimetry and airborne laser surveys of ice-elevation changes. Satellite observations of Greenland indicate that melt rates have increased about 30 percent since 1979. At the same time, data from the Terra satellite and Landsat show a remarkable increase in flow rates of some of Greenland's major outlet glaciers, increasing the rate that ice is draining from the ice sheet and dumping into the ocean in the form of calving icebergs. Like in Antarctica, this acceleration is largely a result of the melting and break-up of floating ice "tongues" at the front of these glaciers. However, unlike Antarctica, which experiences relatively little surface melt, some acceleration in Greenland results from summer surface melt water penetrating the ice sheet and lubricating the ice/bedrock interface at the bottom of the ice sheet. Over time, the ice sheet's melt will contribute significantly to global sea levels. Aircraft and radar altimetry data also reveal that the ice sheet is growing at its higher, colder interior, most likely a result of increased snowfall, much like the East Antarctic ice sheet.

In August 2006, a study using NASA and NOAA data indicates that the decline in Earth's protective ozone layer outside the polar regions has not continued. The study team analyzed 25 years of ozone observations made at different altitudes in the stratosphere (the second layer of atmosphere, which contains about 90 percent of atmospheric ozone) by balloons, ground-based instruments, and five NASA/NOAA satellites. The results showed that ozone column amounts outside of the polar regions stopped thinning around 1997 and are remaining approximately stable, although significant recovery has not yet taken place. The data also showed that the abundance of human-produced, ozone-destroying gases, such as chlorofluorocarbons, peaked between 1993 and 1997 and is now declining.

The study team compared observation data taken from different altitudes with computer predictions, which combined measured variations in human-produced, ozone-destroying chemicals with other factors, such as sunspot activity, that can affect ozone levels. The results indicate that the 1987 international Montreal Protocol, which phased out over the course of more than a decade the production and use of ozone-depleting compounds, is succeeding in stopping further loss of ozone in the stratosphere.



In this set of graphs, NASA/NOAA satellite data shows the rise in stratospheric chlorine (top) and a corresponding decline in ozone layer thickness from 1979 to 1997. As stratospheric chlorine declined in response to enactment of the Montreal Protocol, the rate of ozone destruction decreased to the point at which there was little or no change with time. (NASA)

However, the decline in levels of these ozone-depleting compounds in the stratosphere will be gradual, and full recovery of the ozone layer will take significant time. A related study carried out by NASA suggests that full recovery of ozone over the Antarctic will not take place until approximately 2065.

Confronting Challenges

NASA delayed the CloudSat/CALIPSO joint launch several times due to technical problems with the Delta II launch vehicle and due to a strike by personnel needed to support the launch. Such delays place added stress on tight mission budgets and schedules. The Earth Science Division is working with the Space Operations Mission Directorate to manage launch provider options.

Moving Forward

In the next couple of years, NASA will launch a number of advanced Earth observation satellites:

- Measurements taken by the Orbiting Carbon Observatory (OCO), scheduled for launch in 2008, will help researchers better understand the human and natural processes controlling atmospheric carbon dioxide, a key greenhouse gas, and the roles that ocean and land ecosystems play in absorbing carbon dioxide;
- The Glory mission, also scheduled for launch in 2008, will continue measurements of solar irradiance and provide new space-based measurements of aerosol properties that will help scientists better understand the spatial and temporal variability of aerosol properties and the extent to which aerosols produced by natural events or human activities affect climate variability and change;
- The National Polar Orbiting Operational Earth Satellite System (NPOESS) Preparatory Project, or NPP satellite, will continue some of the measurements begun by the Earth Observing System and will demonstrate new instruments for the Nation's future joint civilian and military weather satellite system. NPP is scheduled for launch in 2009; and
- The Aquarius mission, scheduled for launch in 2009, will be the first satellite dedicated to obtaining global measurements of sea surface salinity, a key factor linking global ocean circulation and climate change.

NASA also is working with partners to reduce the time span between observations and production of useful data products. NASA is working with NOAA and inter-agency forums to transition mature research capabilities to operational systems and to utilize fully those assets for research purposes. In particular, they have created the Joint Center for Satellite Data Assimilation and the Short-Term Regional Prediction Center to accelerate the use of research data in operational forecasting in global and local weather forecasting, respectively.

On April 28, 2006, two Earth-observation satellites—CloudSat, a joint effort of NASA, the Canadian Space Agency, and the United States Air Force, and the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) satellite, a joint project of NASA and France's Centre National d'Etudes Spatiale—launched from Vandenberg Air Force Base in California. The satellites joined the Afternoon, or "A-train," constellation, which measures gases, aerosols, clouds, temperature, relative humidity, and radiative fluxes (the amount of radiation passing through the atmosphere). By mid-summer, both satellites were producing valuable data. (Boeing/T. Baur)

Findings from a decadal survey conducted by the National Research Council's Ad-hoc Committee on Earth Science and Applications from Space will influence strongly the process by which NASA implements future space-based missions for Earth science. The committee's final report is scheduled for release at the end of 2006.

Sub-goal 3B: Understand the Sun and its effects on Earth and the solar system.

Cost of Performance (in millions)
$974.71
Responsible Mission Directorate
Science

Life on Earth is closely linked to the Sun. Changes in the Sun's average energy output have been shown to cause dramatic climate changes over the centuries as solar activity went through a series of high and low cycles. During increased solar activity (i.e., an increase in sunspots), the Sun emits powerful flares that can disrupt telecommunications and navigation, threaten the health of astronauts in space, damage satellites, and disable electric power grids.

Scientists are just beginning to understand the physics of the Sun and its connection to Earth and the solar system. Increasing this understanding will enable scientists to predict the impact of solar variability on humans and space hardware. To achieve this goal, NASA is enhancing scientific understanding of the characteristics of solar wind, Earth's magnetosphere, and the space environment throughout the solar system, the heliosphere (the bubble in space around the Sun created by the solar wind), and planetary environments as a single, connected system. NASA also has begun to characterize the internal dynamics of the Sun and how Earth's magnetosphere responds to solar activity. Now NASA's challenge is to use this new knowledge to enable prediction of solar events and the space weather they produce.

Reaping Benefits

Society is becoming increasingly dependent on technologies that are vulnerable to solar activity and space weather events, like wireless communications and satellite-based navigation, so the need to predict solar events and mitigate their effect is critical to the public's safety, security, convenience, and comfort. This prediction capability is critical to both human and robotic space exploration, as well, since space weather events can disrupt communications and spacecraft navigation and expose astronauts to unsafe levels of radiation. A better understanding of solar events and heliophysics will provide researchers the information needed to develop systems that will protect astronauts, satellites, and technologies in space and on Earth from harmful space radiation.

In addition to helping with space weather prediction and mitigation, NASA's heliophysics research provides insights into how the solar system evolved, how it produced and sustains life, and what will happen to this unique environment over time.

Highlighting Achievements

The backbone of NASA's heliophysics research is the multi-satellite Heliospheric Great Observatory, which includes all of NASA's currently operational heliophysics spacecraft. In FY 2006, the Heliospheric Great Observatory, including U.S. instruments on the European Space Agency's four Cluster spacecraft, observed an immense jet of electrically charged solar wind particles between the Sun and Earth. The jet was powered by clashing magnetic fields in a process called "magnetic reconnection." Similar reconnection-powered jets occur in Earth's magnetosphere, producing an effect that can disable orbiting spacecraft and disrupt power grids. However, the recently

NASA's Advanced Composition Explorer (ACE) and Wind spacecrafts, along with the European Space Agency's Cluster spacecrafts, encountered solar particle jets spanning 1.5 million miles. The jets (indicated by red arrows) are sandwiched between sheets of opposite magnetic fields (blue arrows). Earth's magnetic environment is visible to the right. The blue bubble in this magnetic environment represents a cross-section of the bow shock formed as solar wind hits Earth's magnetic field. The red area is a cross section of the magnetic field surrounding Earth (the small blue sphere). (NASA/M. Davis, Univ. of California at Berkeley)

discovered interplanetary jets are far larger than those that occur within Earth's magnetosphere. This observation is the first direct measurement indicating that magnetic reconnection can happen on immense scales.

Understanding magnetic reconnection is fundamental to understanding explosive phenomena like solar flares and gamma ray bursts throughout the universe and even nuclear fusion experiments conducted in laboratories. These observations also are proving important for planning the future four-spacecraft Magnetospheric Multiscale mission, which will study the fundamental physical process of magnetic reconnection.

The Great Observatory also discovered that rising tides of hot air from intense thunderstorm activity over South America, Africa, and Southeast Asia are connected to changes in the structure of Earth's ionosphere, according to NASA-funded researchers in a paper published in the August 11, 2006, issue of *Geophysical Research Letters*. The ionosphere is a layer of electrically charged plasma formed by solar X-rays and ultraviolet light. Storm-induced changes to the ionosphere influence the structure of the atmosphere and can disrupt radio signals from communication and navigation satellites.

Using data from NASA's Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) spacecraft, the research team found four mysterious bright regions of plasma that were 20 to 30 percent more dense than the average bands of plasma encircling Earth above the equator. Three of the bright regions were located over tropical rainforests with plenty of storm activity. Computer simulations confirmed that the storms in these tropical areas produce rising tides of hot air, but the simulations could not explain the connection between the storms and the bright areas in the two bands. Thunderstorms develop in Earth's dense lower atmosphere just 10 miles over the equator. However, the plasma bands develop 500 miles above Earth in the ionosphere where the gas is about 100 million times less dense. The tide of hot air needs to collide with atoms in the ionosphere to create the bright areas, but because the gas in the ionosphere is so thin, atoms rarely collide.

In FY 2006, additional research showed that the tides could affect the plasma bands indirectly. Below the plasma bands, a layer of the ionosphere called the E-layer becomes partially electrified during the day. This E-layer shapes the plasma bands above by creating an electric field when the charged particles in the E-layer are blown across Earth's magnetic field. The research model showed that the rising tides of hot air from tropical storms around the world dump their energy in the E-layer, disrupting the plasma there. This in turn disrupts the electric fields and creates dense, bright zones in the bands above.

This is the first time that scientists have identified a regional influence on multiple layers of the atmosphere and related space weather. They now know that accurate predictions of ionospheric space weather disturbances must incorporate the effect of tropical weather.

In May 2006, NASA added five new Virtual Observatories to its Heliophysics Data Environment, a project to create a standardized, electronic tool to collect, store, manage, and distribute Sun–Earth physics mission data. The Virtual Observatories concept is part of an international effort to make accessible to the world's science community the vast, dynamic body of available astronomy and astrophysics data.

Confronting Challenges

All spacecraft that currently constitute NASA's Heliospheric Great Observatory are operating in extended service, past their planned ends-of-missions. However, the Heliophysics Division made good progress in FY 2006 toward refreshing the Observatory. NASA's partner for the Time History of Events and Macroscale Interactions (THEMIS) mission delivered, integrated, and tested the instruments for THEMIS's five spacecraft, and the mission is on schedule to launch late in 2006. NASA also tested and prepared the Aeronomy of Ice in Mesosphere (AIM) and Solar Terrestrial Relations Observatory (STEREO) missions for launch in FY 2007. Both missions were delayed in FY 2006 due to technical problems with their launch vehicles. NASA is working with the launch providers to prevent further delays. In addition, the Japanese Aerospace Exploration Agency (JAXA) launched the joint JAXA–NASA Solar–B mission, now renamed Hinode (the Japanese word for "sunrise"), on September 22, 2006. Through high-resolution observations, Solar–B will help researchers study the mechanisms that power the solar atmosphere and drive solar eruptions.

Moving Forward

In the years ahead, NASA will reconfigure portions of the Heliospheric Great Observatory into "smart" constellations, sets of strategically located satellites that will distribute data through Virtual Observatories.

STEREO is the next mission scheduled to launch in the Solar Terrestrial Probes Program, which manages missions that study the basic physics of how the Sun, its heliosphere, and planetary environments are connected in one system. STEREO will use two identical spacecraft to provide stereoscopic measurements of the Sun and coronal mass ejections, powerful solar eruptions that are a major source of magnetic disruptions on Earth and a key component of space weather.

Scheduled to launch in early 2007, THEMIS will study the onset of magnetic substorms within the tail of Earth's magnetosphere. THEMIS is composed of five microsatellite probes that will travel through different regions of the magnetosphere to provide information about substorm instability, a fundamental process of transporting charged particles from the magnetosphere into Earth's upper atmosphere.

AIM, a mission scheduled for launch in early 2007, will look at Earth's highest-altitude clouds. By characterizing the regions in which these clouds form, AIM will test the hypothesis that increased sightings of these clouds are related to changes in the concentrations of trace gases in the atmosphere and associated temperatures.

NASA will launch the second of the Two Wide-angle Imaging Neutral Atom Spectrometers, or TWINS–B, in 2007. NASA launched TWINS–A in early FY 2006. Together, the two TWINS spacecraft will provide stereo imaging of Earth's magnetosphere enabling three-dimensional global visualization of the connections between different regions of the magnetosphere and solar wind.

Launched almost 30 years ago to study Jupiter and Saturn, the Voyager spacecraft are journeying slowly out of the solar system. Scientists expect that in FY 2007, Voyager 2 will cross the termination shock, a boundary where solar winds slow to subsonic speeds at the edge of the Sun's influence. Early observations of this boundary by Voyager 2 indicate a large distortion in the shape of the heliosphere. Voyager 2 will supplement the data collected from Voyager 1 when it crossed the termination shock boundary in 2005, providing scientists with new information about local processes and the global structure and dynamics of the heliosphere.

In July 2006, technicians at Astrotech Space Operations, a commercial provider of satellite launch processing services in Florida, performed black-light inspection and cleaning of Observatory B, part of the twin-spacecraft STEREO mission. Later, the technicians wrapped the observatory for transfer to the hazardous processing facility, where it was weighed and fueled. At the Kennedy Space Center, crews stacked the Delta II rocket designated to launch STEREO in FY 2007. (NASA/G. Shelton)

Sub-goal 3C: Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space.

Cost of Performance (in millions)
$1,948.93
Responsible Mission Directorate
Science

NASA uses robotic science missions to investigate alien and extreme environments throughout the solar system. These missions help scientists understand how the planets of the solar system formed, what triggered the evolutionary paths that formed rocky terrestrial planets, gas giants, and small, icy bodies, and how Earth originated, evolved, and spawned life. The data from these missions guide scientists in the search for life and its precursors beyond Earth and provide information to help NASA plan future human missions into the solar system.

Reaping Benefits

NASA's robotic exploration missions have taken humans to the edge of the solar system, revealing the beauty and complexity of its planets, moons, comets, and asteroids. These missions extend knowledge and understanding about Earth's neighborhood, the evolution of planetary systems, and the solar system's future. They also offer clues to the processes and events that created habitable zones in the solar system and beyond.

Robotic exploration lays the groundwork for future human missions to the Moon, Mars, and other bodies in the solar system by characterizing the environment of these distant worlds, validating new capabilities, and identifying potential landing sites. Robotic missions help NASA scientists explore the space environment to identify potential hazards, so that future human exploration missions can avoid the hazards or find ways to ameliorate the effects. In addition to hazards, robotic missions search for resources that could support long-duration human exploration. For example, the Mars Exploration Rovers and the current suite of Mars-orbiting missions are providing detailed information about the topography and mineral composition of the Martian surface and searching for signs of liquid water to identify landing sites that could provide human explorers with resources that would allow them to "live off the land."

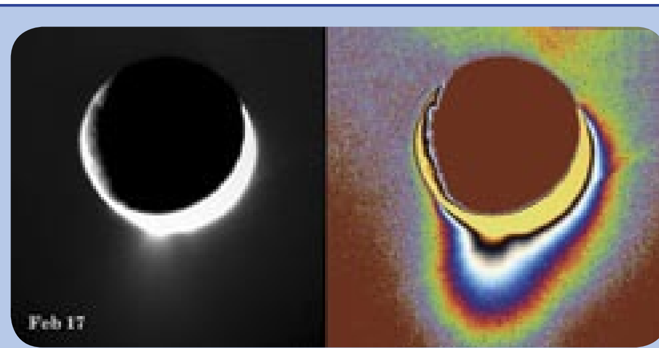
Highlighting Achievements

Launched in 2005, the Mars Reconnaissance Orbiter (MRO) entered Mars orbit in March 2006 and began its six-month campaign of aerobraking, a process by which the spacecraft repeatedly dips into Mars' atmosphere until it achieves the desired orbit. Using aerobraking instead of thruster firings reduces the amount of fuel required for the mission, making the vehicle lighter for launch. MRO achieved the desired orbit in early September 2006 and it will begin its two-year science phase in November 2006.

Team members for MRO's High Resolution Imaging Science Experiment gather at the University of Arizona campus in Tucson to view the first Mars images (visible on the computer screen and projection screen in this photo) taken on March 24, 2006. (NASA/JPL/University of Arizona)

During its five-year mission, MRO will perform two important tasks: search for water and conduct reconnaissance for future robotic and human Mars missions. During MRO's science phase, it will return more data about the Red Planet than all previous Mars missions combined, helping researchers decipher the processes of change and prepare for human missions to Mars. It will study geological formations revealing the history of water on Mars, and it will search for minerals indicating whether water still sits below the surface. MRO will conduct close-up surveys, using the largest cameras ever flown on a planetary mission, to look for hot springs and other small water features and to identify obstacles like large rocks that could jeopardize the safety of future landers and rovers. MRO also will provide a high-data-rate communications relay that will support future missions to the surface of Mars.

The Cassini spacecraft, which has been in orbit around Saturn since July 2004, may have found liquid water reservoirs that erupt in Yellowstone-like geysers on Saturn's moon, Enceladus. This rare occurrence of liquid water so near the surface raises new questions about this mysterious moon. If the plume does contain liquid water, Enceladus may provide an environment suitable for living organisms. Other moons in the solar system, like Jupiter's moon Europa, have liquid water oceans covered by miles of icy crust. Enceladus, however, appears to have pockets of liquid water just yards below the surface.



Plumes of icy material extend above Enceladus's southern polar region in this image taken by Cassini on February 17, 2006. The color-coded version on the right reveals a fainter and much more extended plume component separated from the main plume by about 60 miles. (NASA/JPL/Space Science Institute)

Study of the plumes also suggest that Enceladus has active volcanism, where molten rock from the core pushes its way to the surface and releases lava, ash, and gas that alter the surrounding environment. Previously, researchers only knew of two places in the solar system where volcanism currently occurs, Earth and Jupiter's moon, Io. Volcanism also may occur on Neptune's moon, Triton.

In spring 2008, researchers will get another chance to look at Enceladus when Cassini flies within 220 miles of the moon.

Confronting Challenges

NASA's Planetary Science Division had a successful fiscal year, with operational missions working well and returning exciting scientific data. Several missions in implementation incurred problems. Due to cost and technical problems, NASA stopped the Dawn mission, then restarted it once a revamped implementation schedule and plan was developed and approved. This delayed the Dawn's launch date, but did not impact key science requirements. Due to funding shortfalls caused by Agency reprioritizations, NASA re-baselined the Juno mission. The new plan will delay launch, but will not impact key science requirements.

Moving Forward

New Horizons, launched in January 2006, is on its multi-year journey to Pluto, Charon, and the small rocky bodies that make up the Kuiper Belt. After an encounter with Jupiter in early 2007, when the spacecraft will gain a gravity assist from the massive planet, New Horizons will cruise for approximately eight years and arrive at Pluto in 2015. Once there, New Horizons will study the small, icy objects that inhabit this distant part of the solar system, revealing new information about their formation and the source and composition of comets.

The MESSENGER spacecraft, which NASA launched in August 2004, will fly by Venus in October 2006 and again in June 2007 as the spacecraft makes its way to the solar system's innermost planet, Mercury. The flybys will provide a gravity assist, after which MESSENGER will use the pull of Venus' gravity to alter and correct its path to Mercury, saving precious fuel. MESSENGER will perform its first flyby of Mercury in January 2008, and it will gradually work its way into orbit by March 2011. The spacecraft will take a close look at Mercury's surface, crust, atmosphere, and magnetic field to learn more about Earth's mysterious, rocky neighbor.

In 2006, NASA began to build and test the Phoenix Mars Lander. Scheduled for launch in 2007, Phoenix will land on Mars' icy northern pole to study the history of water and assess the potential for life at the ice–soil boundary. The spacecraft will take samples with a robotic arm and analyze the samples using its on-board "portable laboratory."

Throughout 2006, the Dawn mission underwent review, and engineers began preparing the spacecraft for launch in summer 2007. Dawn will study two large asteroids, 1 Ceres and 4 Vesta, to help scientists learn more about the conditions and processes that formed the solar system.

Also in 2006, NASA initiated the implementation phase of the Mars Science Laboratory (MSL) mission. MSL is the next flagship mission to conduct exploration of the solar system. This challenging mission, planned for launch in 2009, is a rover the size of a compact car. It boasts a suite of 10 scientific instruments that will conduct definitive mineralogy, search for organic compounds, study Mars's meteorology, and explore the potential past and present habitability of Mars. The largest lander since Viking in the 1970s, MSL's technologies will pave the way for future missions to planetary surfaces and directly benefit eventual human exploration of Mars.

Sub-goal 3D: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.

Cost of Performance (in millions)
$1,910.95
Responsible Mission Directorate
Science

NASA's Astrophysics Division seeks to answer fundamental questions about the larger environment in which humans live: How did the universe begin? Will the universe have an end? How are galaxies, stars, and planets created and how do they evolve? Are humans alone in the universe?

Using ground-based telescopes and space missions, NASA enables research to understand the structure, content, and evolution of the universe. This research provides information about humankind's origins and the fundamental physics that govern the behavior of matter, energy, space, and time. NASA-supported researchers look far into the universe, towards the beginning of time, to see galaxies forming. They also search for Earth-like planets around distant stars, determine if life could exist elsewhere in the galaxy, and investigate the processes that formed Earth's solar system.

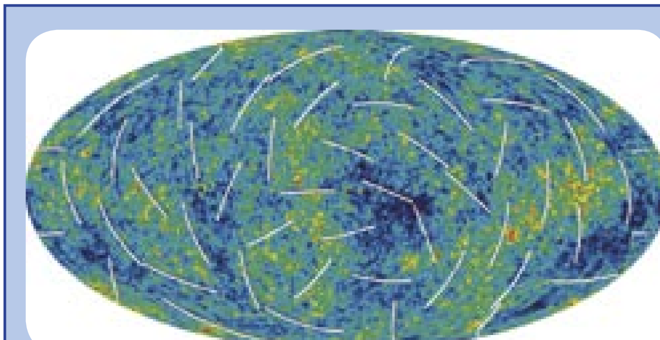
Reaping Benefits

The study of the universe benefits the Nation's scientific research community and industrial base by focusing research and advanced technology development on optics, sensors, guidance systems, and power and propulsion systems. Some of these technologies find their way into the commercial and defense sectors.

Research into the origins and nature of the universe contributes to "the expansion of human knowledge . . . of phenomena in the atmosphere and space," a charter objective in the 1958 Space Act. NASA's astrophysics missions—particularly the three Great Observatories, the Hubble Space Telescope, the Spitzer Space Telescope, and the Chandra X-ray Observatory—have provided researchers with new ways of looking at the universe so that they can expand knowledge about cosmic origins and fundamental physics. The interesting and beautiful images from these observatories also are educational tools to help spark student interest in science, technology, engineering, and mathematics.

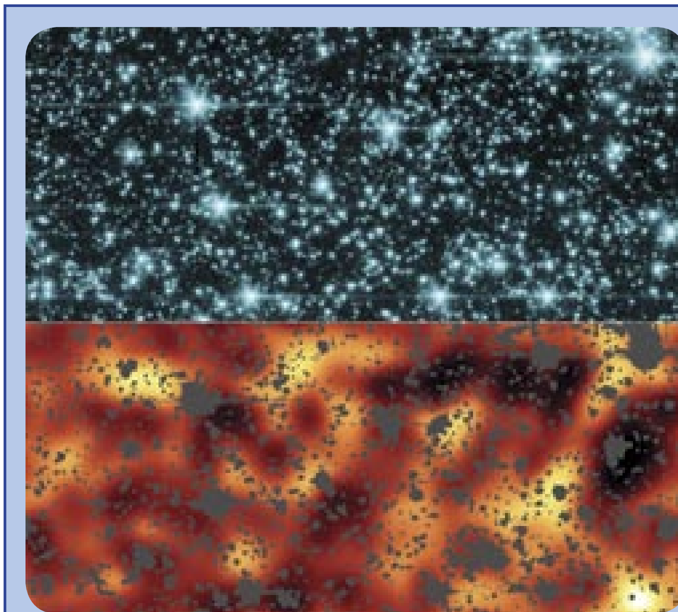
Highlighting Achievements

New results based on three years of continuous observations from the Wilkinson Microwave Anisotropy Probe (WMAP) provided the most detailed temperature map to date of the early universe. The map discerns temperature differences of less than one-millionth of a degree, yielding the first full-sky map of the polarization of the cosmic microwave background, the afterglow light from the first moments after the Big Bang. Using this information, the WMAP science team announced two major results: additional evidence that cosmic inflation drove the early expansion of the universe and an improved estimate of when stars first "turned on."



This map, created using data from WMAP, helps to pinpoint when the first stars formed and provides new clues about events that transpired in the first trillionth of a second of the universe. Colors indicate "warmer" (red) and "cooler" (blue) spots. The white bars show the "polarization" direction of the oldest light. (NASA/WMAP Science Team)

In November 2005, scientists using NASA's Spitzer Space Telescope announced that they detected light in the Draco constellation that may be from the earliest objects in the universe. This light could be from the very first stars or from hot gas falling into the first black holes. The science team described the observation as comparable to the glow of a distant city at night from an airplane—bright, but too distant and feeble to resolve individual objects. If confirmed, the observation will provide a glimpse of an era more than 13 billion years ago when, after the fading embers of the Big Bang gave way to millions of years of pervasive darkness, the universe came alive. The Spitzer discovery supports observations made in the 1990s by NASA's Cosmic Background Explorer (COBE) suggesting there may be an infrared background that scientists could not attribute to known stars. It also supports observations made in 2003 by WMAP estimating that stars first ignited 200 million to 400 million years after the Big Bang.



The top panel is an infrared image from Spitzer of stars and galaxies in the Draco constellation. The bottom panel is the result after all the forefront stars, galaxies, and artifacts have been masked out. The background has been enhanced to reveal a glow that cannot be attributed to more recent galaxies or stars. This could be the glow of the first stars in the universe. (NASA/GSFC/JPL–Caltech)

Using an armada of telescopes, an international team of astronomers, funded in part by NASA, found the smallest planet ever detected outside the solar system. The extrasolar planet is five times as massive as Earth and orbits every 10 years around a red dwarf, a relatively cool star. The distance between the planet and its host is about three times greater than that between Earth and the Sun. The planet's large orbit and its dim parent star make its likely surface temperature a frigid minus 364 degrees Fahrenheit, a temperature similar to that of Pluto even though the planet is about 10 times closer to its star than Pluto is to the Sun.

The new planet, which scientists think is an icy, giant version of terrestrial planets like Earth and Mars, orbits the most common type of star in the Milky Way Galaxy, a red dwarf 20,000 light-years away in the Scorpius constellation. The discovery indicates that Earth-mass planets are not uncommon. The finding also supports theories of how Earth's solar system was formed, which proposes that planets were created from material accreting around a star.

Confronting Challenges

The Science Mission Directorate's Astrophysics Division is facing a budgetary challenge stemming from the many big missions it has undertaken. The biggest, most complex of these missions is the James Webb Space Telescope (JWST), identified by the National Research Council as a top-priority new initiative for astronomy and astrophysics in the current decade. NASA initially underestimated the life-cycle cost for JWST because of the difficulties predicting costs associated with developing a cutting-edge mission before completing the first major design review. In FY 2007, NASA and Agency partners will verify that all JWST new technologies have reached sufficient maturity to permit a realistic estimate of what the mission will cost.

Both the schedule and budget for the Space Interferometry Mission (SIM) exceeded NASA's initial estimates. To fit the mission within the Astrophysics Program's resources, NASA will scale back the pace of the SIM project and consider how this activity fits within the NASA planet finding and characterization program.

Since 1996, NASA and the German aerospace agency DLR have been developing the Stratospheric Observatory for Infrared Astronomy (SOFIA) mission, an astronomical observatory permanently installed in a modified Boeing 747 aircraft. Because of cost growth from technical and schedule problems, NASA held off on committing final funding to the project in its FY 2007 budget submission to Congress. In June 2006, NASA's Program Management Council determined that the program faces no insurmountable technical or programmatic challenges and, on July 6, NASA's Administrator gave the go-ahead to complete development. However, the Agency will conduct additional reviews to examine the proposed management and operations scenarios for this observatory and will base future development decisions on the project's successful achievement of cost and schedule milestones.

Moving Forward

SOFIA passed a major milestone in August 2006 when its Boeing 747 aircraft taxied down a runway in Texas under its own power. The SOFIA Aircraft Operations Team will conduct the first test flight in early 2007.

In FY 2006, the Stanford Linear Accelerator Center delivered to NASA the Gamma-ray Large Area Space Telescope's (GLAST's) primary instrument, the Large Area Telescope. The GLAST mission will improve scientists' understanding of the structure of the universe by analyzing the direction, energy, and arrival time of celestial high-energy gamma rays. GLAST will study the mechanisms of galaxies possessing a central core, or nuclei, that produces more radiation than the rest of the galaxy. It also will study dark matter, supernova remnants, pulsars, and rotating neutron stars, providing information crucial to solving the mysteries of high-energy gamma ray sources. NASA continues to prepare GLAST for launch in Fall 2007.

NASA's Astrophysics Division also has other observatory missions—including JWST, the Wide field Infrared Survey Explorer (WISE), and the Kepler mission—in formulation or development for launch near the end of the decade or early in the next decade. Managers for the Beyond Einstein Program have deferred selecting the program's next mission until a program-level review is completed. To aid with mission selection, program engineers will assess technology readiness for several mission options, including the Joint Dark Energy Mission (JDEM, a joint activity of NASA and the Department of Energy), Constellation–X (Con–X), the Laser Interferometer Space Antenna (LISA), Cosmic Microwave Background Polarization Probe (CMBPol), and the Black Hole Finder Probe (BHFP). The Beyond Einstein Program develops missions that study the physics of phenomena, like black holes, dark energy, and the Big Bang, predicted by several of Albert Einstein's theories.

Sub-goal 3E: Advance knowledge in the fundamental disciplines of aeronautics, and develop technologies for safer aircraft and higher capacity airspace systems.

Cost of Performance (in millions)
$1,050.00
Responsible Mission Directorate
Aeronautics Research

NASA's Aeronautics Research Mission Directorate conducts high-quality, innovative research to expand the boundaries of aeronautical knowledge for the benefit of the broad aeronautics community, which includes the Agency's partners in academia, industry, and other government agencies.

Reaping Benefits

NASA's aeronautics research leads to the development of revolutionary concepts, technologies, and capabilities that enable revolutionary change to both the airspace system and the aircraft that fly within it, facilitating a safer, more environmentally friendly, and more efficient air transportation system.

NASA's aeronautics research also supports the Agency's space exploration Strategic Goals. The Aeronautics Research Mission Directorate conducts research in key aeronautics disciplines such as aerodynamics, aerothermodynamics, materials, structures, and flight controls to advance the Nation's capabilities for safe flight through any atmosphere at any speed, be it our own, or that of another planet.

Highlighting Achievements

During FY 2006, NASA initiated a comprehensive restructuring of the Aeronautics Research Mission Directorate to ensure that it pursues long-term, cutting-edge research that expands the boundaries of aeronautical knowledge for the benefit of the broad aeronautics community, including the Agency's partners in academia, industry and other government agencies. Three core principles guided the restructuring:

1. Dedicate NASA aeronautics initiatives to the mastery and intellectual stewardship of the core competencies of aeronautics for the Nation in all flight regimes;
2. Focus research in areas that are appropriate to NASA's unique capabilities; and
3. Address the fundamental research needs of the Next Generation Air Transportation System (NGATS) while working closely with Agency partners in the Joint Planning and Development Office (JPDO).

Given these three principles, NASA then established the four programs within the Aeronautics Research Mission Directorate: the Fundamental Aeronautics Program; the Aviation Safety Program; the Airspace Systems Program; and the Aeronautics Test Program. The Fundamental Aeronautics Program conducts cutting-edge research that produces concepts, tools, and technologies that enable the design of vehicles that fly through any atmosphere at any speed. The Aviation Safety Program is focused on developing revolutionary tools, methods, and technologies that will improve the inherent safety attributes of current and future aircraft that will be operating in the evolving National Airspace System. The Airspace Systems Program directly addresses the fundamental air traffic management research needs of the NGATS. This research will yield revolutionary concepts, capabilities, and technologies that will enable significant increases in the capacity, efficiency and flexibility of the National Airspace System. The Aeronautics Test Program is ensuring the strategic availability and accessibility of a critical suite of aeronautics test facilities necessary to meet aeronautics, Agency, and national needs.

The Aeronautics Research Mission Directorate established a four-step approach to putting together technical plans in the ten aeronautics projects in our four aeronautics programs. The approach was designed to enable us to foster close collaboration with and to facilitate the exchange of ideas and information among researchers at NASA, industry, academia, and other government agencies, in a manner that benefits the community broadly. The four steps were:

1. NASA researchers, with input from other government agency partners, developed preliminary 10-year roadmaps for each program including technical milestones for each project.

2. NASA released a Request for Information to solicit interest from industry for non-reimbursable cooperative partnerships in pre-competitive research that would allow NASA to leverage industry's systems-level expertise while facilitating the rapid transfer of knowledge and technology from NASA to industry.
3. Using the preliminary roadmaps as a starting point, NASA researchers incorporated feedback from respondents to the Request for Information, as well as from colleagues in other government agencies, to develop refined technical proposals for each project. Panels of government subject-matter experts then reviewed and evaluated the proposals based on their technical, management, resource, and partnership plans. This rigorous proposal review process ensured that NASA has technically credible and relevant research objectives and a sound approach for pursuing these objectives. It also allowed NASA to identify research areas where it needed to supplement in-house capabilities with external expertise.
4. Finally, NASA released a NASA Research Announcement to solicit proposals, in a full and open competition, from the external community in those research areas. The Aeronautics Research Mission Directorate intends to have awards in place by November 2006.

While NASA spent much of the fiscal year planning and reorganizing the Agency's aeronautics research activities, several programs continued to make notable achievements. Within the Airspace Systems Program, the Future Air Traffic Management Concepts Evaluation Tool (FACET) won NASA's Software of the Year award for 2006. FACET is a flexible software tool that rapidly models up to 15,000 aircraft trajectories, using Federal Aviation Administration air traffic data and weather data from the National Weather Service, on a desktop computer to help plan traffic flows at the national level. The Aeronautics Test Program initiated test technology investments, including standardizing wind tunnel measurement systems across all the Centers and developing test facility control system simulators. The Aviation Safety Program completed the Airborne Subscale Transport Aircraft Research (AirSTAR) test bed. It will support research in the prevention and recovery of upsets in transport aircraft. Finally, the Fundamental Aeronautics Program completed the Mach 5 testing of the Ground Demonstration Engine–2 in the NASA 8-Foot High Temperature Tunnel. NASA teamed with the Air Force Research Laboratory and Pratt & Whitney Rocketdyne to complete the tests. The NASA tests marked the first time a closed-loop, hydrocarbon-fueled, fuel-cooled scramjet was tested at hypersonic conditions. Fuel cooling of the scramjet is essential for the hardware to survive the extreme temperatures of hypersonic flight.

The Ground Demonstration Engine–2 (GDE–2) undergoes tests at the NASA Langley Research Center 8-Foot High Temperature Tunnel. Mach 5 air is compressed in the inlet, without the aid of rotating parts, and ignited with the addition of a hydrocarbon fuel to produce thrust at hypersonic speeds. (NASA)

Confronting Challenges

In FY 2006, the Aeronautics Research Mission Directorate worked toward aligning its research with current Agency needs. NASA leadership closed-out discontinued projects, reassigned staff, and identified new projects. The Aeronautics Research Mission Directorate now is positioned to begin work on these challenging new projects.

Moving Forward

Fundamental Aeronautics Program (projects to be achieved in 2007 to 2008)

- The Subsonic Fixed Wing project will develop and test component technology concepts used in conventional aircraft configurations to establish the feasibility of achieving significant noise reduction (Stage 3—42 EPNdb cum). For unconventional aircraft configurations, project engineers will develop and test component technology that establishes the feasibility of achieving short take-offs and landings on runways less than 3,000 feet.

- The Subsonic Rotary Wing project will validate model engine stall-control concepts using component test data obtained in the Glenn Research Center's CE18 Facility in order to improve the operability range of rotorcraft (helicopter) engines.
- The Supersonics project will use laboratory tests to validate a composite containment system for supersonic engine fan blades that is 20-percent lighter than the metallic containment system developed by the High Speed Research Program in the late 1990s (which now serves as a technology baseline). This will demonstrate advancement in new concepts for high efficiency propulsion and airframes for supersonic aircraft. The project also will validate a high-fidelity analysis technique for assessing the impact of nozzle plume effects on the off-body flow field of a supersonic aircraft, aiding in the development of predictive noise-propagation modeling.
- The Hypersonics Project will investigate an advanced Mars entry shape by sub-orbital flight testing of the Sub-orbital Aerodynamic Re-entry Experiments (SOAREX). The flight data, coupled with ground-based experimental data, will provide a baseline for the validation of computational tools to predict flight characteristics and the life of the ablator heat shield materials under extreme heating. In a separate activity, NASA's arc-jet facilities will be used to characterize the behavior of advanced heat shield systems to provide a database for material degradation models for hypersonic vehicles.

Aviation Safety Program (projects to be achieved in 2007)

- Researchers will assess aircraft aging and durability research capabilities at NASA and other agencies to establish a baseline for the project.
- The Integrated Intelligent Flight Deck project will develop a Phenomena Identification and Ranking Table that baselines the project's state-of-the-art hazard knowledge and identifies future flight deck research needs in sensor technologies.
- The Integrated Vehicle Health Management project will install flight research measurement equipment and perform flight-readiness checks of ice crystal measuring systems for follow-on flight research campaigns. In 2008, the project will conduct in-flight tests in high ice–water content conditions to increase the accuracy of measured total water content by 50 percent over the existing instrumentation.
- The Integrated Resilient Aircraft Controls project will assess a dynamic tool that is to be operated in the AirSTAR flight research testbed. Additionally, project members will define upset condition capability requirements in aerodynamics, propulsion, and structures and identify potential technology barriers.

Airspace Systems Program

- In FY 2007 through FY 2008, the Airspace Systems Program researchers will pursue advanced formulation and development activities through laboratory analysis, as well as human-in-the-loop experiments with air and ground operators, to evaluate automated strategic and tactical separation assurance under conditions with increasing air-space complexity. Elements of complexity will include extensive diversity in aircraft size and type, initial time-based metering technologies, refined communication, navigation, and surveillance capabilities, failure recovery operations, increased uncertainty, and two- to three- times nominal traffic levels.

Aeronautics Test Program

- NASA and the Department of Defense will begin an aeronautics facility testing alliance, the National Partnership for Aeronautics Testing, to develop cost and access policies to aid interagency cooperation and use in the management of their respective assets.
- The Aeronautics Test Program will initiate activities that will improve facility operational efficiencies. Activities of interest include exploring the centralization of NASA strain gauge balance (instrumentation that measures forces in wind tunnels) activities which include balance technology development, design, manufacture, and calibration.

Sub-goal 3F: Understand the effects of the space environment on human performance, and test new technologies and countermeasures for long-duration human space exploration.

Cost of Performance (in millions)
$367.07
Responsible Mission Directorates
Exploration Systems Space Operations

When astronauts return to the Moon and journey to further destinations, they will be exposed to the microgravity, radiation, and the isolation of space for long periods of time. Keeping crews physically and mentally healthy during such long-duration missions will require new technologies and capabilities. NASA is studying how the space environment, close quarters, heavy workloads, and long periods of time away from home contribute to physical and psychological stresses and is developing technologies that can prevent or mitigate the effects of these stresses. NASA also is looking for innovative ways to meet the basic needs of astronauts—oxygen, water, food, and shelter—with systems that can operate dependably for weeks on the Moon and, eventually, for months on Mars.

Reaping Benefits

The medical knowledge and diagnostic and treatment technologies NASA uses to keep humans healthy and productive in space improve the medical treatment and health of humans on Earth. For example, NASA's research into human adaptation to microgravity has helped scientists better understand the changes that come with aging, such as bone loss, muscle atrophy, and loss of balance. NASA-developed telemedicine technologies, which helps doctors on Earth monitor and treat astronauts in space through a combination of computer-assisted imaging and diagnostics, video, and telecommunications, also help doctors deliver quality medical care to people in isolated or underserved areas of the world. These technologies allow doctors located thousands of miles apart to collaborate in real time on medical treatment.

Companies have taken NASA life-support and medical technologies and developed them into commercial products that serve the public. Light-emitting diodes originally designed to grow plants in experiments aboard the Space Shuttle are now used to treat brain tumors. Devices built to measure the astronauts' equilibrium when they return from space are widely used by major medical centers to diagnose and treat patients with head injuries, stroke, chronic dizziness, and central nervous system disorders. A company turned a small, portable device originally designed to warn Shuttle and International Space Station (ISS) crewmembers of depressurization into a hand-held device that warns pilots, mountain climbers, skydivers, and scuba divers of hazardous conditions before depressurization and hypoxia become a health threat. For more information on NASA technology-transfer successes, please visit the Spinoff home page at *http://www.sti.nasa.gov/tto/*.

Highlighting Achievements

In FY 2006, the Exploration Systems Mission Directorate began implementing a number of recommendations presented in the Exploration Systems Architecture Study completed in 2005. The Exploration Systems Mission

In Spring 2006, engineers from NASA's Marshall Space Flight Center helped improve the lives of villagers in Kendala, Iraq, using technologies and capabilities developed for the Environmental Control and Life Support System used on the International Space Station. A non-profit group, Concern for Kids, donated to Kendala a water filtration and purification pump system designed by Water Security Corporation using Space Certified Technology developed for NASA. When the system first arrived in Kendala, the iodine bed that helps purify the water had dried out. Engineers at Marshall emailed advice and instructions that helped the team in Kendala fix the system. The villagers now have safe, clean drinking water. (NASA)

Directorate refocused biomedical research and human life support activities through a new set of milestones and requirements that target timely delivery of research products and reorganized its management structure to support NASA's exploration goals. As part of this effort, Exploration Systems created two new programs, the Human Research Program and the Exploration Technology Development Program. During this refocusing, Human Research and Exploration Technology researchers continued work on many projects, continuing the Exploration Systems Mission Directorate's progress toward achieving Sub-goal 3F.

To mitigate the highest risks to astronaut health and performance, the Human Research Program conducts research and develops technologies to enable safe, reliable, and productive human space exploration. In FY 2006, the program initiated an exhaustive programmatic review of its focus areas—bone and muscle research, cardiology, pharmacology, neurological sciences, nutrition, immunology, behavioral health, and performance disciplines—to assess the program's research, data, and knowledge completed to date and its significance to current exploration missions and determine what work still needs to be done to implement the Vision for Space Exploration.

The Human Research Program also restructured and refocused its ISS utilization approach under the ISS Medical project to better coordinate ISS research and maximize use of facilities aboard the ISS and other space-based research platforms. One of the first flight experiments conducted under this new project is the Stability of Pharmacotherapeutic and Nutritional Compounds experiment, delivered to the ISS by STS-121 in July 2006. The Stability experiment documents how the radiation environment in space affects vitamins and compounds in foods and medication. The results will help researchers select, or develop if necessary, foods and medications that will remain stable and reliable during long-duration human exploration missions to the Moon and Mars.

Scientists at Johnson Space Center analyze the Stability samples returned on STS-121. Knowing how the space radiation environment affects foodstuffs and pharmaceuticals will help NASA better plan for exploration missions. (NASA)

The Exploration Technology Development Program develops technologies—structures, thermal protection systems, non-toxic propulsion, life support systems, capabilities for in-situ resource utilization, and many others—for future human and robotic exploration missions. In FY 2006, the program focused on maturing technologies for the Orion Crew Exploration Vehicle through a combination of ground- and ISS-based research. Within the program, the Exploration Life Support project made progress in developing new concepts and technologies for removing carbon dioxide and humidity from spacecraft environments. These technologies are lighter and smaller than those currently used on the ISS, freeing up valuable mass on future exploration vehicles. The Advanced Environmental Monitoring and Controls project prepared monitoring technologies for flight deployment and testing aboard the ISS: the Vehicle Cabin Air Monitor, which monitors gases in the air, the Electronic-Nose, which detects air "events," and a first-generation bacterial monitoring system.

In August 2006, ISS crew successfully completed the Dust and Aerosol Measurement Feasibility Test (DAFT), an experiment to characterize the distribution and size of dust particles floating in the air aboard the ISS. DAFT tested the effectiveness of fire safety technology in detecting greater-than-normal amounts of particles in the air, a difficult task in a near-weightless environment where air circulates differently and heavier particles are not pulled toward the ground. The technology validated by DAFT will fly as part of the Smoke Aerosol Measurement Experiment (SAME) in 2007.

The NASA science officers for ISS Expeditions 12 and 13 conducted the Capillary Flow Experiment (CFE) to determine how capillary forces—the interaction of liquid with solid that can draw a fluid up a narrow tube—act in a near-weightless environment. NASA can use capillary forces to control fluid orientation and transport to enable predictable performance for mission-critical systems such as propellant storage and water purification.

CFE first flew during Expedition 9 in 2004, and experiment results have provided new data that engineers can apply to current and advanced system designs.

Confronting Challenges

NASA's greatest challenge for Sub-goal 3F is limited access to the ISS and reduced ISS crew size following the *Columbia* accident. With the reestablishment of regular Space Shuttle flights and the restoration of the ISS crew complement to three, ISS science productivity should increase.

In June 2006, NASA conducted "walk back" tests at the Johnson Space Center's mock-up facility to determine if a crewmember could walk 10 kilometers (a little over six miles) from a failed lunar rover back to home base. In this photo, a technician inside NASA's Mark III Advanced Space Suit is attached to a rig that simulates low gravity. While he walked, equipment monitored his heart rate, temperature, and carbon dioxide output to evaluate how hard he worked to go 10 kilometers. The results of the walk back tests will be used to improve space suit designs. (NASA)

Moving Forward

The Exploration Systems Mission Directorate is on track to develop critical technologies in time for the Orion Crew Exploration Vehicle preliminary design review in 2008. To support this ambitious goal, NASA will fly a number of experiments on the ISS, including SAME and the Boiling Experiment Facility, which will study boiling mechanisms critical to the proper design of heat removal equipment for spacecraft. The Glenn Research Center is conducting final flight hardware testing on the Combustion Integrated Rack and the Fluids Integrated Rack that will form the Fluids and Combustion Facility, an ISS facility that will accommodate the research needs of fluid physics and combustion science. The Combustion Integrated Rack, currently scheduled for launch in summer 2008, has a 100-liter combustion chamber surrounded by optical and other diagnostic packages. The Fluids Integrated Rack, scheduled for launch in early 2009, features a large, user-configurable space for conducting experiments, advanced imaging capabilities, laser and white light sources, and other capabilities. Once completed, the Fluids and Combustion Facility will support experiments in fundamental fluids physics and combustion science to help NASA develop life support technologies and propulsion systems.

In June 2006, the European Space Agency delivered its ISS module, the Columbus research module, to the Kennedy Space Center. NASA engineers are processing the module for launch on the Space Shuttle in 2007. Columbus will expand ISS research facilities and provide researchers with the ability to conduct numerous experiments in the life, physical, and materials sciences. NASA plans to move the Human Research Facility racks from the U.S. Destiny Laboratory (added to the ISS in 2001 and 2005) to Columbus to combine them with the European Space Agency's physiology racks, maximizing flight research capabilities for the Human Research Program.

In addition to its planned work on the ISS, the Human Research Program will characterize the structure and toxicity of lunar dust. Using samples of dust vacuumed from Apollo space suits, scientists will analyze dust particle size, morphology, and mineralogy to develop a simulated lunar dust that NASA can distribute in larger quantities for research and testing. The program will start toxicity testing in 2008. Scientists will use test results to establish crew exposure limits and to help them design environmental control and life support systems for lunar surface vehicles and suits for extravehicular activities.

Strategic Goal 4: Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.

Cost of Performance (in millions)
$1,622.16
Responsible Mission Directorate
Exploration Systems

The Nation's current space transportation systems—NASA's Space Shuttle and commercially available expendable launch vehicles—are unsuitable for human exploration beyond low Earth orbit. Therefore, the President and Congress directed NASA to develop new space transportation capabilities to return humans to the Moon and eventually carry them to Mars. NASA initiated the Constellation Systems Program to achieve this objective. So far, the program includes the Orion Crew Exploration Vehicle (CEV), Ares I, an expendable crew launch vehicle, Ares V, a heavy-lift cargo launch vehicle, spacesuits and tools required by the flight crews, and associated ground and mission operations infrastructure to support initial low Earth orbit missions.

Orion will be America's new spacecraft for human space exploration. It will carry four crewmembers to the Moon and serve as the primary exploration vehicle for future missions. It also will be capable of ferrying up to six astronauts (plus additional cargo) to and from the International Space Station (ISS) if commercial transport services are unavailable. The Ares I will consist of a solid rocket booster and an upper stage that can carry Orion into low Earth orbit.

Reaping Benefits

Orion will support the expansion of human exploration missions and provide the means to take humans to the Moon and eventually Mars, where they can conduct scientific activities and make discoveries not possible solely with robotic explorers.

As with past and current human exploration programs, NASA's efforts to develop Orion and the Ares launchers will accelerate the development of technologies that are important for the economy and national security. The advanced systems and capabilities required for space travel include power generation and storage, communications and navigation, networking, robotics, and improved materials, all of which could be used on Earth to meet commercial and other national needs. As Shuttle activities begin to wind down, Shuttle personnel will find new, challenging positions working on Constellation Systems development efforts, keeping this highly skilled segment of America's workforce productive and competitive. Constellation Systems also will provide a training ground for the next generation of scientists and engineers who will realize the Nation's space exploration dreams.

Furthermore, Orion will serve as a public symbol of the Nation's continued commitment to space exploration, much as the Shuttle has over the past 25 years. NASA anticipates that the exploration initiatives will spark the public's imagination and inspire the Nation's youth to pursue careers in science, technology, engineering, and mathematics as a result of their renewed interest in space.

Highlighting Achievements

During FY 2006, NASA continued preliminary design work and began systems testing, including heat shield tests at the Ames Research Center arc-jet facility. Johnson Space Center engineers built a full-scale mock-up of the command module, which will be used to test systems in situ. NASA established an intra-agency CEV Smart Buyer Team to perform trade studies and design analysis to help the CEV Project Office understand and verify the appropriateness of the requirements incorporated into the CEV Phase II solicitation.

On August 31, 2006, NASA announced that it would award to Lockheed Martin the contract to build the Orion Crew Exploration Vehicle, shown here in an artist's rendering. Since July 2005, NASA worked with two teams, Lockheed Martin and Northrop Grumman/Boeing, to do preliminary trade studies, requirements, and design concepts in preparation for the August 2006 selection. (Lockheed Martin)

On August 31, after careful consideration of the submitted proposals, NASA awarded to Lockheed Martin the contract to develop Orion—the first in over 30 years calling for the development of a new manned space vehicle. Lockheed Martin will work with NASA to deliver the Orion vehicle by 2014.

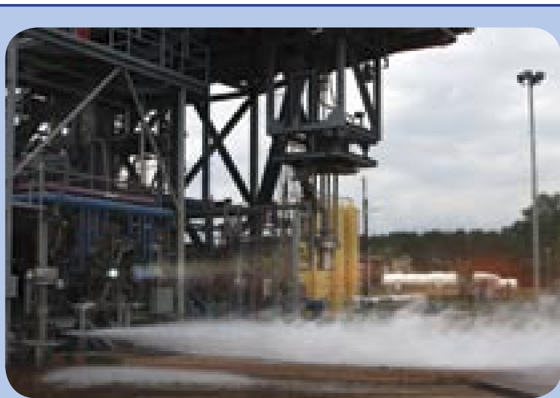
NASA subjected a partial model of Ares I, including part of the upper stage, the spacecraft adapter, Orion, and the launch abort system, to over 80 runs of wind tunnel tests at the Ames Research Center. Data collected during these tests help engineers understand the aerodynamic characteristics of the vehicle, giving the designers insight into the algorithms necessary for flight control software to control the vehicle during ascent. NASA also successfully completed preliminary tests of an augmented spark igniter, a critical engine component that ignites a mixture of liquid hydrogen and liquid oxygen propellants while in-flight.

Throughout the fiscal year, NASA took small, but important steps toward achieving Strategic Goal 4:

- In May, NASA selected the RS-68 engine to power the core stage of the heavy-lift cargo launch vehicle, Ares V, superseding NASA's initial decision to use a derivative of the Shuttle main engine. Studies examining life-cycle cost showed the RS-68, which is the most powerful liquid oxygen/liquid hydrogen booster in existence, to be the best choice. The RS-68 currently is used in the Delta IV launcher, the largest of the Delta rocket family.
- NASA assigned development tasks to each of the Centers:
    - Ames Research Center is developing the thermal protection systems and information technology systems for the spacecraft;
    - Dryden Flight Research Center leads the abort flight test integration and operations;
    - Glenn Research Center manages the work on Orion's service module and the development of the Ares I upper stage;
    - Goddard Space Flight Center is responsible for communications, tracking, and support mechanisms;
    - Jet Propulsion Laboratory leads planning for systems engineering processes related to operations development and preparation;
    - Johnson Space Center manages Constellation Systems and the astronaut corps and leads development for the crew module;
    - Kennedy Space Center is developing the ground systems for Constellation Systems and will process and launch Orion and Ares;
    - Langley Research Center leads the Launch Abort System integration;
    - Marshall Space Flight Center manages all launch vehicle projects and launch vehicle testing; and
    - Stennis Space Center tests the rocket propulsion systems.

In March 2006, NASA engineers (from left) Paul Espinosa and Tuan Truong, study a scale model of the CEV under blue light to prepare the model for testing in the Ames Research Center's Unitary Wind Tunnel Complex. This test demonstrated the aerodynamic properties of the heat shield design (the model is painted with special, pressure-sensitive pink paint used in the testing). Additional tests conducted in the Ames arc-jet facility, which resembles a room-size blowtorch, tested potential materials for the heat shield. (NASA)

In addition to the Orion development, Strategic Goal 4 includes development of a next-generation spacesuit capable of supporting exploration. Engineers at Johnson Space Center are testing spacesuit configurations under various scenarios, like an emergency "walk back" during which a crewmember would walk from a stalled rover to a lunar lander or habitat. In June, Johnson Space Center conducted a walk back simulation where a NASA engineer walked more than six miles on a treadmill wearing the Mark III Advanced Space Suit Technology Demonstrator (see photo in Sub-goal 3F). Rigging connected to the spacesuit helped simulate different gravity levels, including



Engineers at Marshall Space Flight Center conduct a hot-fire test of a scaled-down model of main injector hardware in July 2006. This device will inject and mix liquid hydrogen and liquid oxygen propellants in the main combustion chamber of the upper-stage rocket engine that will be used in the Ares I Crew Launch Vehicle and the Ares V Cargo Launch Vehicle. The hot-fire tests are part of efforts to investigate design options for, and maximize performance of, the J-2X upper stage engine, an updated version of the powerful J-2 engine used to launch the Saturn V rocket upper stages during Apollo. The injector was fired horizontally with varying fuel temperatures and different propellant mixtures for 10 to 20 seconds at a thrust of approximately 20,000 pounds. Data collected during these tests will help engineers investigate design options for, and maximize performance of the J-2X upper stage engine. (NASA)

lunar gravity. The goal was to determine if an astronaut could do a strenuous walk in the spacesuit and still be able mentally and physically to work the hatch on the lander or habitat. The results provided useful guidance for spacesuit modifications.

Confronting Challenges

Achieving Strategic Goal 4 will require careful management to keep the Constellation Systems Program within budget and on schedule.

Another factor affecting achievement of Strategic Goal 4 is performance under Strategic Goals 1 and 2. The Space Shuttle represents the biggest commitment in NASA's budget. NASA must retire the Shuttle as soon as possible, while also meeting the commitment to complete the ISS, to free up budget for Constellation Systems.

In preparation for the transition from Shuttle to Orion, NASA is studying options for transitioning workforce, facilities, and assets from the Space Shuttle Program to Constellation Systems. If the transition is delayed, NASA could face increased costs and the loss of skilled workers. Therefore, NASA is conducting trade studies and analyses to understand more clearly the technical requirements for projects, space systems, and vehicle development and testing to ensure that Orion and Ares I are operational no later than 2014.

Moving Forward

Now that NASA Centers have their assigned tasks, work on Orion, Ares I, and supporting systems can begin in earnest. In FY 2007, NASA will conduct a System Design Review for all elements of Constellation Systems. A successful review will allow the program to begin preliminary design work on additional projects. A Preliminary Design Review of Orion, the Ares I, and the Exploration Communications and Navigation Systems project will also be completed. In FY 2007, NASA also will conduct a Preliminary Design Review for a spacesuit that can be worn during extravehicular activity.

Strategic Goal 5: Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.

Cost of Performance (in millions)
$44.00
Responsible Mission Directorates
Exploration Systems

NASA pursues collaborations that help expand the commercial space sector and support NASA's Mission. Of particular interest to NASA is the expansion of launch service providers. As the Space Shuttle nears retirement, NASA is interested in obtaining International Space Station (ISS) cargo delivery and return services provided by emerging companies. By helping them to expand their services and increase their experience, NASA hopes to encourage the growth of a competitive market that will help to reduce launch costs and provide NASA with access to new capabilities. NASA hopes to stimulate the emerging U.S. entrepreneurial launch sector and accelerate the growth of the commercial space industry by awarding prizes and intellectual property rights for achievements in creating space technologies and systems.

NASA also is encouraging the emerging U.S. commercial space sector through more creative, less traditional approaches. In 2006, NASA selected two emerging aerospace companies, Space Exploration Technologies and Rocketplane–Kistler to demonstrate ISS cargo transportation services. Should they successfully demonstrate their cargo transportation capabilities, they will be able to bid to provide cargo transportation services for the ISS after Shuttle retirement. Since FY 2005, NASA has held prize competitions, called Centennial Challenges, for ground-based demonstrations of breakthroughs in various aerospace technologies. Although there is no guarantee that a breakthrough or winner will emerge from any particular prize competition, by encouraging participation, NASA hopes to encourage private sector breakthroughs across a broad range of technologies and designs.

Reaping Benefits

Since NASA's creation in 1958, the commercial sector has been the Agency's partner in space exploration. NASA purchases launch vehicles for robotic missions from the commercial sector. NASA works with commercial partners to develop communication and navigation systems, build spacecraft, and design spacesuits. Along the way, the commercial space sector has grown into a multi-billion-dollar industry that delivers services, such as satellite television and global navigation, to the public and contributes to a strong U.S. economy. Historically, several large corporations have driven the commercial space industry, but now start-up ventures are pushing the sector into new areas. With the 2004 award of the first Ansari X–Prize—to Mojave Aerospace Ventures for flying its sub-orbital vehicle to more than 62 miles altitude twice in two weeks—and other ongoing private space efforts, the potential for the commercial space sector to engage new markets is stronger than ever. In return for supporting both established and emerging commercial ventures, NASA gains access to a wider range of technologies and services at more competitive prices.

Highlighting Achievements

The emerging commercial space sector continued to grow in FY 2006 with the successful launch in July of Bigelow Aerospace's Genesis I inflatable Earth-orbit module, a proof-of-concept mission to show the feasibility of using inflatable structures to serve as modules for future space stations and habitats. Inflatables are attractive for space exploration because they offer large volume, but are easier to launch than rigid structures because they weigh far less and pack up smaller. Bigelow will evolve the Genesis technology into a larger, more capable Nautilus inflatable structure.

The technology used for Genesis I originated in the 1990s at the Johnson Space Center as part of NASA's TransHab project to create an inflatable module for the ISS. Although NASA discontinued the TransHab project, technology development continued when NASA and Bigelow signed an exclusive licensing agreement transferring the technology to Bigelow. A second license gave Bigelow access to NASA's radiation shielding technology. Bigelow and NASA continue to collaborate to evolve inflatable technology.

The multi-day Genesis I mission yielded a second benefit for NASA because the inflatable carried the NASA Genebox, a prototype microlaboratory that may fly on small-scale satellites (called nanosats) in the near future. The ability to perform research in such small-scale laboratories could mean more experiments launching for less money and in less time than costly larger counterparts. Although this flight of the NASA Genebox focused on testing the microlab's systems and NASA's procedures for working with the hardware, a later version of the Genebox will track and analyze DNA changes in living things while in space.

The Exploration Systems Mission Directorate established the Commercial Crew and Cargo Program Office at Johnson Space Center and assigned the office responsibility for managing NASA's Commercial Orbital Transportation Services Projects. The program office released a final Commercial Orbital Transportation Services demonstration announcement to solicit proposals for the initial commercial ISS transportation demonstration phase. On August 18, 2006, NASA entered into agreements with Space Exploration Technologies and Rocketplane–Kistler to demonstrate the vehicles, systems, and operations needed to re-supply, return cargo from, and transport crew to and from the ISS.

Bigelow Aerospace used inflatable technology developed for NASA's TransHab module, shown here (top photo) during testing at Johnson Space Center, as the basis for the company's Genesis project. Genesis I, shown here (bottom) in a photo taken by a camera mounted to the inflatable as it successfully orbited Earth in August 2006, is a one-third-scale model meant to shake-out problems. Bigelow will fly a follow-up mission, Genesis II, in early 2007. (top: NASA; bottom: Bigelow Aerospace)

Confronting Challenges

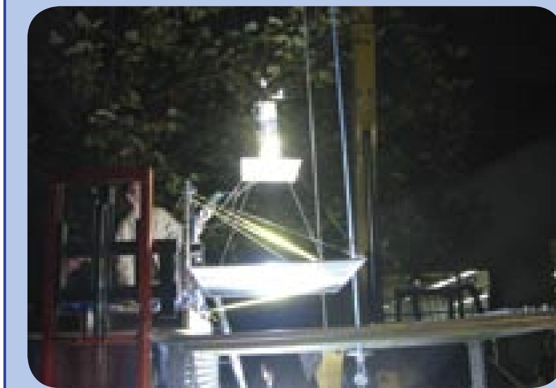
One of NASA's challenges is to expand the Agency's base of launch services providers to include emerging U.S. companies. The current requirements for launching NASA payloads are designed to protect NASA's investment in Agency missions. NASA payloads are often one-of-a-kind and of high value, so it is imperative that all reasonable measures be taken to assure launch success. The NASA Launch Services Program is exploring ways to open the bidding process to a larger number of launch providers, lowering launch prices and helping emerging launch providers gain experience to compete more successfully, while protecting NASA's—and the country's—investment in valuable mission assets. The Commercial Orbital Transportation Services projects are a new approach to providing launch services for the ISS. But before NASA will purchase these services, the companies will have to demonstrate the required capabilities.

Moving Forward

In FY 2007, the Innovative Partnerships Program, the Mission Support Office that manages NASA's partnership, technology transfer, and space product development efforts, will concentrate on integrating its business areas so that they better complement and leverage each other. Program management also will develop additional performance metrics (see Part 2 for the program's FY 2006 performance metrics) and build civil servant core competencies.

The Exploration Systems Mission Directorate currently is working with commercial partners to demonstrate cargo delivery and return capabilities to support ISS cargo re-supply once the Shuttle retires. Partner demonstrations are on track to be able to provide operational cargo services to the ISS beginning in 2010. Additionally, NASA's commercial partners have agreed to the budgets and schedules that will allow bringing an optional crew transportation capability on-line after initial successful cargo demonstrations. The Space Operations Mission Directorate, which acquires commercially available expendable launch vehicles for the Agency's mission needs, plans to purchase crew and cargo launch services for the ISS from U.S. commercial launch providers when they become available.

NASA wants to obtain these services as soon as possible so that Shuttle flights can focus on delivering large construction elements and facilities to the ISS. The commercial flights would augment launch services currently provided by the Russian Space Agency's Soyuz and uncrewed Progress vehicles, enabling the partners to increase the number of crewmembers aboard the International Space Station. The Space Operations Mission Directorate also will continue advanced planning to support NASA's evolving launch requirements for lunar exploration.



A team demonstrates their concept for a robotic climber, which could climb a ribbon, powered only by the beam from an industrial searchlight during the 2005 Beam Power Challenge, held in October. Although none of the 11 teams won the challenge, the University of Saskatchewan Space Design Team had the farthest climb, approximately 40 feet. Participants will meet again in October 2006 to compete for the Beam Power Challenge prize offered by NASA's Centennial Challenges Program. (NASA/K. Davidian)

In FY 2007, NASA and Agency partners will conduct several Centennial Challenges competitions:

- The Beam Power Challenge, to improve the efficiencies and power densities of wireless power transmission;
- The Lunar Lander Challenge, to develop the necessary technologies for reusable transport between low lunar orbit and the lunar surface;
- The Tether Challenge, to stimulate the development of new high-strength, low-weight materials;
- The Astronaut Glove Challenge, to make pressurized gloves less fatiguing and more dexterous for the astronauts' hands;
- The Regolith Excavation Challenge, promoting development of new technologies to excavate lunar soil (also known as regolith); and
- The Personal Air Vehicle Challenge, encouraging technology developments that increase safety, usability, and capacity of general aviation aircraft.

The on-going Moon Regolith Oxygen (MoonROx) Challenge, to develop technologies for technology demonstration of high extraction rates of breathable oxygen from simulated lunar soil, is open throughout all of FY 2007 and expires in June 2008.

NASA has restructured the Centennial Challenges to ensure that some of these competitions will be conducted on an annual basis, through the year 2011.

Strategic Goal 6: Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.

Cost of Performance (in millions)
$665.26
Responsible Mission Directorates
Exploration Systems Science Space Operations

NASA's Vision for the future is clear. America's robotic and human explorers will venture farther into the solar system than ever before. The first stop on this exciting voyage will be the Moon, where robots, then humans, will explore the lunar surface in depth to supplement the work done by their Apollo predecessors. Early robotic missions will survey and characterize potential landing sites, as well as mining sites from which astronauts later can process lunar resources. Longer-duration lunar missions will enable astronauts to test new technologies for communications, computing, navigation, power generation, propulsion, habitation systems, and in-space construction and servicing processes. NASA and the Agency's partners are developing these technologies today to support achieving the Vision for Space Exploration tomorrow.

Reaping Benefits

NASA and the Agency's partners transfer advanced space exploration systems and capabilities—power generation, communications, computing, robotics, and improved materials from space exploration research and execution—to the commercial sector to serve public, national, and global needs. In the past, technologies developed for space exploration have yielded ground-based applications such as non-polluting solar energy systems, advanced batteries for laptop computers and cell phones, and fuel cells for electric vehicles.

Historically, space exploration has inspired industry, academia, and individual researchers to redefine what is "possible." NASA's Vision to expand the limits of robotic and human exploration through a technically ambitious portfolio of programs should provide even greater challenges and opportunities for personal development and future economic growth to NASA's extended family of visionary partners.

The activities under Strategic Goal 6 lay the groundwork for NASA's future human space exploration goals. Through the successful completion of these activities, NASA will have the technologies and capabilities to support humans on the Moon by the time the Orion Crew Exploration Vehicle and the Ares launch vehicles are fully operational. Along the way, these activities will benefit other efforts across NASA: new power generation and nuclear technologies will help future space exploration missions; autonomous systems and integrated systems health management can make air travel safer and more efficient; and improved space communications enable better data delivery to and from the Space Shuttle, the International Space Station, and robotic spacecraft.

Highlighting Achievements

In 2006, the Exploration Systems Mission Directorate initiated development of a multinational exploration strategy. Working with the worldwide community of space agencies, academia, and private sector stakeholders, the Exploration Systems Mission Directorate defined six primary lunar exploration themes that provide the high-level rationale for lunar exploration and a detailed set of over one hundred lunar exploration objectives. The Exploration Systems Mission Directorate and the Office of External Relations are engaged in discussions with 13 international space agencies to understand each agency's unique interests related to lunar exploration and to determine where NASA's interests overlap. The Exploration Systems Mission Directorate also is engaged in discussions with the private sector to understand the role that these organizations may play in future lunar exploration efforts.

During FY 2006, NASA established the Lunar Precursor and Robotic Program (previously called the Robotic Lunar Exploration Program) Office at Marshall Space Flight Center. The program will conduct a series of missions that support the overall lunar exploration effort, and may include missions that will investigate radiation protection and dust mitigation technologies.

In 2006, the Lunar Reconnaissance Orbiter (LRO) mission passed the Preliminary Design and Confirmation Reviews, where an external team reviewed plans for systems, software, and vehicle configuration and determined that the project should progress forward to the development stage. To take advantage of the launch vehicle's ability to carry two spacecraft, NASA also selected a secondary lunar mission, the Lunar Crater Observation and Sensing Satellite (LCROSS), to launch with LRO.

NASA is conducting a multi-Center effort to develop robotic vehicles capable of crossing a wide variety of terrains. As part of this effort, the Jet Propulsion Laboratory developed the All-Terrain Hex-Legged Extra-Terrestrial Explorer (ATHLETE). As the name suggests, ATHLETE is tough and flexible, able to roll over smooth terrain similar to the Apollo landing sites or walk (the wheels freeze to serve as “feet”) over extremely rough or steep terrain and sandy grades. On smooth terrain, ATHLETE can move more than a 100 times the speed of its Mars Exploration Rover cousins. ATHLETE can support robotic or human missions on the Moon by loading, transporting, manipulating, and depositing payloads almost anywhere. It can dock or mate with other devices, including refueling stations, excavation equipment, and other ATHLETE rovers to provide increased payload capacity. In FY 2006, the Jet Propulsion Laboratory demonstrated ATHLETE’s capabilities in desert field tests and conducted autonomous tests, during which two ATHLETE rovers docked together.

Engineers at the Jet Propulsion Laboratory conduct a docking experiment with two ATHLETE rovers. The legs move independently and offer six degrees of freedom for greater manipulation and balance. The robot responds to voice and gestures, enabling suited astronauts to direct it easily. ATHLETE’s shape allows it to fold up for compact stowage, and it can deploy itself at the destination. (NASA/JPL–Caltech)

Confronting Challenges

Currently, the major risk for the LRO mission is the schedule to meet the milestone to launch in 2008 set forth in the Vision for Space Exploration. Another schedule-related challenge is that LCROSS, as a design-to-cost mission, must stay on schedule to launch with LRO and to stay within its proposed cost.

Moving Forward

In November 2006, the Exploration Systems Mission Directorate plans to conduct the Critical Design Review for LRO, when NASA validates the LRO spacecraft design. If the design passes review, NASA’s mission partners will begin fabricating the spacecraft. The mission currently is scheduled to launch in October 2008.

NASA will pursue other activities in support of Goal 6 starting in FY 2007:

- The Exploration Systems Mission Directorate is conducting a lunar architecture study to identify the systems needed for lunar surface exploration and to determine when the systems must be available to meet NASA’s schedule. As part of this, the Exploration Systems Mission Directorate will determine the technology requirements for power, in-situ resource utilization, and autonomous systems.
- NASA engineers will demonstrate four processes for producing oxygen from lunar soil. This is an important step toward in-situ resource utilization, a necessary capability for long-duration lunar exploration.
- NASA will continue to test in a series of field campaigns advanced robotic systems working in collaboration with suited astronauts.
- NASA engineers will demonstrate advanced storage of cryogenic propellants to support long-duration orbiting of the Earth departure stage and the lunar lander.
- NASA engineers also will initiate non-nuclear, subscale tests of fission power conversion subsystems, as part of a larger effort to develop the fission surface power technology demonstration unit. The results of these activities would provide performance and cost data and reduce technical risk and cost uncertainties associated with the design and development of a nuclear flight power system.
- NASA researchers will begin a new project to investigate the effects of lunar dust on surface systems and humans. The researchers will use the results to develop techniques for minimizing dust accumulation.

Financial Overview

Financial Statements and Stewardship

NASA's financial statements, which appear in Part 3: Financials of this Performance and Accountability Report, are unaudited. The statements provide information regarding the financial position and results of the Agency's operations. Agency management is responsible for the integrity and objectivity of the financial information in these statements.

NASA prepared the financial statements and financial data presented throughout this Performance and Accountability Report from the Agency's financial management system and other Treasury reports in accordance with the requirements and formats prescribed by the Office of Management and Budget. The Agency's financial statements, notes, Required Supplementary Information, and Required Supplementary Stewardship Information are provided in Part 3: Financials of this Report.

Overview of Financial Position

The following table provides summary financial information for fiscal years 2006 and 2005. Significant changes in balances are discussed in the sections that follow.

(Dollars in Millions)

	Change 2006 Over 2005		Unaudited FY 2006		Unaudited FY 2005
Condensed Balance Sheet Data					
Fund Balance with Treasury	18%	$	9,585	$	8,146
Accounts Receivable	-6%		185		196
Inventory and Related Property, Net	-23%		2,330		3,019
Property, Plant, and Equipment	-5%		33,193		34,926
Other Assets	0%		17		17
Total Assets	**-2%**	**$**	**45,310**	**$**	**46,304**
Accounts Payable	-13%	$	1,848	$	2,132
Environmental and Disposal	8%		893		825
Other Liabilities	9%		572		526
Total Liabilities	**-5%**	**$**	**3,313**	**$**	**3,483**
Unexpended Appropriations	31%	$	6,981	$	5,318
Cumulative Results of Operations	-7%		35,016		37,503
Total Net Position	**-2%**	**$**	**41,997**	**$**	**42,821**
Total Liabilities and Net Position	**-2%**	**$**	**45,310**	**$**	**46,304**
Intragovernmental Net Costs	10%	$	403	$	367
Gross Costs with the Public	16%		17,268		14,927
Less: Earned Revenues from the Public	-67%		29		88
Total Net Cost of Operations	**17%**	**$**	**17,642**	**$**	**15,206**

Assets

NASA's Consolidated Balance Sheet shows that the Agency had total assets of $45.3 billion at the end of fiscal year 2006, compared with $46.3 billion in 2005. This represents a net decrease in assets of $994 million (2.1%). The decrease in net assets is a result of a decrease in the Agency's net General Property, Plant and Equipment (PP&E), due largely to the impact of current period depreciation.

NASA's Inventory and Related Property decreased by $689 million (22.8%) in FY 2006 as a result of a reclassification of certain reusable materials to PP&E. These items are in support of NASA's International Space Station, Shuttle and Hubble Space Telescope programs.

NASA's General PP&E, at $33.2 billion, represents 74% of the Agency's total assets as of September 30, 2006. This is a decrease of $1.7 billion (5%) from 2005 General PP&E balances. This decrease is primarily related to a decrease in net Theme Assets. Current period Theme Assets increased by $1.5 billion in 2006, offset by an increase in accumulated deprecation for Theme Assets of $3.4 billion. This resulted in a decrease in the net (book value) of the Agency's Theme Assets by $1.9 billion (12%).

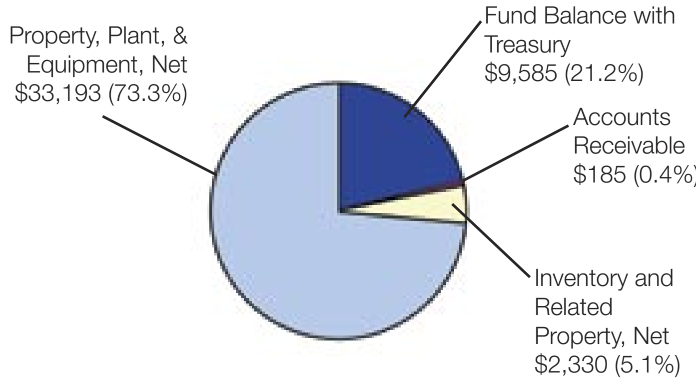
Theme Assets, at $14.5 billion, are the largest component of the Agency's General PP&E, representing 44% of General PP&E. Work-in-Process, at $13.2 billion, is the next largest component of total General PP&E (40%). Work-in-Process reflects the cost of equipment and facilities currently under construction. Total Work-in-Process decreased by $203 million (1.5%) in FY 2006.

NASA's contractors hold over 24% of the Agency's General PP&E. Difficulties substantiating the value of contractor-held General PP&E have contributed to a continuing material weakness identified by NASA's independent public auditors. NASA has developed improved internal controls for all types of PP&E. Those improvements will be implemented throughout 2007.

As one of those improvements, NASA is considering a change in its accounting policy for Theme Assets to reclassify some costs previously categorized as General Property, Plant & Equipment (PP&E) as Research and Development (R&D) expenses. In FY 2006, NASA drafted a policy to implement this change and requested that FASAB clarify the accounting standards the Agency used as the basis for the draft change. NASA anticipates a response from the Federal Accounting Standards Advisory Board (FASAB) in FY 2007.

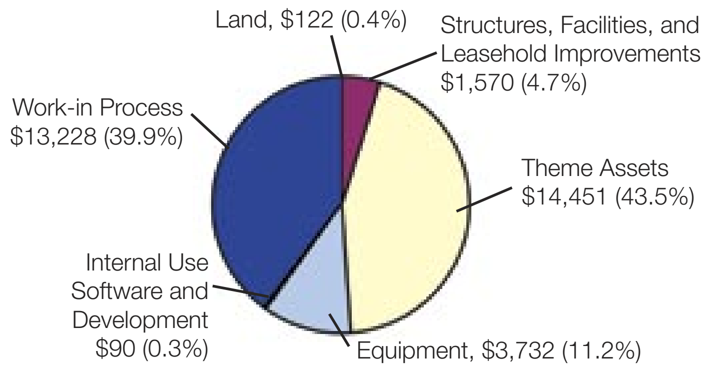
NASA's Fund Balance with Treasury (FBWT), at $9.6 billion, accounts for 21 % of the Agency's total assets. FBWT represents the Agency's "cash" account, and includes funds available for disbursement in support of NASA programs and projects.

Major Assets By Type (Dollars in Millions)
As of September 30, 2006



Total Assets $45,310 (amount includes other assets of $17 million)
Source: Consolidated Balance Sheet

General PP&E (Dollars in Millions)
As of September 30, 2006



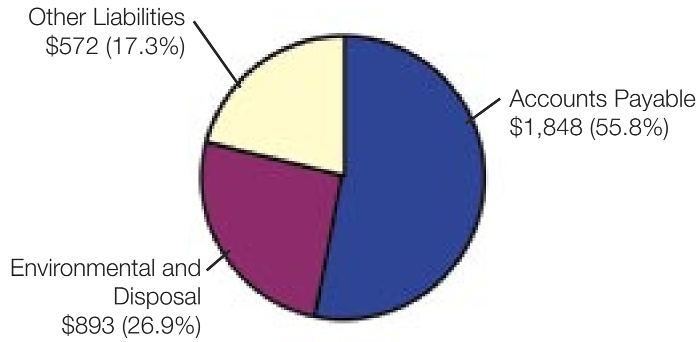
Total General PP&E $33,193
Source: Notes to FY 2006 Financial Statements, Note 7

Liabilities

The Agency had total liabilities of $3.3 billion as of September 30, 2006. This represents a decrease in total liabilities from fiscal year ends' 2006 to 2005 by $170 million. NASA's largest liability is its Accounts Payable. This balance is consistent with the accrued payables necessary to support NASA operations. NASA is compliant with all prompt payment regulations and is timely in its vendor payments, with only 0.001% of interest penalties paid on total non-credit card invoices. This compares favorably with the government standard of no more than 0.02%.

Environmental and Disposal liabilities represents estimated cleanup costs from NASA operations resulting from actual or anticipated contamination from waste disposal methods, leaks, spills, and other past activity that created a public health or environmental risk. This estimate could change in the future due to the identification of additional contamination, inflation, deflation, changes in technology or applicable laws and regulations. The estimate will also change through ordinary liquidation of these liabilities as the cleanup program continues into the future. The estimate represents the amount that NASA expects to spend in the future to remediate currently known contamination. NASA has implemented new procedures and tools to improve the accuracy and consistency of environmental cleanup estimates. Estimates increased this year from last year by 8%, from $825 million to $893 million.

Major Liabilities By Type (Dollars in Millions)
As of September 30, 2006



Total Liabilities $3,313
Source: Consolidated Balance Sheet

Ending Net Position

NASA's Net Position as of September 30, 2006, reported on the Consolidated Balance Sheet and the Consolidated Statement of Changes in Net Position, was $41.9 billion, a $824 million (1.9%) decrease from 2005. Net Position is the sum of Unexpended Appropriations and Cumulative Results of Operations.

NASA's Unexpended Appropriations increased by 31.3% in 2006, to $6.9 billion from $5.3 billion. The increase in Unexpended Appropriations is due principally to a delay in receiving this year's full apportionment that resulted in corresponding delays in incurring costs and disbursements.

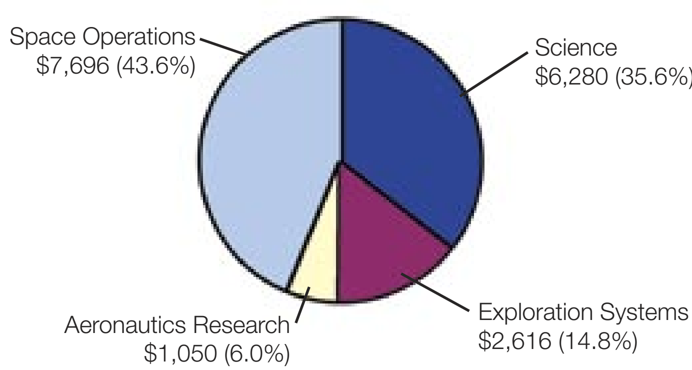
Results of Operations

NASA's total sources of funds available for 2006 operations were $20.1 billion. This compares with total sources of funds in FY 2005 of $20.2 billion, a decrease of 0.6%. Unobligated Balances, Brought Forward were $860 million (27.8%) less in 2006 than in 2005, reflecting the stabilization of Agency programs and projects related to the Vision for Space Exploration. NASA's Budgetary Authority increased by $408 million (2.3%) in 2006, to $17.7 billion.

The Consolidated Statement of Net Cost presents the Agency's gross and net costs by major business lines. The net cost of operations is the gross (total) cost incurred by the Agency, less any earned revenue from other government organizations or from the public. The Agency revised its accounting structure for 2006 to reflect the Agency's major business lines. This enhances the Agency's ability to track and assign costs by capturing them in the same structure used to manage the work, improving the ability to analyze and report on performance. Due to this change, it is not possible to generate a comparable Consolidated Statement of Net Cost for 2005.

The Agency's net cost of operations for 2006 was $17.6 billion. Space Operations (including NASA's

Uses of Funds (Dollars in Millions)
For the Fiscal Year Ended September 30, 2006



Total Uses of Funds $17,642
Source: Consolidated Statement of Net Cost

Shuttle and International Space Station programs), at $7.7 billion, and Science, at $6.3 billion, were the Agency's largest business lines in 2006.

Limitation of the Financial Statements

These financial statements have been prepared to report the financial position and results of operations for NASA pursuant to the requirements of Chapter 31 of the United States Code section 3515(b). While these statements have been prepared from the books and records of the Agency in accordance with U.S. generally accepted accounting principles (GAAP) for Federal entities and the formats prescribed by the Office of Management and Budget, these statements are, in addition to the financial reports, used to monitor and control the budgetary resources that are prepared from the same books and records. These statements should be read with the realization that they are for a component of the U.S. government, a sovereign entity.

Key Financial-Related Measures

Below is a table of key financial measures, as of September 30, 2006, consistent with the Chief Financial Officers (CFO) Council financial metrics.

Measure, Frequency, and Importance	NASA Sept. 2006	NASA Sept. 2005	Government-wide July 2006[1]	Government-wide Performance Standards		
				Fully Successful	Minimally Successful	Unsuccessful
Measure: Fund Balance With Treasury—Net Percentage Unreconciled **Frequency:** Monthly **Importance:** Smaller reconciliation differences indicate greater financial integrity	0.07%	0.7%	0.124%	< = 2%	> 2% to < = 10%	> 10%
Measure: Percentage of Amount in Suspense (Absolute) Greater than 60 Days Old **Frequency:** Quarterly **Importance:** Timely reconciliation supports clean audits and accurate financial information	58%	13.5%	60.9%	< = 10%	> 10% to < = 20%	> 20%
Measure: Percentage of Delinquent Accounts Receivable from Public Over 180 Days **Frequency:** Quarterly **Importance:** Actively collecting debt improves management accountability and reduces U.S. borrowing	8.75%	5.8%	13.63%	< = 10%	> 10% to < = 20%	> 20%
Measure: Percentage of Electronic Payments to Vendors **Frequency:** Monthly **Importance:** Electronic funds transfers reduces cost	99.4%	99.6%	95.61%	> = 96%	> = 90%	< 90%
Measure: Percentage of Non-Credit Card Invoices Paid on Time **Frequency:** Monthly **Importance:** Timely payment reduces interest charges	99.1%	95.0%	96.06%	> = 98%	< 98% to > = 97%	< 97%

Measure, Frequency, and Importance	NASA Sept. 2006	NASA Sept. 2005	Government-wide July 2006[1]	Government-wide Performance Standards		
				Fully Successful	Minimally Successful	Unsuccessful
Measure: Percentage of Interest Penalties Paid on Total Non-Credit Card Invoices **Frequency:** Monthly **Importance:** Smaller interest payments show that bills are paid on time and allows funds to be used for their intended purpose	0.001%	0.001%	0.014%	< = .02%	> .02% to < = .03%	> .03%
Measure: Travel Card Delinquency Rate—Individually Billed Accounts **Frequency:** Monthly **Importance:** Reducing outstanding travel card balances helps increase rebates to agencies	2.5%	2.5%	3.16%	< = 2%	> 2% to < = 4%	> 4%
Measure: Travel Card Delinquency Rate—Centrally Billed Account **Frequency:** Monthly **Importance:** Reducing outstanding travel card balances helps increase rebates to agencies	0.0%	0.0%	1.17%	0%	> 0% to < = 1.5%	> 1.5%
Measure: Purchase Card Delinquency Rate **Frequency:** Monthly **Importance:** Reducing outstanding purchase card balances helps increase rebates to agencies and reduces interest payments	0.0%	0.0%	0.98%	0%	> 0% to < = 1.5%	> 1.5%

[1]July 2006 data was the latest available for government-wide reporting from the Chief Financial Officer's Council's Metric Tracking System at publication of this report.

Overall, for FY 2006, the Agency's financial metrics improved due largely to the increased attention received from Agency and Center CFO offices and overall improvements to NASA's financial management internal controls including monthly reporting to the Agency CFO from each Center CFO.

Systems, Controls, & Legal Compliance

Overview

The *Federal Managers' Financial Integrity Act* (FMFIA) of 1982 requires federal agencies to establish "controls that reasonably ensure that (i) obligations and costs are in compliance with applicable law; (ii) funds, property, and other assets are safeguarded against loss, unauthorized use or misappropriation; and (iii) revenues and expenditures applicable to agency operations are properly recorded and accounted for to permit the preparation of accounts and reliable financial and statistical reports and to maintain accountability over the assets." In addition, the agency head annually must evaluate and report on the control and financial systems that protect the integrity of federal programs (Section 2 and Section 4 of FMFIA respectively).

Section 2 of FMFIA requires the head of each agency to submit a statement on whether there is reasonable assurance that the agency's controls are achieving their intended objectives and, as applicable, report on material weaknesses in the agency's controls. A separate statement on the effectiveness of internal controls over financial reporting is included as a subset of the overall assurance statement.

Section 4 of FMFIA requires a statement on whether the agency's financial management systems conform to government-wide requirements. In addition, the *Federal Financial Management Improvement Act* (FFMIA) of 1996 requires the agency head to evaluate and determine whether the financial management systems substantially comply with its requirements. The systems also must comply with any other applicable laws.

The Administrator's statement of assurance is based on information gathered from a variety of sources, including the Administrator's personal knowledge of NASA's day-to-day operations, existing controls, management program reviews, and other internal reports. If the Agency's systems do not comply with the FMFIA, the assurance statement must identify any material weaknesses and include NASA's corrective action plan to address those weaknesses.

This year, NASA began several initiatives to improve internal accounting and administrative control processes. As part of this effort, NASA's Office of the Chief Financial Officer established an Office of Quality Assurance to strengthen and improve both internal controls and NASA compliance with financial management policy, FMFIA, and requirements from the Office of Management and Budget (OMB). Personnel from the Office of Quality Assurance conducted on-site assessments to document and test key internal controls for compliance with FMFIA and OMB Circular A-123, Appendix A: *Internal Control over Financial Reporting*.

NASA further improved the Agency's internal accounting and administrative controls processes by taking the following actions: developing and distributing a new policy on internal controls; conducting training on the requirements and implementation of OMB Circular A-123, *Management's Responsibility for Internal Control*; assessing and testing financial statement line items and related processes; and analyzing 120 identified risks as supporting evidence for the Administrator's statement of assurance. The Officials-in-Charge of NASA Headquarters offices and the Agency's Center Directors identified these risks by submitting individual statements of assurance for their respective organizations to the NASA Administrator.

A NASA Headquarters team evaluated the 120 risks identified in the 28 statements of assurance and developed recommendations for consideration by the Operations Management Council, one of NASA's three governing bodies that provide senior-level oversight of NASA's operations. The Operations Management Council holds an annual meeting to confirm the deficiencies in Agency processes that will be reported as material weaknesses. This year, the Council recommended that two previously reported material weaknesses—Space Shuttle Return to Flight and Financial Management Data Integrity—be closed out; two previously reported material weaknesses—Asset Management and Financial Management System—continue to be reported as weaknesses; and Information Technology Security be raised from an internally tracked deficiency to an externally reported material weakness.

Management Assurances

November 15, 2006

NASA management is responsible for developing and maintaining effective internal controls and financial management systems that meet the objectives of the *Federal Managers Financial Integrity Act* (FMFIA). Based on the results of our FY 2006 assessment of the effectiveness and efficiency of operations, and compliance with applicable laws and regulations in accordance with OMB Circular A-123, *Management's Responsibility for Internal Control*, I am able to submit a qualified statement of assurance that NASA's internal controls and financial management systems meet the objectives of FMFIA. This assessment identified two material weaknesses, Asset Management and Information Technology Security, reported under Section 2 of FMFIA, and a third material weakness, Financial Management System, reported as a non-conformance under Section 4 of FMFIA. In FY 2006, NASA closed two previously reported material weaknesses: Space Shuttle Return to Flight and Financial Management Data Integrity. (A summary of the weaknesses and corrective action plans follow this statement.) Other than these exceptions, the Agency found no other material weaknesses in the design or operations of internal controls.

NASA also conducted an assessment focused on the effectiveness of internal control over financial reporting, which includes safeguarding of assets and compliance with applicable laws and regulations, in accordance with the requirements of Appendix A of OMB Circular A-123. NASA is taking a multi-year approach toward achieving compliance through the NASA Financial Management Internal Control (FMIC) Plan. This statement reflects the status of internal control over financial reporting for four significant line items as of June 30, 2006: Property, Plant, and Equipment; Fund Balance with Treasury; Material and Supplies; and Unfunded Environmental Liabilities. Based on the results of this evaluation, NASA identified one material weakness—Financial Management System—related to internal control over financial reporting. Other than this exception, the Agency found no additional material weaknesses in the design or operation of the internal controls over financial reporting. Due to the identified weakness and the scope of our assessment for FY 2006, NASA is only able to provide a qualified statement of assurance that the Agency's internal controls over financial reporting were operating effectively as of June 30, 2006.

In accordance with the *Federal Financial Management Improvement Act* (FFMIA), NASA management is responsible for implementing and maintaining financial management systems that substantially comply with federal systems requirements, applicable federal accounting standards, and the U.S. Government Standard General Ledger (SGL) at the transaction level. Due to several remaining corrective actions defined in the Agency's 2005 Corrective Action Plan, NASA's financial management systems are not substantially compliant with the requirements of the Act as of September 30, 2006.

As explained in the auditor's report in Part 3: Financials, NASA's independent auditors were unable to render an opinion on our FY 2006 financial statements and issued a disclaimer of opinion. Therefore, I cannot provide reasonable assurance that the financial data in this report are complete and reliable. As we face the many challenges ahead of us, we will focus on bringing NASA's financial management system into compliance.

Michael D. Griffin
Administrator

Corrective Action Plan

New Material Weakness

Information Technology (IT) Security

FMFIA Section 2 Weakness

Responsible Official: Chief Information Officer

Description: NASA's IT Security Program needs more effective implementation, monitoring, enforcement, verification, and validation. NASA's policy and procedures are not consistent with new OMB directives, and the Agency's systems are noncompliant with the *Federal Information Security Management Act of 2002*. This deficiency affects mission accomplishment by compromising the integrity, availability, and confidentiality of mission critical data. The operational efficiency of the Agency also is hampered by the inconsistent application of security solutions at different Centers. If this weakness goes unchecked, mission resources may have to be reallocated to bring the Agency's IT systems into compliance.

Corrective Action Plan: NASA has been improving IT security for the past three years through a corrective action plan that made changes to the Agency's IT security policies and requirements. In FY 2006, NASA updated and distributed a new NASA IT security policy, established standard operating procedures to meet Agency requirements, and updated NASA's IT security training and certification programs. Despite these changes, recent IT security incidents and Office of Inspector General audit results revealed that the same problems still exist. Therefore, in FY 2007, NASA will: establish independent methods for verifying and validating processes related to IT security; create an organizational structure that will assure consistency in the way that Centers implement new IT security processes; and, revise IT security clauses for use in NASA contracts.

Continuing Material Weaknesses

Asset Management

FMFIA Section 2 Weakness

Responsible Official: Chief Financial Officer

Description: NASA's lack of proper management controls has resulted in inconsistent financial recording practices contributing to misstated asset values and period expenses. Therefore, NASA needs to improve the Agency's management controls for the financial accounting and reporting of NASA owned Property, Plant, and Equipment; materials; space parts; and other assets. The Agency also needs to improve accounting for contractor-held property.

Corrective Action Plan: The Agency's strategy for addressing this material weakness is to align NASA's policies, processes, and systems with published accounting standards and appropriate accounting standards-setting organizations. As part of this strategy, NASA revised the Agency's asset capitalization policy (currently under review by the Federal Accounting Standards Advisory Board). NASA also used working groups to identify solutions and implementation plans for process and system gaps between current and desired business processes. In addition, the Agency implemented a new Procurement Information Circular to improve accounting for property furnished to contractors, including transfers, retirement, and recovery of government property.

Financial Management System

FMFIA Section 4 Weakness

Responsible Official: Chief Financial Officer

Description: In FY 2003, NASA implemented the Core Financial Module of the Integrated Enterprise Management System. The Core Financial Module replaced all disparate Center-level accounting systems, the NASA Headquarters accounting system, and approximately 120 ancillary systems. However, NASA management identified significant errors in the data produced by Core Financial Module beginning in September 2003 as a result of problems in the conversion effort and system configuration. Limitations in Core Financial Module software still require the implementation of compensating controls and systems, further complicating the resolution of this weakness.

Corrective Action Plan: NASA continues to develop and implement procedures for identifying and validating the Agency's financial data and processes. In FY 2006, these efforts included aligning internal controls with authoritative guidance and implementing automated financial system functions to complement process changes. Specific progress toward improving this material weakness included:

- Developing and distributing a monthly schedule with due dates generated by a cross-Agency task team for data processing, reconciliations, verifications, feedback, and reports;
- Performing periodic controls reviews and reconciliations at all Centers for 23 specific activities, after which each Center developed a corrective action plan (monitored monthly by Headquarters) to assure the timely resolution of anomalies;
- Completing financial management internal control assessments and testing for four significant accounts (Fund Balance with Treasury; Property, Plant, and Equipment; Material and Supplies; and Environmental Liabilities) in accordance with the NASA Financial Management Internal Control Plan. In June 2006, NASA updated and submitted this plan to OMB;
- Reviewing, validating and redesigning NASA's financial statements to ensure accuracy of reporting and consistency with the requirement of OMB Circular A-136, *Financial Reporting Requirements*;
- Producing monthly financial statements directly from the Core Financial system within 30 days after the closing of each period. This process included documenting data anomalies or corrections and preparing of statement analyses; and
- Modifying the Agency's Statement of Net Cost to provide a breakdown of net costs by major lines of business, consistent with OMB Circular A-136.

Closed Items

Space Shuttle Return to Flight

FMFIA Section 2 Weakness

Responsible Official: Associate Administrator for Space Operations Mission Directorate

Description: The loss of the Space Shuttle *Columbia* in 2003 revealed a material weakness centered on loss of control and enforcement of NASA's standards of technical excellence, safety, teamwork, and integrity.

Corrective Action Plan: NASA established a formal Return to Flight (RTF) Planning Team to manage all aspects of a safe return to flight, including complying with the recommendations of the Columbia Accident Investigation Board. The Space Flight Leadership Council, co-chaired by the Associate Administrator for Space Operations and the Deputy Chief Engineer for Independent Technical Authority, assessed the options and recommendations from the RTF Planning Team. Through this process, NASA identified the technical causes and systemic cultural, organizational, and managerial issues associated with the *Columbia* accident. NASA then addressed the deficiencies by implementing a governance structure that includes forums for open discussions of technical and safety issues.

Following the completion of major test flight objectives on STS-121 in July 2006, only one vehicle modification remains—the Ice Frost Ramp design—scheduled for testing in February 2007 aboard STS-117. Therefore, NASA's Operations Management Council removed the Space Shuttle RTF as a material weakness based on evidence that the technical and cultural issues contributing to the *Columbia* accident have been corrected.

Financial Management Data Integrity

FMFIA Section 2 Weakness

Responsible Official: Chief Financial Officer

Description: This material weakness focused on two identified challenges: Fund Balance with Treasury differences and estimating environmental liabilities. Weaknesses in NASA's procedures for reconciling items resulted in unexplained differences in the Agency's Fund Balance with Treasury account, as compared to Treasury balances. Weaknesses in NASA's procedures for generating estimates of its Unfunded Environmental Liabilities resulted in a lack of auditable evidence to support estimates of environmental liabilities.

Corrective Action Plan: NASA established additional reconciliation controls and procedures at all Centers and at Headquarters to assure consistent access to the data required for Agency oversight. NASA also developed and implemented a process for estimating environmental liabilities in a consistent manner and held joint training classes for the environmental engineers and accountants responsible for identifying and reporting environmental liabilities to assure consistent application of policies and procedures. Additional performance reporting, in the form of a monthly review of Center corrective action plans and monthly financial metrics, also contributed to resolution of this weakness. As a result of these improvements, the Operations Management Council removed this item from the reported material weakness list.

Office of the Inspector General Statement on Material Weaknesses at the Agency

National Aeronautics and
Space Administration

Office of Inspector General
Washington, DC 20546-0001

NOV 9 2006

TO: Administrator

FROM: Inspector General

SUBJECT: NASA's Most Serious Management and Performance Challenges

As required by the Reports Consolidation Act of 2000, these are our views of the most serious management and performance challenges facing NASA. NASA is working to address these challenges and improve Agency programs and operations through various initiatives and by implementing recommendations made by the Office of Inspector General (OIG) and other evaluative bodies, such as the Government Accountability Office (GAO). An overarching challenge concerns how the Agency integrates diverse programmatic and institutional functions that are geographically dispersed. Each of the five challenges listed below, and summarized in the enclosure, is colored by this overarching challenge.

- **Transitioning from the Space Shuttle to the Next Generation of Space Vehicles.** Effectively planning, implementing, and measuring transition activities while maintaining the capabilities required to fly the Space Shuttle safely and effectively.

- **Managing Risk to People, Equipment, and Mission.** In the context of very challenging launch and mission schedules, ensuring that risk management, safety, and mission assurance controls operate robustly and reliably.

- **Financial Management.** Continuing to resolve internal control problems, which led to four consecutive disclaimers of opinion on NASA's financial statements, including FY 2006, and ensuring that the Integrated Enterprise Management Program (IEMP) improves NASA's ability to accurately allocate costs to programs, efficiently provides reliable information to management, and supports compliance with the Chief Financial Officers Act.

- **Information Technology (IT) Security.** Continuing efforts to enhance IT security by addressing significant weaknesses in controls.

- **Acquisition and Contracting Processes.** Ensuring that requirements are identified before the start of each project and that resources are properly matched with those requirements during the execution of the project.

Transitioning from the Space Shuttle to the next-generation space vehicles, which is key to implementing the President's Vision for Space Exploration,[1] was added as a most serious challenge last year. A draft OIG audit report on the transition process[2] discusses NASA's lack of a comprehensive transition plan that addresses issues critical for efficient and effective management of that process.

The Agency has focused considerable effort on safely returning the Space Shuttle to flight and completing the International Space Station. As a result, we removed the completion of the International Space Station from this year's challenges and refocused last year's challenge of "Continuing to Correct the Serious Organizational and Technical Deficiencies that Contributed to the Columbia Accident in 2003" to "Managing Risk to People, Equipment, and Mission."

NASA's financial management remains on the list of challenges because of continued internal control weaknesses affecting the Agency's ability to produce complete and accurate financial statements. In addition, during FY 2006, we reported on Antideficiency Act violations that the Administrator was required to report to the President, Congress, and the Office of Management and Budget.

Although we removed IT security from last year's list of challenges, we have again included it as a most serious management and performance challenge. The Agency has been responsive to our recommendations, and the Office of the Chief Information Officer has implemented policies and procedures that strengthen the Agency's IT security internal controls. However, our audit and investigative work shows that significant weaknesses persist and many IT security challenges remain.

In the past, various aspects of NASA's acquisition process and contract management have been included as a most serious management challenge. Over the past year, OIG and GAO audits and investigations have revealed additional indications of systemic problems in these areas, leading to the addition of the acquisition and contracting processes as a management challenge this year.

If you have any questions, or need additional information, please call me at 202-358-1220.

Robert W Cobb

Robert W. Cobb

Enclosure

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[1] "A Renewed Spirit of Discovery: The President's Vision for U.S. Space Exploration," January 2004.

[2] The final audit report will be issued in December 2006.

NASA's Most Serious Management and Performance Challenges

Transitioning from the Space Shuttle to the Next Generation of Space Vehicles

As part of the President's 2004 Vision for Space Exploration, NASA was directed to return the Space Shuttle to flight as soon as practical, focus the use of the Space Shuttle to complete the International Space Station (ISS), and retire the Space Shuttle by 2010. With respect to the broader space mission, the President directed NASA to develop new vehicles to provide crew transportation for missions beyond low Earth orbit. One of the key challenges associated with achieving the President's Vision is for NASA to maintain the capabilities required to fly the Space Shuttle safely and effectively while transitioning human capital and critical skills, real and personal property, and related capabilities to support projects within the Constellation Systems Program,[3] such as the Crew Exploration Vehicle (CEV) and the Crew Launch Vehicle (CLV).

To manage the transition, NASA established a Transition Governance Structure comprising transition managers and control boards appointed at the Agency, Directorate, Center, program, and project levels. The Transition Governance Structure includes representatives from two of NASA's four Mission Directorates—the Space Operations Mission Directorate (SOMD) and the Exploration Systems Mission Directorate (ESMD)—and representatives from NASA's Mission Support Offices. SOMD is responsible for operating the Space Shuttle Program (SSP) until its retirement in 2010 and for managing the completion and use of the ISS. ESMD is responsible for the Constellation Systems Program. The Mission Support Offices provide the institutional capabilities to support transition. The responsibilities of the transition managers and control boards include evaluating transition decisions to ensure that the decisions promote efficiencies and synergies between the human space flight programs; ensuring that existing infrastructure and resources evolve to future programs; and ensuring that strategies, decision-making, priorities, budgets, schedules, and top-level development and operational requirements are coordinated among ESMD, SOMD, and the appropriate Mission Support Offices.

In addition to establishing the Transition Governance Structure, NASA also developed a draft transition plan describing how the Agency will transition from operating the Space Shuttle and the ISS to flying the CEV and exploring the Moon and beyond. Version 7 of the draft transition plan, "Human Space Flight Transition Plan," undated, discusses topics such as transition management, acquisition, budget, data and records management, environmental management, human capital, information technology, property, and transition metrics. NASA is also developing the National Space Transportation System 07700, Volume XX, "Space Shuttle Program Transition and Retirement Requirements," to document the requirements for managing the SSP's end-of-program transition.

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[3] The Constellation Systems Program is responsible for developing the next-generation space vehicles and the related exploration architecture systems.

Enclosure
Page 1 of 7

The success of the transition effort is dependent on the development of a comprehensive plan for the transition and the timely execution of that plan.[4] The comprehensive plan must focus on transition requirements and how those requirements intersect with the requirements of three major programs involved in transition—Space Shuttle, ISS, and Constellation—recognizing that changes in requirements within any of those programs will not only have an effect on the overall transition effort but may also directly affect the other programs. Since the initial architecture for the next generation of space vehicles was announced, NASA has revised the size, configuration, and hardware for those vehicles and extended the completion date for the CEV. Because the initial architecture was developed to take advantage of SSP technology and workforce assets, the revisions not only impact the acquisition of the new vehicles, but may also impact SSP closeout activities.

The transition effort poses a tremendous challenge to NASA, and the planning, implementing, and measuring of transition requirements should be tracked from the highest management levels of the Agency.

Managing Risk to People, Equipment, and Mission

In FY 2006, NASA launched two Space Shuttle missions to the International Space Station notwithstanding concerns raised by engineers and safety officials. In January 2006, NASA proceeded with the New Horizons launch, also notwithstanding objections from safety and mission assurance officials. We have no basis to question the decision to proceed in any of these launches. Furthermore, we applaud the fact that those who have a technical basis to object to launch of missions are empowered to voice concerns. On the other hand, the lack of technical consensus at late stages of pre-launch activities suggests that launch vehicles' compliance with launch requirements is less than optimal.

In the context of the objective to complete the International Space Station by 2010, where a decision to forgo launching a Space Shuttle mission in a given launch window creates risk to meeting the objective, there is schedule pressure. NASA must guard against this pressure manifesting itself in the acceptance of undue risk. We recognize that the complex effort to balance mission execution in defined timeframes against the imperfections of hardware, while ensuring that a robust process exists for voicing safety and engineering concerns, is a serious performance and management challenge to the Agency.

Financial Management

In FY 2003, NASA converted its accounting data from 10 separate systems to a single Integrated Enterprise Management Program (IEMP). The backbone of IEMP is the Core Financial module. However, despite substantial investment, in both time and money, into the development and implementation of the Core Financial module, NASA still cannot produce

[4] The OIG initiated an audit in January 2006 to evaluate NASA's plans for managing the Space Shuttle's retirement and transition to the CEV and CLV. We expect to issue the audit report in December 2006.

auditable financial statements—a key goal of the module. NASA has made progress in addressing material weaknesses and other deficiencies but improving financial management remains a formidable challenge.

NASA received a disclaimer of opinion on its financial statements as a result of the Independent Public Accountant (IPA) audits in FY 2003 by PricewaterhouseCoopers and in FY 2004, FY 2005, and FY 2006 by Ernst & Young LLP (E&Y) because NASA has been unable to provide auditable financial statements and sufficient evidence to support statements throughout the fiscal year. The IPAs' reports identified instances of noncompliance with generally accepted accounting principles, reportable conditions (with most being material weaknesses) in internal controls, and noncompliance with the Federal Financial Management Improvement Act of 1996 and the Improper Payments Information Act of 2002. Many of the weaknesses the audits disclosed resulted from a lack of effective internal control procedures and data integrity issues.

Two of the most significant material weaknesses involve NASA's internal controls over property, plant, and equipment and materials (PP&E) and the financial statement preparation oversight and process. As shown in the following table, these weaknesses have been reported for several years.

Internal Control Deficiencies

Fiscal Year		2006	2005	2004	2003	2002
Independent Public Accountant		E&Y	E&Y	E&Y	PwC[1]	PwC
Audit Opinion		Disclaimer	Disclaimer	Disclaimer	Disclaimer	Unqualified
Internal Control Deficiencies	General Controls Environment[2]	—	—	material weakness	reportable condition	reportable condition
	Property, Plant, and Equipment and Materials	material weakness	material weakness	material weakness	material weakness	material weakness
	Financial Statement Preparation Process and Oversight	material weakness	material weakness	material weakness	material weakness	material weakness
	Fund Balance with Treasury[3]	—	material weakness	material weakness	material weakness	—
	Audit Trail and Documentation to Support Financial Statements[4]	—	—	—	material weakness	—
	Environmental Liability Estimation[5]	—	reportable condition	reportable condition	—	—

[1] PricewaterhouseCoopers.

[2] The General Controls Environment weakness had mostly been resolved for FY 2005. The segregation of duties component of this weakness was included in the Financial Statement Preparation Process and Oversight weakness for FYs 2005 and 2006.

[3] The weakness cited for Fund Balance with Treasury reconciliations cited in FY 2005 had mostly been resolved; a weakness relating to timely resolution of Budget Clearing Account balances was included in the overall Financial Statement Preparation Process and Oversight weakness for FY 2006.

[4] The weakness on Audit Trail cited in FY 2003 continued to exist in subsequent years (FYs 2004–2006); however, it was included in the overall Financial Statement Preparation Process and Oversight weakness.

[5] The deficiency cited for Environmental Liability Estimation had mostly been resolved for FY 2006. Control deficiencies surrounding the software application used to prepare the estimates and a lack of appropriate OCFO involvement in related accounting matters were included in the Financial Statement Preparation Process and Oversight weakness for FY 2006.

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NASA has made significant progress in correcting two of the four deficiencies noted in FY 2005; specifically, Fund Balance with Treasury (FBWT) and Environmental Liability Estimation. NASA demonstrated its progress in correcting the FBWT material weakness by substantially resolving outstanding reconciliation items from prior periods at year-end and introducing reconciliation procedures that track current period differences. For the Environmental Liability Estimation deficiency, progress was made in documenting the environmental liability estimation process and training the engineers who prepare the estimates.

NASA is also working to ensure that the Office of the Chief Financial Officer (OCFO) is adequately staffed to address its challenges, enhance the OCFO's financial management skills, and provide value-added financial management support to the Agency's mission. In September 2006, the OCFO completed a workforce planning assessment at Headquarters and each Center's OCFO.

Some of the challenges noted in the workforce assessment report are the need for an increase in

- analytical skills, understanding of full-cost accounting, and property accounting;
- project management knowledge;
- succession planning; and
- flexibility to respond to program, process, and policy changes.

The OCFO also needs to fill some key leadership positions, such as the Chief of the External Reporting Branch, who is responsible for preparing NASA's financial statements.

To further address its financial management deficiencies, NASA initiated the Systems, Applications, and Products (SAP) Version Update Project in September 2005 to update the Core Financial module to the most recent version of SAP. NASA plans to implement the update in November 2006. The update contains code fixes and redesigns based on issues encountered in previous versions of the software. Once the update is complete, NASA expects to have the ability to use the Agency's Operating and Execution Plans as the funds distribution control mechanism; establish lower levels of funds control; record commitments and obligations at their time of approval; more efficiently and effectively identify, investigate, and resolve errors on purchase orders; generate cost accruals; and streamline the year-end closing processes. According to NASA, those abilities will enhance its financial tracking and reporting capabilities, which are vital to achieving an unqualified audit opinion.

In response to a request by the House Committee on Science, Subcommittee on Space and Aeronautics, NASA prepared a corrective action plan to address the material weaknesses and recommendations noted in the FY 2005 financial statement audit report. NASA implemented periodic monitoring activities as an Agency-wide key control. These activities include reviewing and analyzing each Center's financial data to identify inaccurate data, abnormal balances, account relationship differences, and other financial reporting anomalies resulting in reporting discrepancies. While these monitoring activities identified issues requiring immediate attention by NASA management, they could be improved because Headquarters guidance to the Centers is not always clear and is open to interpretation by Center personnel.

NASA still needs to ensure that it develops and implements comprehensive corrective action plans, within parameters set by financial management and accounting laws and regulations, which are the collaborative product of NASA program and institutional leadership. The plans must address the FY 2006 IPA findings and NASA's internally identified material weaknesses noted in the Administrator's Statement of Assurance, and the plans must be detailed enough to ensure successful implementation with desired results. The OIG will continue to work with Agency leadership toward solutions.

Information Technology (IT) Security

Despite the progress NASA made in improving its IT security program, systemic IT security weaknesses persisted and many IT security challenges remain. Specifically, our audits and assessments found recurring and significant internal control weaknesses related to IT security, including patch management, monitoring of critical system activities, backup of systems, and certification of IT systems. In addition, several NASA Centers have experienced IT security incidents, which the OIG is investigating. As a result, NASA's FY 2006 Federal Information Security Management Act report to the Office of Management and Budget identified the IT security program as a material weakness. Elevating NASA's IT security program to a material weakness should help focus management's attention and resource decisions on the program's shortcomings. In addition, the Deputy Administrator has mandated a comprehensive, NASA-wide IT security review that should result in recommendations to improve the Agency's IT security posture.

Because of the sensitivity of IT security vulnerabilities, we are not providing details on specific weaknesses in this document. However, we have provided the Agency detailed information on vulnerabilities as well as recommendations for corrective action in reports and other controlled documents.

Acquisition and Contracting Processes

In a December 2005 report to the Chairmen of the House and Senate Appropriations Committees, we identified a number of trouble areas in NASA's acquisition and contracting processes that were uncovered in our audit and investigative work, including

- inadequate control over Government property held by contractors,
- single-bidder contracts with undefined and changing contract requirements,
- lack of transparency to subcontractors working on NASA programs,
- questionable contract management practices under NASA's Small Business Innovation Research (SBIR) program,

- procurement process abuses by NASA employees and contractors, and
- significant cost overruns in some Agency programs.

GAO first identified NASA's contract management as a high-risk area in 1990 and reiterated that assessment in 2005, citing NASA's lack of a modern, fully implemented integrated financial management system; undisciplined cost-estimating processes in project development; and project mangers' inability to obtain information needed to assess contract progress. Over the past year, GAO audits have revealed additional indications of systemic problems in NASA's acquisition process.

Given that NASA spends about 85 percent of its annual budget on contracts, these weaknesses pose significant challenges to NASA's ability to make informed investment decisions and implement appropriate corrective actions.

Improving Acquisition Integrity. OIG audits and investigations during FY 2006 revealed continued, systemic problems in the contract area. The OIG has worked closely with the NASA Office of the General Counsel to promote NASA's implementation of a new Agency-wide Acquisition Integrity Program, which NASA leadership has endorsed. The program is designed to enhance NASA's internal control framework for ensuring integrity in its contracts, promoting competition in contracting, and identifying and addressing wrongdoing by contractors. As part of this, a remedy coordination official will ensure that there is an Agency-wide approach to NASA's administration of civil, administrative, and contractual remedies resulting from investigations, audits, or other examinations related to procurement activities. The new program will provide NASA with a more structured and thoughtful approach for administering contract remedies, sharing best practices, improving internal controls, and raising employee awareness of procurement fraud indicators.

Competition in Contracting. In December 2003, the OIG received allegations that the Boeing Company unfairly secured a NASA Launch Services task order for 19 NASA expendable launch vehicle missions using proprietary data from Lockheed Martin. An OIG investigation disclosed that Boeing's possession and use of Lockheed's proprietary data plus the unfair advantage the company had gained in the Air Force's Evolved Expandable Launch Vehicle Program contract enabled Boeing to persuade NASA to award the 19 expendable launch vehicle missions on a sole-source basis. NASA received $106.7 million from the $615 million settlement the U.S. Government received from Boeing for its improper use of proprietary data.

Undefinitized Contracts. In 2001, GAO identified undefinitized contracts as an issue requiring NASA management attention. Although the Agency appropriately addressed the findings raised by GAO, the issue has returned. A 2006 OIG audit report[5] on subcontract management noted that NASA took more than a year to definitize a contract action, which increased the risk of unanticipated cost growth and delayed NASA's ability to negotiate a fair

[5] "Subcontract Management by United Space Alliance under the Space Flight Operations Contract" (IG-06-013, August 28, 2006)

and reasonable cost. Another 2006 OIG audit report[6] identified that NASA experienced unanticipated cost growth when it issued a letter directing a contractor to commence building and roof repairs during the aftermath of Hurricane Katrina. NASA had estimated the work effort at $991,000, but because the work effort was unclear, and because there was no *Not-To-Exceed* amount in the "letter contract," the contractor later reported costs exceeding $7 million. Recently, the Agency again identified undefinitized contracts as an area warranting senior management attention and raised the question of whether the Agency had implemented sufficient internal controls to prevent the use of this form of contracting from becoming a management weakness.

Lack of a Knowledge-based Acquisition Framework. GAO found that NASA's acquisition policies lacked major decision reviews beyond the initial project approval phase and lacked a standard set of criteria with which to measure projects at crucial phases in the development life-cycle. In response, NASA agreed to apply a knowledge-based acquisition approach, to include incremental markers that ensured adequate knowledge is attained at key decision points before proceeding to the next project phase. A standardized, knowledge-based acquisition approach will help NASA evaluate competing budgetary priorities and enhance the Agency's ability to make difficult decisions regarding investments and the continuation of projects. It is imperative that results of the decision reviews be monitored and reported to the appropriate decision authority where decision makers can reassess whether continued investment in a program or project is warranted. For example, GAO stated that, to help mitigate risks to the CEV project, NASA must ensure that decision reviews are completed at key junctures during the project's development.

Managing Program Costs. In a review of selected NASA programs, GAO found that NASA lacked the disciplined cost-estimating processes and financial and performance management systems needed to establish priorities, quantify risks, and manage program costs. GAO noted that until NASA has the data, tools, and analytical skills needed to alert program managers of potential cost overruns and schedule delays, allowing them to take corrective action before problems occur, the Agency will continue to face challenges in effectively overseeing its contractors. NASA has experienced cost overruns on some of its major programs, most notably the International Space Station. The Agency has also disclosed that it experienced cost overruns in its effort to return the Space Shuttle to flight and the James Webb Telescope Program.

[6] "Final Memorandum on the Audit of the Management of Hurricane Katrina Disaster Relief Efforts" (ML-06-009, August 29, 2006)

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Federal Financial Management Improvement Act

NASA assessed the Agency's financial management systems to determine whether they comply with the requirements of the *Federal Financial Management Improvement Act* (FFMIA) of 1996. The assessment was based on guidance issued by the Office of Management and Budget (OMB). NASA management agrees with the findings set forth in the independent auditor's Report on Compliance with Laws and Regulations.

NASA is in the process of implementing remaining corrective actions from its 2005 Corrective Action Plan that address the Agency's FFMIA weaknesses. Those corrective actions are intended to resolve the following:

- Certain weaknesses in financial management process controls, primarily related to the Agency's Property, Plant and Equipment;
- Limitations in NASA's Core Financial Module software that continue to require compensating controls and systems; and
- Incorrect postings to certain general ledger accounts due to system configuration or design issues.

As of September 30, 2006, NASA financial management systems do not substantially comply with federal financial management systems standards and requirements.

Improper Payments Information Act

The *Improper Payments Information Act* (IPIA) of 2002 requires federal agencies to review their programs and activities annually to identify those that are susceptible to risk. OMB guidance defines significant improper payments as annual improper payments in a Line of Business or Program that exceed both 2.5 percent of program payments and $10 million. Agencies are required to identify any programs and activities at risk, report the annual amount of improper payments, and implement corrective actions. NASA's improper payment risk assessments identify existing and emerging vulnerabilities that can be reduced through corrective actions and that may produce a corresponding increase in program savings for the Agency.

In FY 2006, NASA continued to improve the Agency's internal controls by establishing policies and procedures in NASA's *Financial Management Requirements* (FMR), *Volume 19: Periodic Monitoring Controls Activities*, and by requiring that all NASA Field Centers perform 23 financial reconciliations or verifications on a scheduled basis. The Agency also established a Quality Assurance Office within the Office of the Chief Financial Officer to provide direction and focus for NASA Internal Control activities.

NASA's Efforts to Identify Erroneous/Improper Payments

NASA reviews historical performance from the Office of the Chief Financial Officer to identify programs and activities susceptible to significant improper payments. NASA's assessed risk and actual results for the past three fiscal years have shown NASA's improper payments to be less than 2.5 percent of program payments and less than $10 million.

In FY 2006, the Office of the Chief Financial Officer expedited the identification and recapturing of improper payments that may have occurred at NASA Centers by implementing new processes based on OMB Memoranda M-03-07, *Programs to Identify and Recover Erroneous Payments to Contractors*. NASA further strengthened the Agency's approach for addressing IPIA requirements by conducting an erroneous/improper payment assessment on all the research and development contract disbursements processed between FY 1997 and FY 2005, with a cumulative value of approximately $57.5 billion, as depicted in the chart below. The assessment validated that NASA's susceptibility to improper payments is low under current guidance. (Note: The Improper Payment Reduction Outlook chart required by OMB Circular A-136, *Financial Reporting Requirements*, is not included in this report because NASA identified no programs susceptible to significant risk.)

NASA's Planned Fiscal Year 2007 IPIA Compliance Approach

In FY 2007, NASA plans to perform a risk assessment of the Agency's commercial and non-commercial disbursement activities based on lessons learned from the FY 1997 to FY 2005 results of audit recovery activities (see table below), and guidance from OMB Memorandum M-06-23, *Issuance of Appendix C to OMB Circular A-123*, August 10, 2006. NASA also plans to re-compete the Agency's recovery audit services contract.

NASA's recovery audit results are shown below:

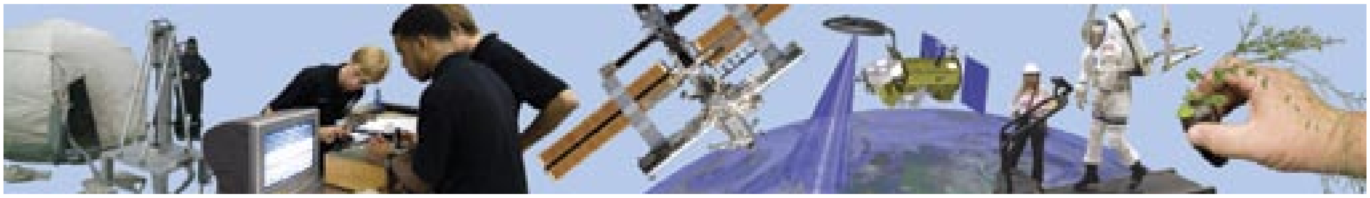
NASA FY 1997 to FY 2005 Recovery Audit Summary						
Agency Component	Actual Amount Reviewed and Reported		Amounts Identified for Recovery		Amounts Recovered, Current Year	
Ames Research Center	N/A		$	9,608.00	$	9,608.00
Glenn Research Center	N/A		$	6,254.00	$	—
Langley Research Center	N/A		$	—	$	—
Dryden Flight Research Center	N/A		$	9,312.00	$	—
Goddard Space Flight Center	N/A		$	17,634.87	$	—
Marshall Space Flight Center	N/A		$	111,276.66	$	111,276.66
Johnson Space Center	N/A		$	99,200.00	$	15,566.00
Kennedy Space Center	N/A		$	2,969.00	$	2,969.00
Total	**$**	**57,439,000,000.00**	**$**	**256,254.53**	**$**	**139,419.66**

Legal Compliance

NASA's Annual Performance and Accountability Report must meet legislative and regulatory government-wide requirements established by Congress and OMB. The table below lists these requirements and indicates where in this Report each requirement is satisfied.

Summary of Legislative and Regulatory Requirements			
Legislation	Guidance	Summary of Requirements	Comments
Reports Consolidation Act of 2000	—	Authorizes the combining of performance and financial reports into a consolidated Performance and Accountability Report (PAR). Requires a statement on the reliability and completeness of the data contained in the report.	The statement of reliability and completeness is included in the Administrator's transmittal letter.
Government Performance Results Act of 1993	OMB Circular A-11 Part 6, *Preparation and Submission of Strategic Plans, Annual Performance Plans, and Annual Program Performance Reports* OMB Circular A-136, *Federal Financial Accounting Standards*	Provides for the establishment of strategic planning and performance measurement in the federal government. Mandates that agencies prepare strategic plans, performance plans, and report on the results.	Parts 1 and 2 of this report contain information on NASA's performance results for FY 2006.
Federal Managers Financial Integrity Act of 1982	OMB Circular A-123, *Management's Responsibility for Internal Control*	Requires ongoing evaluation of and reporting on the adequacy of the systems of internal accounting and administrative control.	The FMFIA statement is included in Systems, Controls, & Legal Compliance.
Federal Financial Management Improvement Act of 1996	January 4, 2001 OMB Memorandum, Revised Implementation Guidance for FFMIA	Requires a determination and report on the substantial compliance of agency systems with federal financial management system requirements, federal accounting standards, and the U.S. government Standard General Ledger at the transaction level.	FFMIA is addressed in Systems, Controls, & Legal Compliance.
Inspector General Act of 1978	OMB Circular A-136, *Federal Financial Accounting Standards*	Provides for independent review of agency programs and operations. Annual report of material weaknesses required in the PAR.	The Office of the Inspector General report of material weaknesses is included in Systems, Controls, & Legal Compliance.
The E-Government Act of 2002	—	Requires the agency's strategic plan be posted on the Agency's Web site.	NASA's Strategic Plan, budget, and PAR are available at *http://www.nasa.gov/about/budget/index.html*.
The Chief Financial Officers Act of 1990	OMB Circular A-136, *Federal Financial Accounting Standards*	Requires the Chief Financial Officer to submit a financial report to OMB. This report is consolidated with performance data under the *Reports Consolidation Act of 2000*.	See Part 3: Financials.
Improper Payments Information Act of 2002	OMB Memorandum M-06-23, *Issuance of Appendix C to OMB Circular A-123*, August 10, 2006	Requires an assessment of the potential for improper payments and a report of this assessment to Congress.	See Systems, Controls, & Legal Compliance.

Looking Ahead



Staying on Target and on Budget

To achieve the Vision for Space Exploration, NASA is focusing resources on tasks that will enable the Agency to achieve the Vision's goals in the target timeframes. In a February 2006 statement about NASA's FY 2007 budget request, NASA Administrator Mike Griffin stated that NASA is, and will continue to be, faced with making difficult decisions in setting priorities for the Agency's resources, time, and energy. For example, Agency management greatly scaled down near-term research and development within the Prometheus Nuclear Systems and Technology Program to free up funds for more pressing research and development. NASA also opted to keep the budgets for space and Earth science portfolios relatively flat in the five-year budget horizon. During the past decade, budget increases in these portfolios surpassed NASA's top-line budget growth, and NASA cannot sustain that growth rate. NASA will continue to fund operational missions, as well as priority missions in formulation or development, but by eliminating or deferring lower-priority missions, the Agency will control budget growth and free up resources for mandated human exploration initiatives.

Transitions

NASA will retire the Space Shuttle in 2010 and begin the Agency's transition to a new human-rated space transportation system, the Orion Crew Exploration Vehicle and the Ares family of launch vehicles. As part of this transition, NASA will move more than 1,000 employees from the Space Shuttle Program to the Constellation Systems Program and other understaffed areas. NASA also must transition surplus Shuttle facilities and assets for other uses.

To facilitate these considerable transitional tasks, NASA is conducting internal and external studies as a basis for formulating processes and establishing realistic timeframes that will support a smooth transition with the fewest negative impacts possible.

Maximizing NASA's Workforce

In FY 2006, NASA identified under-utilized personnel and skill gaps in the Agency's current and future workforce needs. At NASA's request, the National Research Council is conducting a study of issues affecting science and engineering workforce needs, particularly workforce trends in the future. The final report, due by the end of 2006, will provide reference information as NASA develops strategies for future workforce development and management.

In addition, NASA is gathering skill information on the Agency's current civil service employees using the Competency Management System (CMS). CMS is a new Agency-wide tool that will enable NASA to maintain a listing of workforce knowledge capabilities, align the expertise of the workforce to the Mission via the budget planning process, and increase staff capabilities in targeted knowledge areas. NASA's CMS team also will use CMS data on employee competencies to modify the process for analyzing future workforce competency gaps and to address

Developing the Workforce of the Future

NASA's continued success is built on a steady supply of highly skilled, dedicated, and diverse professionals. NASA's Education programs use the Agency's missions and research to spark student interest in science, technology, engineering, and mathematics (STEM) and prepare tomorrow's workforce for challenging STEM-related careers.

NASA's Education programs provide opportunities that allow undergraduate, graduate, and post-doctoral students to hone their skills and expand their knowledge by working alongside NASA scientists and engineers. Many programs target underrepresented and under-served communities to help create a more balanced national workforce. For example, the Jenkins Predoctoral Fellowship Program (JPFP), which creates opportunities for minorities, women, and individuals with disabilities, provides up to three years of financial support for graduate education leading to a doctoral degree in a NASA-related discipline. NASA scientists and engineers serve as research leads and mentors throughout a JPFP fellow's tenure to ensure their success. In summer 2006, NASA and the American Indian Higher Education Consortium (AIHEC) launched the NASA–AIHEC Summer Research Program, a strategic approach to inspire young American Indians to pursue STEM-related careers. Student–faculty teams from 14 of the Nation's 35 Tribal Colleges and Universities conducted research alongside mentors at NASA Centers on a broad range of subjects, including robotics, three-dimensional design, geospatial data analysis, and astrobiology.

Dr. Shavesha Anderson, an aerospace engineer and JPFP alumni fellow, conducts research in the area of analytical chemistry. She participated in JPFP while pursuing a Ph.D. in chemistry at the American University in Washington, D.C. After completing her degree, she joined the workforce at NASA's Goddard Space Flight Center. (NASA)

employee development needs through the Agency's new System for Administration, Training, and Educational Resources for NASA (SATERN). In the future, NASA will use CMS to link together people with the same or similar competencies into communities of practice. Managers will be able to search through these communities of practice to find employees, positions, or organizations with desired competencies, helping NASA to maximize available workforce, partner across organizations or Centers, and disseminate information relevant to a community.

Improving Agency Management

NASA is improving management of the Agency's finances and physical and human resources, assets, and processes through a combination of supporting technology and business infrastructure.

During FY 2006, the Integrated Enterprise Management Program (IEMP) developed for implementation in FY 2007 an updated version of the SAP Core Financial software to improve the Financial system's compliance with federal financial and accounting systems standards and to respond to recommendations from the Government Accountability Office. The SAP Version Update project will help improve the quality of financial and management information available for Agency decision-making, streamline the funds-distribution process, and stabilize the impact of converting to full-cost accounting on programs and projects. The updated software also should help NASA make progress towards achieving a clean audit opinion on future fiscal year-end financial statements, as well as a "Green" rating on the President's Management Agenda (PMA) scorecard for "improved financial performance."

In the coming year, IEMP will implement a number of tools to enhance Agency operations:

- The Contract Management Module, a tool to support contract/grant writing and administration, procurement workload management, and data reporting and management. NASA will implement the Contract Management Module at the same time as the SAP Version Update;
- The Aircraft Management Module, an integrated toolset that will help NASA manage the Agency's fleet of mission-support, research, and mission-management aircraft by tracking aircraft inspections, mission configurations, and aircrew qualifications and status to help NASA control and reduce the cost of operations; and
- eTravel, a government-wide, Web-based travel management service that includes self-service travel booking, authorization, and vouchering. This initiative, part of the PMA EGovernment effort, will simplify the travel process for employees and help NASA track, manage, and control travel expenses.

IEMP also is planning initiatives for implementation by the end of the decade:

- The Property, Plant, and Equipment (PP&E) module will focus on the accountability, valuation, and tracking of internal-use software, program/project assets, and personal property that is either NASA-owned and held or NASA-owned and contractor-held. The project team plans to use the Department of Energy's Oak Ridge National Laboratory version of SAP PP&E implementation as a model for processes and configuration.
- The Human Capital Information Environment, which will provide online access to near-real-time human captial information;

In March 2006, NASA opened the NASA Shared Services Center (NSSC) at Stennis Space Center in Mississippi. This public/private partnership between NASA and Computer Sciences Corporation Service Providers consolidates all Agency support services, including financial management, human resources, information technology, and procurement. NASA is transitioning support services to NSSC in phases. In FY 2007, NASA will complete the moves of employee services and payroll, procurement, contract services, and information technology and will begin to transition Small Business Innovative Research/Small Business Technology Transfer. Accounts payable and receivable will be the last major service elements to transition, scheduled for FY 2008.

Thinking (and Contracting) Outside of the Box

To increase Agency efficiencies, NASA is seeking ways to leverage technology and additional capabilities available through commercial industry, other federal agencies, academia, and international partners.

In August 2006, NASA signed Space Act Agreements with two commercial companies—Space Exploration Technologies and Rocketplane–Kistler—to develop and demonstrate commercial orbital transportation services that can deliver crew and cargo to the International Space Station (ISS). Should they successfully demonstrate their cargo transportation capabilities, they will be able to bid to provide cargo transportation services for the ISS after Shuttle retirement. Space Exploration Technologies plans to begin demonstrations of its Falcon 9 reusable launch vehicle and Dragon spacecraft in late FY 2008. Rocketplane–Kistler also plans the first launch of its K–1 launch vehicle in early FY 2009. If these new commercial partnerships are successful, the resulting vehicles will increase NASA's options for launching cargo to the ISS as the Agency transitions from the Shuttle to the Ares and Orion space transportation elements.

To encourage emerging commercial launch service providers and potentially provide significant cost savings to the science and exploration community, the Agency modified the NASA Launch Services contract to allow onto the contract new proposers who have not yet had a successful flight. By August, an alternate launch provider responded to the contract modification with a proposal that currently is under evaluation. In addition, NASA conducted a study of emerging launch providers. During summer 2006, a cross-Agency team visited four out of an initial 40 emerging launch service providers to gather information and evaluate their maturity and ability to satisfy NASA's mission requirements.

In September, NASA formed a unique partnership with Red Planet Capital, Inc., to give NASA earlier and broader exposure to emerging technologies. Red Planet Capital, a non-profit organization, will use venture capital and a NASA investment of approximately $75 million over five years to attract private-sector technology innovators and investors who typically have not done business with the Agency. NASA will provide strategic direction and technical input to this partnership to assure that it complements other NASA strategies to promote private sector participation in space exploration.

Strengthening International Relationships and Collaboration

International partnerships are playing an increasing role in space exploration as robotic and human missions become more complex and more expensive. Through international partnerships, NASA and the space agencies of other nations can pool resources and capabilities while forging unique international alliances.

Administrator Mike Griffin and G. Madhavan Nair, Chair of the Indian Space Research Organization, signed two Memoranda of Understanding in May 2006 stating that NASA will provide two scientific instruments for India's Chandrayaan–1 lunar orbiter mission, scheduled to launch in FY 2008. This follows the Joint Statement of July 18, 2005, signed by President George W. Bush and Indian Prime Minister Singh, pledging to build closer ties between the United States and India in space exploration, satellite navigation and launch, and commercial space enterprise. NASA's contributions to Chandrayaan–1 will include the Moon Mineralogy Mapper, which will assess the Moon's mineral resources, and the miniature synthetic aperture radar, which will look for ice deposits in the Moon's polar regions. The Chandrayaan–1 mission also will give NASA additional information about the lunar environment as the Agency prepares for future robotic and human lunar missions.

In September 2006, NASA's Administrator met in China with Laiyan Sun, administrator of the China National Space Administration. This was the first time a NASA Administrator has visited China.

The two administrators discussed the space exploration goals of their respective countries and agencies, and the visit marked a first, tentative step toward U.S.–China cooperation in space exploration. Because of political considerations, the two countries are constrained in what they can discuss, and no human-spaceflight cooperative efforts are under consideration. A protocol agreement signed by John Marburger, director of the White House Office of Science and Technology Policy and the President's science advisor, and Xu Guanhua, China's minister of science and technology, allows the countries to exchange scientific and technical knowledge and to pursue advanced and applied technology projects in specific research areas, including Earth and atmospheric sciences.

On his first day of visiting China, Administrator Mike Griffin presents a picture montage with a flown American and Chinese flags to Dr. Yuan Jiajun, President and CEO of the China Academy of Space Technology. The next day, Griffin and astronaut Shannon Lucid spoke to graduate students at the Chinese Academy of Sciences about the U.S. space program. (NASA)